Banking, Financial Integration, and International Crises

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Banking, Financial Integration, and International Crises: An Overview

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The devaluation of the Thai baht in July 1997 triggered a major international financial crisis in East Asia, similar in many ways to the Latin American debt crisis of the early 1980s. The baht's devaluation led to a series of sharp devaluations in several other Asian countries, in particular Indonesia, Korea, Malaysia, and the Philippines. The Russian debt moratorium and the Long Term Capital Management crisis in 1998, and the devaluation of the Brazilian real in early 1999, sent additional shock waves throughout the world's emerging markets. In each of these episodes, strong market pressures were observed in currency and debt markets. Although most emerging market economies faced contagion effects, the weakest countries—those with fragile domestic banks, large fiscal deficits and external debts, severe currency and maturity mismatches, poor macroeconomic policies, and more rigid foreign exchange regimes—were most affected by the loss of investor confidence. These countries suffered some combination of lack of access to international liquidity, currency devaluation, asset price collapse, bank failures, recession, and large-scale bankruptcies and unemployment.

After the storm, however, relative calm returned to international financial markets in 1999, and East Asia started to recover vigorously. During 2000-01, major new crises were avoided in Ecuador,

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Argentina, and Turkey only by last-minute massive provision of emergency liquidity by the multilateral financial institutions.

The Asian crisis, together with its aftershocks, has changed our understanding of how international financial markets operate. It has shed some light on the policies that countries should adopt to better face adverse shocks and contagion effects, and on the measures that should be promoted to reshape the international financial architecture so as to reduce contagion. Much new theoretical, empirical, and policy research has had the recent international financial turmoil as its focus. Among the major research issues are the market and incentive structures of banks and their supervision and regulation; the interplay of banks, foreign creditors, nonfinancial firms, and the government when moral hazard is widespread; the interrelationships among institutions, financial development, and growth; the macroeconomic aspects of overlending and overborrowing, and of high volatility in asset prices and exchange rates; the optimal degree and pace of financial integration into world capital markets when contagion is a threat; and new policies to reduce the likelihood of losses of confidence in domestic and international financial markets.

This book seeks to contribute to the literature by publishing new and relevant research on banking, financial integration, and international crises, providing answers to old and new questions in the light of the recent experience of international financial turmoil. Most of the papers published in this volume are substantially revised versions of papers presented at the Second Annual Conference of the Central Bank of Chile on "Financial Integration, Banking Systems, and Macroeconomic Stability," held in Santiago in September 1998.

This overview reviews the issues addressed in the various papers. The first section analyzes new research on the relationships among institutions, financial development, growth, and the likelihood of banking crises. Section 2 reviews issues in the banking sector, and in particular some new findings regarding bank regulation and supervision and the behavior of bank market participants. The interface between macroeconomic and financial variables during booms and busts is taken up in section 3, with a focus on credit booms, asset price bubbles and busts, and the behavior of exchange rates after financial crises. New findings on banking internationalization, overall financial integration, the elements of international financial crises, capital controls to stem inflows, and components of an international safety net are reviewed in section 4. The overview concludes and identifies some lessons for policy in section 5.

1. Institutions, Financial Development, Growth, and Banking Crises

Legal and political institutions are crucial for financial development, and financial development in turn is important for rapid economic growth. Political conditions also affect the likelihood of banking crises. New research adds significantly to the stock of knowledge on these relationships.

1.1 Determinants of Financial Development and Growth

The legal systems of emerging market countries are of differing national origins, and these tend to result in different types of laws, regulations, and legal enforcement mechanisms. Recent research shows that the development and efficiency of a country's financial market depend ultimately on what kind of institutional and legal framework prevails in the country (Laporta and others, 1998). Financial markets develop best where there is protection of creditor rights, compliance with the law, an effective and efficient judiciary system, stringent disclosure requirements on firms, compliance with international accounting standards, a multiplicity of entities involved in the political process, and relatively little government corruption.

It has also been observed for years that financial development and economic growth are highly correlated. However, it was not until recently that causality could be established between these two forces. King and Levine (1993) and Levine and Zervos (1998), among others, show that the degree of financial development helps explain long-run growth (for a survey see Levine, 1997). A more developed financial sector intermediates funds more efficiently, promotes technological innovation, diversifies risks, and exerts corporate governance more effectively, ultimately leading to more capital accumulation in more profitable and less risky investment projects.

The paper in this volume by Ross Levine, Norman Loayza, and Thorsten Beck is an important complement to these findings. The authors show that countries whose laws give a high priority to secured creditors, whose legal systems rigorously enforce contracts, and whose accounting standards produce high-quality financial statements tend to have better financial intermediaries. They also review the earlier findings of King and Levine. Using a larger sample of

countries and more advanced econometric techniques, they find that a more developed and efficient financial system allows countries to achieve faster growth. And they conclude that this effect is large. According to their estimates, an economy with a level of financial intermediation reflected by a private credit ratio to GDP of 18 percent on average during 1960-95 would have experienced annual growth of GDP that was 1 percentage point faster than an economy with a level of private credit of only 12 percent of GDP.

1.2 Political Institutions and Banking Crises

A large number of financial crises—most of them banking crises—have hit both developing and industrial countries during the last quarter century, from Argentina and Mexico to Korea and Thailand, and from India and Russia to Japan and the United States. These crises have spawned much research attempting to document their characteristics and explain their causes and consequences.[1] A number of factors—foreign overborrowing by banks, excessive private sector credit growth, adverse terms-of-trade shocks, inflation, large fiscal deficits, high interest rates, low income levels and growth rates—have been found to be significantly associated with, or to contribute to, the likelihood of banking crises. Weak institutions and ineffective regulations are typically found to be the factors underpinning such developments as excessive credit growth and skyrocketing interest rates. Inadequate banking regulation and supervision, rapid financial liberalization in the absence of sound regulation and supervision, explicit but underfunded deposit insurance, implicit gov-ernment bail-out guarantees to bank depositors and owners, the presence of large state banks, and a lack of bank competition contribute to inefficient management and moral hazard in banking, and have indeed been associated with subsequent financial crises.

Philip Keefer's paper in this volume extends previous research on this topic by focusing on political conditions that contribute to the likelihood of systemic bank failure. His cross-country findings show that the extent of government checks and balances—measured by the extent to which the executive branch of government is constrained by party fractionalization—affects the probability with which banking

1. See Caprio (1998), Caprio and Klingebiel (1997), Demirgüç-Kunt and Detragiache (1997, 1998), Goldstein and Turner (1996), and Radelet and Sachs (1998), among others.

crises occur in two ways. First, high fractionalization may directly influence the magnitude and probability of a crisis through its effect on intragovernmental negotiation costs, which in turn slow the response to an incipient crisis. The second effect is indirect, by changing the influence of other banking crisis determinants. In a country where checks and balances are few or absent, the probability that, say, an unfavorable terms-of-trade shock will cause a banking crisis is higher than in a country with extensive checks and balances. The same is true of other banking crisis determinants, such as low cash reserves, a large volume of outstanding credit to the private sector, and extensive deposit insurance. All these can trigger crises in countries where checks and balances are weak, as governments can more easily shift the costs of financial crises onto unrepresented sectors of society.

2. Regulation and Supervision of Banks and Depositor Behavior

Many countries can significantly improve upon their existing financial systems. There is wide consensus that inappropriate regulations and supervisory standards not only retard economic growth but also increase the probability of a financial crisis that could spread beyond the country's own borders. In response to a rising incidence of banking crises, the multilateral financial institutions are vigorously urging countries to implement appropriate regulations and supervisory practices for their financial sectors.

In 1988 the Basle Committee on Banking Supervision introduced international guidelines for the determination of bank capital requirements. The Basle guidelines required a minimum risk-weighted capital-asset ratio of 8 percent but considered only credit risk in the calculation of risk. Although these guidelines were meant for internationally active banks, they have increasingly been adopted by banks in developing countries. Recently, the Basle Committee issued new guidelines considering market and operational as well as credit risks, and allowing for a more flexible approach in determining bank minimum capital requirements.[2] The new guidelines, expected to be

2. For the new guidelines see www.bis.org/publ/bcbsa.htm.

fully implemented by 2004, depart from the 1988 version by relying more on market assessment and handling of risks.

New empirical research explores three questions relating to bank regulation, supervision, and risk. First, how do political institutions, banking regulation, banking performance, and crises interact? Second, how might market-based mechanisms complement rule-based banking supervision? Finally, do market participants (both bank depositors and interbank lenders) take banks' underlying risks into account in their transactions?

2.1 Prudential Regulation and Bank Performance

Despite widespread agreement on the need for financial reform, there is little empirical evidence to support any concrete advice regarding either specific or comprehensive regulatory or supervisory norms and regulations. The reason is that detailed cross-country comparisons of financial systems for developing countries have until recently been unavailable. James Barth, Gerard Caprio, Jr., and Ross Levine, in this volume, make use of a new data set covering about fifty countries to examine empirically the relationships among regulatory, government, and financial variables.

The authors report three main empirical results. First, countries whose governments are more bureaucratic, corrupt, and prone to breach traditions of law and order tend to impose harsher regulatory restrictions on nontraditional bank activities. Second, countries with more restrictions do not necessarily have less poorly functioning banking systems. Third, and most surprising, in countries with more restrictions, the likelihood of a banking crisis is not lower but higher; this suggests that restricting the ability of banks to diversify increases their fragility. This finding contradicts the notion that imposing stricter restrictions on banks' nontraditional activities reduces excessive risk taking. Two forces may be at work here. First, the more-diversified banking activities and portfolios that a less restrictive regulatory regime allows may reduce bank risk and thus the likelihood of bank failure. Second, lower restrictions may raise the franchise value of banks, leading to better bank management and governance, although it complicates bank supervision. Hence this study suggests that the gains from allowing broader banking activities more than offset the potential risks and supervisory complications.

2.2 Rule-Based and Market-Based Banking Supervision

A standard way of reducing the likelihood of financial crises in the past has been to put in place one or more of the following: rules and norms that limit the actions of financial intermediaries;[3] supervisory agencies that monitor compliance with such rules and assess bank solvency; and institutional arrangements (a financial safety net) that guarantee the continuity of the payments system and avoid liquidity and confidence crises.[4] But experience has shown that these three elements require careful design and implementation to avoid creating new problems and distortions that can lead to the very outcome they seek to avoid. Such problems arise when restrictions on financial firms contribute to the emergence of less efficient and usually less regulated (sometimes informal) financial intermediaries, when regulatory agencies are unable to keep pace with market developments and become obsolete (as usually happens), and when the safety net intensifies moral hazard problems, leading to unsound banking practices. Striking a balance between the costs and the benefits of banking regulation and supervision has proved difficult, especially in recent years, as the explosive development of communications and technology has spurred rapid change in the financial services industry.

In confronting these difficulties and trade-offs, countries may wish to complement (or even replace) their rule-based bank supervision with properly designed, market-friendly mechanisms aimed at enhancing market discipline. These have the advantage of encouraging sound banking practices while allowing the industry to follow market developments and trends more closely. For instance, countries could replace their state-run deposit insurance agencies with a requirement that banks contract for deposit insurance directly with private providers. At the same time, countries could make greater use of interbank interest rates to assess individual bank solvency and liquidity problems. Also, instead of restricting bank activities, countries could require banks to subject themselves to periodic risk assessment by independent rating agencies; the ratings would then be made public so that depositors become fully

3. These regulations include minimum liquidity and capitalization requirements, portfolio restrictions, and disclosure requirements, among others.

4. Safety net arrangements comprise lender-of-last-resort and deposit insurance schemes.

aware of banks' underlying risks. Requirements of the latter type have been adopted with great success in recent years by New Zealand and, to a lesser extent, by Chile. Market-based mechanisms along these lines raise the effectiveness of the regulatory and supervisory framework and hence foster market discipline and efficiency.

2.3 Bank Risk and Depositor Behavior

A necessary condition for the success of market-friendly bank regulation is that market participants be responsive to information on banks' underlying risks and overall health. What does the evidence about bank depositors and interbank lenders suggest on this score?

The paper by María Soledad Martínez-Peria and Sergio Schmukler, in this volume, analyzes two issues related to bank market discipline as reflected in the behavior of depositors in Argentina, Chile, and Mexico during the past two decades. First, they examine depositor behavior and the relationship between market discipline and deposit insurance. It is shown that depositors both small and large punish banks for risky behavior, both by withdrawing deposits and by requiring higher interest rates. Insured and uninsured depositors alike respond to bank risk taking. This result suggests that none of the deposit insurance schemes in the three countries considered is fully credible, and it raises doubts about similar schemes in similar countries.

Next the authors analyze the link between market discipline and banking crises, showing that large systemic effects take place during crises, affecting deposits and interest rates across banks regardless of their fundamentals. Following bank interventions and failures, depositors become more aware of the risk of losing their deposits, and therefore they exercise stricter market discipline than before. In sum, banking crises are a wake-up call for depositors, exerting a greater impact on their behavior than the introduction of deposit insurance systems of dubious credibility.

In a related study in this volume, Antonio Ahumada and Carlos Budnevich investigate bank riskiness and the behavior of interbank lenders in Chile. They provide empirical evidence on nonperforming loans and interbank interest spreads, using monthly bank-level data for the 1990s. The ratio of nonperforming bank loans to total loans—a good measure of overall bank fragility—is shown to decline, after a lag, as bank capital and liquidity ratios rise, and

to increase with bank lending growth. The ratio also rises with the tightness of monetary policy. The results for interbank interest spreads show that more illiquid banks also pay higher interbank interest rates. Other financial variables (including nonperforming loan ratios) do not contribute separately and significantly to interbank spreads.

These two studies thus support the view that interest rates are responsive to banks' fundamentals, and suggest that bank deposit rates or interbank lending rates could be used to determine the premiums charged to banks participating in deposit insurance schemes. In fact, Argentina adopted just such a mechanism in response to contagion from the 1994 Mexican crisis, as a tool for regulating bank provisioning against bad loans. In particular, the nonperforming loan provision that banks were required to make for each loan was made dependent on the loan's interest rate. Since it is in the interest of each bank to charge a rate proportional to the loan's risk, the new provision allows Argentinean bank supervisors to rely on each bank's internal risk assessment instead of having to evaluate each loan directly.

Hence the recent evidence summarized here suggests important benefits from complementing conventional, rule-based regulatory systems with market-based mechanisms designed to enhance market discipline and self-regulation. By doing so, supervisors may avoid some of the dismal consequences of the rapid obsolescence of rule-based regulatory frameworks that stems from the superior ability of private agents to keep pace with market developments.

3. Lending Booms, Asset Prices, and Exchange Rates

We now shift the focus away from banking to consider macroeconomic and macrofinancial issues, and in particular the phenomenon of lending booms and the behavior of asset prices and exchange rates during boom-and-bust cycles.

3.1 Lending Booms

Recent evidence suggests that credit booms are partly financed by large capital inflows and often lead to financial crises (World Bank, 1997, 2001). However, capital inflows may not be the cause but rather

the consequence of credit booms. In fact, credit booms can be caused either by domestic changes (such as a financial liberalization) or by an exogenous shock (such as lower foreign interest rates).

Gourinchas, Valdés, and Landerretche (2001) present empirical cross-country evidence for 1960-96, showing that financial crises are more likely after a credit boom has taken place. They also provide evidence that the dominant forces behind a surge in capital inflows are domestic (pull) factors, not external (push) factors.

Leonardo Hernández and Oscar Landerretche, in this volume, also undertake an empirical study of capital flows, lending booms, and financial crises, focussing more on the role played by the domestic banking system during such cycles. Using a sixty-country sample over a shorter period (1970-95), they conclude that periods of financial distress are indeed more likely after a lending boom, but also that these booms are associated with capital inflows only in the case of developing countries (which in general have weaker banks). Furthermore, capital inflows are smaller (as a percentage of the recipient country's GDP) in countries where the lending boom ends in financial distress. Hence it appears that international investors put proportionately more of their capital into countries with financial systems that are less prone to experience financial crises after lending booms.

3.2 Asset Prices and Exchange Rates

Overvaluation of assets and an overvalued currency are frequently the counterparts of domestic and external lending booms. How much do asset prices and exchange rates diverge from what their fundamentals would indicate during boom episodes? How quickly are overvaluations corrected after a crisis? And what role do policies play during booms and crashes?

A burgeoning literature has focused on the many factors affecting asset price bubbles.[5] In their study of asset prices in Chile during 1978-98, in this volume, Raphael Bergoeing, Felipe Morandé, and Raimundo Soto analyze whether the behavior of equity, land, and real estate prices in that country has been consistent with market fundamentals (including policy variables) or with bubbles. Using

5. See Flood and Garber (1980), Obstfeld and Rogoff (1986), Shleifer and Summers (1990), Kiyotaki and Moore (1997), Stein (1995), Allen and Gale (1998), Krugman (1998), and Edison, Pongsack, and Miller (1998).

long-term cointegration relations for asset prices, the authors find evidence for temporary bubbles and busts. However, the estimates from their short-term error correction models show no significant deviations from fundamentals-driven equilibrium values. They report that policy variables exert a significant influence on asset prices. Counterfactual simulations for alternative paths of fiscal policy (public expenditure), monetary policy (interest rates), and pension fund policy (allowing pension funds to invest in equities) show substantial effects on asset prices in Chile. Surprisingly, no positive and significant effects of foreign capital inflows on domestic asset prices are found by these authors.

The literature on exchange rates has evolved from models of real and financial determinants of equilibrium rates (see Taylor, 1995, for a survey) to the study of episodes of substantial disequilibrium (for example, Goldfajn and Valdés, 1998). Most traditional research has overwhelmingly rejected the uncovered interest parity condition proposed to relate exchange rate and interest rate differentials (see Obstfeld and Rogoff, 1996, for a review). Rejection of this parity condition or its related forward-market efficiency condition is termed the exchange rate premium puzzle. However, recent research on industrial-country exchange rates, based on more flexible specifications and/or cointegration estimation techniques, provide evidence for a close long-run relation between exchange rates and interest rates, in support of the uncovered interest parity condition (Edison and Melick, 1999; MacDonald and Nagayasu, 2000).

Ilan Goldfajn and Poonam Gupta, in this volume, shed new light on these issues by analyzing a large sample of episodes during 1980-98 in which sizable real depreciations occurred in the aftermath of currency crises. They document that the real exchange rate overshoots on the down side during a currency crisis and must be brought back to equilibrium after the crisis subsides. Defining a successful real appreciation as one that takes place through nominal appreciation (not domestic inflation), the authors show that, for large real undervaluations, the probability of success increases significantly when tight monetary policy (a higher real interest rate) is implemented and the banking system is strong. In contrast, tight monetary policy actually lowers the likelihood of successful real ap-preciation when the country is experiencing a "twin" crisis, that is, a currency crisis and a banking crisis simultaneously. Hence banking crises may dampen the effect of interest rates on exchange rates.

This result provides new evidence on a variant of the exchange rate-interest rate parity condition, suggesting that part of the exchange rate premium puzzle mentioned above may be due to severe banking problems that hamper the efficient pricing of financial and monetary assets.

4. Bank Internationalization, International Financial Crises, Capital Controls, and an International Safety Net

Opening up domestic banks to foreign competitors is a potentially important component of international financial integration. Liberalization of the capital account to foreign inflows offers potentially large efficiency and growth gains but has also frequently led to overborrowing and hence to crises. East Asia suffered from a deep crisis in the late 1990s while Latin America remained largely unscathed. Careful scrutiny of these and related issues is important before policies aimed at future crisis prevention are implemented. Possible policy responses include capital controls (to stem "excessive" capital inflows), contingent credit lines (to face international liquidity problems), and elements of a future international safety net.

4.1 Internationalization of Banking

A recent trend toward internationalization of banking can be observed in some emerging market economies: their domestic financial markets are becoming increasingly open to entrance by well-established international banks (Claessens, Demirgüç-Kunt, and Huizinga, 1998; Clarke and others, 1999; Denizer, 2000). This is partly prompted by the growing consensus that internationalization of banking is the most effective way for developing countries to acquire capital, technology, and managerial skills in banking, all of which many developing countries now lack. It is argued that internationalization of banking would allow the introduction of frontier technology and best practices in project evaluation, risk assessment, and hedging; would permit better risk diversification; and would increase competition. All these would lead to more and cheaper financial products. In addition, because international banks are usually subject to more stringent regulation than domestic banks, internationalization of

banking should lead to an upgrade in accounting, disclosure, and transparency standards, improving the regulatory framework in most developing countries (Claessens and Glaessner, 1998; Dobson, 1998).

A more extreme position argues that internationalization of banking is desirable because it permits delegating bank supervision and regulation to the agencies charged with that task in the foreign banks' home countries. Thus opening local markets to foreign banks means substituting imported bank supervision and regulation for its domestically produced counterpart (Hausmann and Gavin, 1996). This is the case, for example, in New Zealand, where most banks are foreign owned.

Because of its close relation to overall financial integration, internationalization of banking may also bring benefits in the form of greater macroeconomic stability. Easing the entrance of foreign banks into developing countries facilitates those countries' access to world capital markets. This allows better smoothing of cyclical income fluctuations and reduces the likelihood of a cutoff of foreign financing due to financial contagion or other international market imperfections. Finally, internationalization of banking could reduce the cost of funds, especially to small and medium-size enterprises that cannot tap international capital markets by issuing equity or bonds abroad.

However, internationalization of banking and financial integration more broadly are also a source of concern to policymakers, mainly for three reasons. First, credit markets may become segmented as foreign banks tend to concentrate their business on the largest and most creditworthy domestic companies, leaving the riskier projects and less solvent firms to be financed locally. Second, financial integration can contribute to economic instability, because foreign capital, although relatively cheap, is also highly volatile: credit booms, asset price bubbles, and overborrowing can emerge and lead to a crisis. Third, in a globally integrated economy it becomes even more difficult for local authorities to confront and effectively contain a confidence crisis, whether founded or unfounded, because now foreign creditors are involved, and because even domestically owned funds now have more avenues to flee abroad. Although these concerns are certainly legitimate (and we discuss below how some of them can be dealt with), international experience suggests that the potential benefits of integration nevertheless outweigh the potential costs.

4.2 The Behavior of Foreign Banks

Japanese banks substantially increased their global presence in the late 1980s through cross-border lending and by opening foreign subsidiaries. Although their initial focus was on the United States, in the 1990s their efforts were aggressively redirected to Southeast Asia. Joe Peek and Eric Rosengren, in this volume, examine Japanese banks' response to home- and host-country shocks in Southeast Asia, and show that the pattern of lending and opening of subsidiaries followed trends in Japan more closely than trends in Southeast Asia. This behavior, which contrasts with Japanese bank retrenchment with respect to the United States, Hong Kong, and Singapore, exerted a stabilizing influence on the economies affected by the Asian crisis and is attributed to the banks' aim to maintain a dominant presence in countries with high long-run profit potential.[6] This result is consistent with Hernández and Landerretche's finding that countries suffering from financial distress continue to receive capital inflows (although smaller than before the crisis). In other words, financial crises cannot in general be attributed to capital outflows.[7]

In sum, from the evidence presented in this volume, it is hard to argue that foreign banks, or foreign lending more generally, are the cause of financial distress and instability. Capital flight and crises tend to occur when domestic investors start fleeing their own countries, leaving governments liable and imposing losses on foreign creditors.

4.3 Overborrowing

A valid concern of policymakers in emerging market economies that liberalize their capital accounts is how to reduce the likelihood that financial integration will lead to excessive external borrowing, making the whole economy more vulnerable to shocks.

6. This finding does not necessarily mean, however, that these countries enjoyed access to additional funding during the crisis. Peek and Rosengren's analysis does not distinguish between new capital inflows and the capitalization of past-due interest. However, the data show that Japanese banks at least did not require repayment of their outstanding loans.

7. It is worth noting that in several crises in the past, such as the Latin American crisis of the 1980s and the Mexican crisis in 1994, well-established foreign banks had been willing to grant new loans to the crisis countries as late as a few weeks or even days before the crisis started.

Should policymakers postpone financial integration until certain conditions are met? And if so, what conditions?

What matters in addressing these questions is making a correct diagnosis of the ultimate causes of overborrowing and overlending—not an easy task, as the competing explanations of the Mexican and Asian crises and their aftermaths make clear. Appropriate policy design with respect to foreign borrowing requires the precise identification of the underlying market failure (Fernández-Arias and Montiel, 1996). One important market imperfection is moral hazard, which can arise on either side of the international financial transaction, due to explicit or implicit guarantees by domestic governments or multilateral financial institutions (McKinnon and Pill, 1997; Dooley, 1997; Krugman, 1998; Corsetti, Pesenti, and Roubini, 1998). Here the first-best solution is to remove those guarantees or make borrowers pay for them at their market or shadow values. If that is not possible, moral hazard may be controlled by adequate regulation and supervision of banks, capital markets at large, and (as one of the lessons of the Asian crisis) the corporate sector. If even that strategy fails or cannot be implemented adequately, a third-best solution could lie in the adoption of barriers to financial integration.

Eduardo Fernández-Arias and Davide Lombardo, in this volume, extend the earlier literature on sovereign debt and risk,[8] as well as the more recent work on multiple equilibria, as an explanation of the Asian crisis.[9] They develop two models of market imperfections in international capital flows that could lead to multiple equilibria through the existence of country risk. In the first model, private sector overborrowing occurs when borrowing approaches or exceeds an effective country credit ceiling, which in turn arises because there are no credible mechanisms to enforce international debt contracts against the will of a sovereign debtor country. However, overborrowing (and any accompanying overconsumption) can be ameliorated by adequate fiscal and trade policies. In the second model, financial fragility is based on investors' self-validating loss of confidence in the debtor country's prospects. If a massive withdrawal of foreign credit adversely affects repayment by domestic debtors (for example, because of a real devaluation that makes debt repayment by firms in the nontradable goods sector too expensive), then the market allocation biases the composition of debt away from long-term and

8. See Harberger (1980), Eaton and Gersovitz (1981, 1989), and Bulow and Rogoff (1989), among others.

9. See Calvo (1998), Sachs and Radelet (1998), among others.

toward short-term debt. This case could justify the adoption of controls or taxes on short-term capital inflows, such as the selective reserve requirement on gross capital inflows adopted by Chile during 1991-98. Alternatively, debtor countries could contract with a foreign entity to provide a line of credit to be drawn upon in the event of a liquidity crisis; Argentina entered into such an arrangement after the 1994 Mexican crisis. Hence, although overborrowing is a valid concern, policymakers need to clearly identify its underlying causes and the optimal policy response before imposing restrictions on financial integration.

4.4 Controls on Capital Inflows

Some emerging market countries (including Brazil, Chile, Colombia, and Malaysia) resorted to temporary controls on capital inflows during the long spell of large inflows in the 1990s, and Malaysia imposed temporary controls on outflows after the 1997 Asian crisis. Among these experiences, Chile's selective controls on capital inflows during 1991-98 provide a unique experiment for testing the effectiveness and assessing the costs and benefits of limiting financial integration.[10] The reasons why Chile's case is illuminating are partly institutional (the tax-equivalent design of the controls and the relatively high degree of compliance) and partly empirical (the relatively high quality, frequency, and variability of the data on controls and related economic variables). Francisco Gallego, Leonardo Hernández, and Klaus Schmidt-Hebbel, in this volume, extend the previous empirical literature on the Chilean experience,[11] by testing for the determinants and effects of capital controls in Chile, using monthly data for 1989-2000.

The results show that capital controls had some effect by increasing the wedge between domestic and foreign interest rates,

10. In September 1998 the Central Bank of Chile suspended application of its one-year unremunerated reserve requirement on selective (mostly financial and short-term) capital inflows by lowering the rate to zero. In May 2000 it abolished the one-year permanence requirement on foreign investment. Final full abolition of the unremunerated reserve requirement on inflows, as well as of all other remaining administrative controls on both inflows and outflows, took place in April 2001.

11. See Soto and Valdés-Prieto (1996), Soto (1997), Eyzaguirre and Schmidt-Hebbel (1997), Le Fort and Sanhueza (1997), Laurens and Cardoso (1998), Nadal De-Simone and Sorsa (1999), Valdés-Prieto and Soto (1998), De Gregorio, Edwards, and Valdés (1999), Herrera and Valdés (2001), and Larraín (2000).

marginally reducing aggregate net capital inflows, and changing the composition of external debt toward longer maturities, without significantly altering the real exchange rate. Part of this effect is temporary, however, as the effectiveness of controls is eroded over time. Controls may have been important in contributing to Chile's relatively low level of outstanding short-term foreign liabilities at the time of the 1997-98 international financial turmoil. On the other hand, the temporary macroeconomic benefits of capital controls could be more than offset by reduced growth and more limited international portfolio diversification, raising concern about their efficiency.

4.5 International Financial Crises

Four years after the outbreak of the East Asian crisis, experts still disagree about its roots. A region that had been considered a paradigm of successful development suddenly found itself mired in financial collapse and deep recession in 1997-98. By contrast, most of Latin America managed to avoid crisis in 1997-2000, in spite of relatively poor macroeconomic management.

Roberto Chang and Andrés Velasco, in this volume, dispute the relevance of *ad hoc* institutional and political explanations for the Asian crisis, arguing instead that all the elements of a conventional international financial crisis were present in Asia, just as they had been in the Latin American debt crisis of 1982-85 and the Mexican crisis of 1994-95.[12] They claim that the main trigger of a crisis is international illiquidity, that is, loss of access to additional foreign borrowing by a country subject to significant currency and maturity mismatches of its assets and liabilities. Such mismatches are often the consequence of earlier domestic and external financial liberalization that has allowed the accumulation of short-term foreign currency liabilities by domestic residents, whose income is largely denominated in national currency. Illiquidity hits when capital inflows turn to outflows in response to an adverse domestic or external shock; the results are a banking crisis, a currency (or balance of payments) crisis, a recession, or some mix of the three.

12. Previous work on financial crises includes Díaz-Alejandro (1985), Velasco (1987), Calvo (1996, 1998), Goldfajn and Valdés (1997), Frankel and Rose (1996), Kaminsky and Reinhart (1996), Sachs, Tornell, and Velasco (1996a,b), Sachs (1997), Corsetti, Pesenti, and Roubini (1998), and Chang and Velasco (2000), among others.

Moreover, the punishment meted out by the market is typically disproportionate to the country's sins, leading to severe international illiquidity, a collapse of domestic asset prices and the real exchange rate as a result of fire sales, and deep recession. The authors provide evidence that these factors were present in East Asia in 1997, but much less prevalent in Latin America in the late 1990s, which could explain why that region largely escaped the crisis.[13]

4.6 Contagion and an International Safety Net

A serious concern for policymakers in emerging market economies is financial contagion, that is, the possibility of liquidity problems—and a currency crisis—spreading from one country to another despite strong fundamentals in the latter. This situation arises when shocks in one or a few countries cause world capital markets to overreact by restricting access to, and withdrawing funds from, emerging market economies as a group.

It is important to stress the difference between real and pure contagion. When contagion is real, meaning that the external shock is indeed related to a deterioration in fundamentals,[14] the only possible response is to adjust fiscal, monetary, and exchange rate policies accordingly—and the sooner the better. Furthermore, the best way to reduce exposure to these shocks is by achieving wide diversification of both income and funding sources. Hence, in order to reduce the likelihood of real contagion, countries should accelerate their economic and financial integration, not slow it down.

Much as domestic financial systems are subject to bank runs and panics, pure contagion across countries can occur because of asymmetric information, "animal spirits," and multiple equilibria. Also like bank runs and panics, episodes of pure contagion can impose heavy deadweight costs on the affected countries. To avoid bank runs, many countries have developed safety nets as discussed above. In world capital markets, however, such mechanisms are missing, and until they are put in place, countries are understandably reluctant to proceed to full financial integration. All parties could potentially gain

13. The obvious exceptions are the Brazilian crisis of 1998-99 and the near crises in Argentina and Ecuador in 2000-01, which were avoided by the massive provision of liquidity by multilateral financial institutions.

14. For instance, when a devaluation in one country translates into a loss of international competitiveness by its trading partners and competitors.

from creating an international safety net or similar mechanisms to reduce the chances of pure contagion. This would foster financial integration, allowing developing countries to benefit from lower funding costs and greater access to new financial instruments, and providing industrial countries higher returns on their capital as well as worldwide portfolio diversification.

Creating an international safety net is a complex undertaking. Like safety nets in individual countries, an effective international safety net needs to strike a balance among regulation, market forces, and incentives. Because the operation of such a safety net will require sizable resources, most likely it will need the concurrence of industrial-country governments, multilateral financial institutions, and the private sector. The discussion regarding a "new international financial architecture," which started after the 1994 Mexican crisis and continues today, and the difficulties encountered by the Contingent Credit Line (CCL) facility of the International Monetary Fund (IMF), demonstrate the complexities of the task at hand.[15]

As in individual countries, an effective international safety net would have to rely on market-friendly instruments to guarantee that it keeps pace with a quickly changing market environment. In recent years a few countries have put in place mechanisms aimed at addressing contagion, all of which are based on market signals as a means to enhance market discipline. As mentioned above, Argentina has contracted a credit line with a consortium of fourteen international banks. The banks provide insurance against liquidity crises in exchange for a fee, which is determined by the performance of the Argentinean economy and especially its banks. As a vehicle for crisis resolution, this private arrangement resembles lending of last resort by an international central bank. However, Gavin and Powell (1998) show that under certain assumptions the private credit line is superior, mainly because it imposes greater ex ante market discipline.[16]

Another example is that of New Zealand, which has significantly upgraded the disclosure requirements imposed on banks and, as already mentioned, has fully opened its domestic financial markets to

15. The CCL was launched in 2000 but at the time of writing no eligible countrie have yet subscribed, mostly because of the perception that to do so would signal weak fundamentals in the subscribing country and thus turn market sentiment against it.

16. Although this issue requires further research, this advantage probably explains the relative success of the Argentinean arrangement compared with the CCL.

well-established international banks. This approach has boosted market competition and self-regulation.[17]

5. Conclusions and Policy Implications

What have been the consequences of the financial turmoil of 1997-98, and what lessons have we learned? What policy recommendations can be offered, and what best practices proposed, to emerging market economies seeking greater integration into the world economy? In this final section we first discuss the consequences and lessons arising from the recent crisis period, and then address the somewhat risky task of advancing policy recommendations.

5.1 Lessons from the Turmoil

We see four main consequences and corresponding lessons emerging from the recent crisis episode. First, there has been a revision—even a questioning—of the net benefits of financial integration. On the upside, nothing has happened to overturn the conviction that financial integration and internationalization of banking can bring great benefits to emerging market economies. These benefits accrue as a result of deeper, more sophisticated, and more efficient financial systems that foster higher investment and faster growth. Financial integration not only reflects changes in policies and regulations but is also the result of ongoing progress in communications and information technology, which emerging market economies could not avoid even if they wanted to. The only way that policymakers could isolate their economies from exogenous technical progress in financial services would be to resort to increasing restrictions, which would cause large and growing efficiency losses in resource accumulation and allocation. Therefore it is becoming ever more difficult and costly for emerging market economies to oppose international financial integration.

However, financial integration also presents downside risks due to capital market volatility. International markets, like their domestic counterparts, are subject to sudden changes of sentiment and to contagion, which can be particularly intense for developing countries.

17. Cordella and Levy-Yeyati (1998) present a theoretical analysis of how these links work.

Thus policymakers in emerging market economies have to find ways to achieve financial integration while minimizing the downside risks. Here it is important to note that other risks—often and wrongly blamed on the process of financial integration itself, such as credit booms and asset price bubbles—are more likely caused by domestic distortions and policy failures. Similarly, foreign overborrowing and asset-liability mismatches—often observed in countries that open their capital accounts—are usually the result of inadequate domestic policies. These cases call for correcting the distortions and improving policies at home, not reversing the process of financial integration itself, which would only make matters worse in the long run by squandering the opportunity to develop more quickly.

Second, it became clear after the Thai crisis that the international financial system is subject to systemic shocks. The 1997 Thai and 1999 Brazilian devaluations, and particularly the 1998 Russian moratorium, showed that shocks in one country could quickly spread across markets and economies, affecting seemingly unrelated emerging market economies and industrial countries alike. Furthermore, compared with previous crises, the punishment that markets administered to many economies in the late 1990s seemed out of proportion to the countries' sins. Markets worldwide reacted very harshly even toward those countries with sound macroeconomic fundamentals (Calvo, 1997).

Here the lessons to be drawn are twofold. First, maintaining strong macroeconomic fundamentals is a necessary but not a sufficient condition to avoid crises and contagion effects. After all, until 1997 the Asian crisis countries boasted low inflation and sustained fiscal surpluses, relatively small current account deficits (with the exception of Thailand), high saving and investment rates, a large export base, and little overvaluation of their currencies. Second, and more important, contagion is a real threat that may affect emerging market economies and developed countries alike irrespective of their macroeconomic fundamentals.

The third main lesson emerges from the Thai crisis in particular. It is that the East Asian countries, which had been depicted as examples of success because of their sound and prudent macroeconomic policies,[18] remained just as vulnerable to changes in market sentiment as other economies following different development and

18. See World Bank (1993).

growth strategies. It could be argued that the ultimate determinant of the crises in the East Asian countries was neither their large capital inflows nor their export-led growth strategies, but rather their unsound financial systems and inadequate regulatory frameworks and business environments. The crises brought these deficiencies of the financial and the corporate sectors into the open.

Countries need to address structural deficiencies like these either before they undertake financial integration or in tandem with it. However, as the East Asian episode has shown, in many cases these weaknesses do not surface until the domestic financial system is put under strain from increasing financial intermediation and large capital inflows. Thus financial integration should become the trigger of much-needed reform in the financial and corporate sectors in developing countries. The internationalization of banking can help by upgrading banking technology and management and improving corporate governance in both the banking and the corporate sectors. But to argue that the process of financial integration is at the root of all the problems that developing countries have suffered, and to conclude from there that policies should be adopted that hinder this process, is misguided. Putting sand into the gears of financial integration will only produce slower growth and a weaker and more vulnerable economy in the long run.

The final lesson: the Asian crisis showed that the measures taken after the Mexican crisis were inadequate to prevent another episode of international financial turmoil.[19] Since the Thai crisis in 1997, several additional measures have been proposed to reduce the frequency and severity of worldwide financial crises. All of these proposals acknowledge the need to redesign the international financial architecture to reduce contagion, and to build additional buffers to allow countries to accommodate shocks more easily. The proposals range from establishing both an international bankruptcy court and a lender of last resort, to abolishing multilateral financial institutions such as the IMF, to imposing Tobin taxes on the free movement of capital across countries to reduce market volatility (for a summary see Eichengreen, 1999). Considering the complexities, both political and

19. After the Mexican crisis of 1994, the international financial community, led by the IMF, introduced new guidelines for the production and dissemination of macroeconomic and financial data, applicable to all countries participating in international capital markets. These measures were prompted by international investors' complaints that publicly available data for Mexico before and during the 1994-95 tequila crisis had been inadequate and insufficient.

technical, involved in such a process, it is unlikely that a comprehensive new global institutional framework governing international financial transactions will be put in place in the near future. It is more likely that, for the foreseeable future, most remedies to crises and contagion will still be applied at the level of individual countries.

5.2 Policy Recommendations

We have argued that financial crises are due mainly to weak domestic financial institutions, not to the joint occurrence of external shocks and financial integration. This does not imply that foreign shocks and contagion effects can be ignored, for in fact they are more likely to occur in more integrated countries. However, the transmission effect of foreign shocks to the domestic economy depends critically on a country's macroeconomic fundamentals and the strength and resilience of its financial institutions.

Three recent examples illustrate this point. First, the Asian crisis proved to be only a passing storm in Singapore, Taiwan, and Hong Kong; all of these economies have strong fundamentals and sound banks. Second, the Chilean banking system was fully restructured and strengthened after the banking crisis of the early 1980s. As a result, Chile was only mildly affected by the 1997-98 turmoil, although it did suffer large terms-of-trade losses and capital inflow reductions. Third, the Argentinean banking system was also restructured and strengthened following the Mexican crisis of 1994. As a result, that country was much less affected during the turmoil of 1997-98 than during the Mexican crisis.

Hence the most important policy lesson that emerges is that financial liberalization should proceed with caution but should include the upgrade or overhaul of the entire regulatory and supervisory framework for banks and a revision of corporate law. This is important because financial liberalization can easily exacerbate moral hazard and adverse selection in the financial sector and in its interaction with the corporate sector. Ignoring these institutional aspects in a liberalizing economy may, instead of pointing it toward higher investment and growth, only sow the seeds of future financial crises and recessions.

Second, because implementing a successful financial liberalization is a difficult and lengthy process, developing countries could consider the use—as a temporary, second-best instrument—of tools aimed at reducing excess reliance on short-term debt, both domestic

and foreign. However, these policies, like Chile's selective controls on capital inflows, should *only* be considered temporary and must be properly designed and implemented so that a reasonable degree of compliance can be attained. These instruments should be abolished in the medium term (as Chile did) when financial markets have reached a certain level of maturity and depth. By then the economy will have developed adequate instruments to cope with maturity and exchange rate risks as well as the risk of a sudden reversal in capital flows due to international contagion.

Third, provided they have in place a credible nominal anchor for the conduct of monetary policy within a consistent set of macroeconomic policies, countries seeking greater financial integration should consider adopting a flexible exchange rate regime.[20] Floating could reduce exposure to short-term debt because market participants would then face greater exchange rate risk. But it will work only if there are no other imperfections in place such as an implicit guarantee on foreign debt that causes overexposure in the first place. At the same time, floating could ease relative price adjustment when short-term nominal price and wage rigidities are pervasive, allowing for rapid nominal and real devaluation.

Fourth, developing countries should focus in the short term on strengthening their banking systems. This includes measures like making banks more resilient by raising capitalization requirements, classifying their loan portfolios according to quality, building up provisions against loan losses, and assessing maturity and exchange rate mismatches. Even if the institutional changes just mentioned take some time to be implemented, there is an urgent need to build up buffers, and nowhere are buffers as important as in the domestic banking system. One way to advance quickly in this regard is by opening the domestic market to well-established foreign banks, complemented by a large buffer stock of international reserves. Countries like Chile and Singapore that fared relatively well during the recent turmoil held large foreign reserves at the outset of the crisis. Such buffers are expensive but may prove worth the cost while financial integration proceeds, and while other institutional issues are being addressed, by avoiding the much higher costs of a crisis.

20. An increasingly popular nominal anchor on which to base a monetary regime is inflation targeting, pursued in combination with floating exchange rates. See Loayza and Soto (2001), and the papers therein, for a review of a decade of experience with inflation targeting in the world.

Fifth, even countries that are fully integrated into the world economy can be affected by domestic and external shocks and suffer a sudden (if temporary) loss of market confidence and large reversals in capital flows. However, this does not mean that countries should seek to protect themselves from these shocks by closing their economies. On the contrary, developing and industrial countries alike need to implement policies aimed at achieving greater diversification of both exports and funding sources (to the extent that contagion is driven by international trade and financial links). Every emerging market country also needs to initiate and sustain a comprehensive communication strategy aimed at keeping markets fully informed of its economic fundamentals, policies, and most recent developments. To the extent that contagion results from information asymmetries and from herd behavior, such a strategy should be of value in warding it off. Countries should also consider following Argentina's example in arranging for liquidity insurance mechanisms.

Finally, countries should put in place mechanisms that ensure prompt action in resolving a crisis should one occur. Good tools for diagnosing the situation are critically needed at an early stage. In many crisis episodes, both diagnoses and remedial actions prove insufficient, requiring drastic subsequent revision and giving rise to opportunistic behavior on the part of viable borrowers. For example, in many country episodes a large initial devaluation (aimed at restoring export competitiveness) occurred after the crisis hit. The devaluation raised the cost of servicing foreign debt and posed a severe financial problem. In countries that failed to address the financial problem promptly, but instead postponed the difficult task of seizing assets and allocating losses among different stakeholders, the initial difficulties worsened existing moral hazard problems. This further aggravated credit rationing and liquidity squeezes and led to a deeper contraction in output and more serious financial problems.[21] Also, a rapid recovery was hindered in some countries by tight monetary and fiscal policies early on, aimed at containing inflationary pressures arising from the devaluations.[22] A more accurate assessment of the real difficulties would have contributed to a more appropriate choice of emergency measures—and to better results.

21. For an anatomy of financial crises see Mishkin (1997).

22. This is a debatable point on which not all observers agree. See Radelet and Sachs (1998) and Sachs and Radelet (1998).

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Financial Intermediation and Growth: Causality and Causes

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Do better functioning financial intermediaries—financial intermediaries that are better at ameliorating information asymmetries and facilitating transactions—exert a causal influence on economic growth? Providing evidence on *causality* has implications for policymakers and economists. For instance, Alexander Hamilton (1781) argued that "banks were the happiest engines that ever were invented" for spurring economic growth. Others, however, question whether finance boosts growth. President John Adams (1819) asserted that banks harm the "morality, tranquility, and even wealth" of nations.[1] Economic theories mirror these divisions. Some models show that economic agents create debt contracts and financial intermediaries to ameliorate the economic consequences of informational asymmetries, with beneficial implications for resource allocation and

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1. The quotations from Hamilton and Adams are taken from Hammond (1991, p. 36). For an historical perspective, also see Bagehot (1873) and Schumpeter (1912) on how intermediaries spur economic growth.

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economic activity.[2] However, other models note that higher returns from better resource allocation may depress saving rates enough such that overall growth rates actually slow with enhanced financial development (Bencivenga and Smith, 1991; King and Levine, 1993b). Furthermore, Robinson (1952) argues that financial development primarily follows economic growth and the engines of growth must be sought elsewhere.[3] In terms of policy, if financial intermediaries exert an economically large impact on growth, then this raises the degree of urgency attached to legal, regulatory, and policy reforms designed to promote financial development.

This paper rigorously examines whether the exogenous component of financial intermediary development influences economic growth. We also present evidence concerning the legal, regulatory, and policy determinants of financial development. While past work shows that the level of financial development is a good predictor of economic growth (King and Levine, 1993a, b; Levine and Zervos, 1998; Neusser and Kugler, 1998; and Rousseau and Wachtel, 1998), these results do not settle the issue of causality. Although this paper does not fully resolve all concerns about causality, it uses new data and new econometric procedures that directly confront the potential biases induced by simultaneity, omitted variables, and unobserved country-specific effects that have plagued previous empirical work on the finance-growth link.[4]

Methodologically, the paper uses two econometric techniques: (1) generalized method of moments (GMM) dynamic panel estimators and (2) a cross-sectional instrumental-variable estimator. Whereas the pure cross-sectional estimator follows directly from traditional growth studies, the panel estimator uses pooled cross-country and

2. Also, see Townsend (1979); Gale and Hellwig (1985); Diamond (1984); Boyd and Prescott (1986); Diamond and Dybvig (1983); and Greenwood and Jovanovic (1990). For reviews of this literature see Gertler (1988) and Levine (1997).

3. For more on how economic activity influences the financial sector, see Patrick (1966) and Greenwood and Jovanovic (1990).

4. This paper complements recent microeconomic efforts aimed at reconciling whether financial development is simply a good predictor of economic growth. Rajan and Zingales (1998) show that, in countries with well-developed financial systems, industries that are naturally heavy users of external finance grow relatively faster than other industries. Demirgüç-Kunt and Maksimovic (1998) show that firms in countries with better-developed financial systems grow faster than they could have grown without this access. Jayaratne and Strahan (1996) show that when individual states of the United States relaxed intrastate branching restrictions the quality of bank loans rose and per capita GDP growth accelerated.

time-series data to exploit the additional information provided by the over-time variation in the growth rate and its determinants. This added information allows us to obtain more precise estimates and, most importantly, correct for biases associated with existing studies of the finance-growth relationship.

Consider first the GMM dynamic panel estimators, which are specifically designed to address the econometric problems induced by unobserved country-specific effects and joint endogeneity of the explanatory variables in lagged-dependent-variable models, such as growth regressions. We assemble a panel dataset of 74 countries, where the data are averaged over each of the seven 5-year intervals composing the period 1960-95. The dependent variable is the growth rate of the real per capita gross domestic product (GDP). The regressors include the level of financial intermediary development, along with a broad set of variables that serve as conditioning information. We employ two GMM panel estimators; both are based on the use of lagged observations of the explanatory variables as instruments (thus labeled "internal" instruments). In the first GMM panel estimator, we (a) difference the regression equation to remove any omitted variable bias created by unobserved country-specific effects, and then (b) instrument the right-hand-side variables (the differenced values of the original regressors) using lagged values of the original regressors to eliminate potential parameter inconsistency arising from simultaneity bias. This *difference* dynamic-panel estimator, developed by Arellano and Bond (1991) and Holtz-Eakin, Newey, and Rosen (1990), has increasingly been used in studies of growth (Caselli, Esquivel, and LeFort, 1996; Easterly, Loayza, and Montiel, 1997). We also use a second GMM dynamic panel estimator that improves upon the *difference* estimator in so far as the quality of the instruments is concerned. Specifically, lagged values of financial development frequently make weak instruments for forecasting *changes* in financial development. This weak instrument problem can induce biases in finite samples and poor precision even asymptotically (Alonso-Borrego and Arellano, 1996). The second GMM panel estimator mitigates this problem by complementing the *difference* specification with the original regression specified in *levels*. This *system* estimator, developed by Arellano and Bover (1995), offers dramatic improvements in both efficiency and consistency in Monte Carlo simulations (Blundell and Bond, 1997). These GMM estimators have not been used before to examine the relationship between financial intermediary development and economic growth.

Our second econometric method to examine the effect of financial intermediary development on economic growth is a cross-sectional estimator. Data for 71 countries are averaged over the period 1960-95, so that there is one observation per country. The countries are listed in appendix table A1. Although the cross-sectional estimator does not deal as rigorously as the panel estimators with the potential problems induced by simultaneity, omitted variables, and unobserved country-specific effects, the cross-sectional results are direct descendants of the cross-country literature on finance and growth (e.g., King and Levine, 1993a; Levine and Zervos, 1998). Also, the cross-sectional estimator serves as a consistency check on the panel findings. Unlike much of the cross-country growth literature, we use instrumental variables to extract the exogenous component of financial intermediary development. For this purpose we use the insight provided by La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997, 1998; henceforth LLSV). They note that most countries can be divided into countries with predominantly English, French, German, or Scandinavian legal origins and that countries typically obtained their legal systems through occupation or colonization. Moreover, LLSV (1998) show that national legal origin strongly influences the legal and regulatory environment governing financial sector transactions. Since legal origin explains cross-country differences in financial intermediary development and since legal origin is (reasonably) exogenous, we use legal origin as an instrumental variable to control for simultaneity bias.

In conducting this research, we construct a new dataset and focus on three measures of financial intermediation. One measures the overall size of the financial intermediation sector. The second measures whether commercial banking institutions, or the central bank, is conducting the intermediation. The third measures the extent to which financial institutions funnel credit to private sector activities. Our financial development indicators improve on past measures by (i) more accurately deflating nominal measures of intermediary liabilities and assets, (ii) more comprehensively measuring the banking sector, and (iii) more carefully distinguishing who is conducting the intermediation and to where the funds are flowing. While the financial intermediary indicators are still imperfect measures of how well financial intermediaries research firms, monitor managers, mobilize savings, pool risk, and ease transactions, these three measures provide more information about financial intermediary development than past measures and together they provide a

more accurate picture than if we used only a single measure. Moreover, they produce similar conclusions.

The GMM dynamic panel estimators and the pure cross-sectional regressions produce very consistent findings: the exogenous component of financial intermediary development is positively and robustly linked with economic growth. In interpreting the results, note that the findings do not reject the view that economic activity influences financial development. Rather, the results show that the positive link between finance and growth is *not only* due to growth influencing financial development; the strong positive relationship between financial intermediary development and long-run growth is at least partly explained by the effect of the exogenous component of financial development on economic growth. Economically, the impact is large. For example, the estimated coefficients suggest that if Argentina had enjoyed the level of financial intermediary development of the average developing country during the 1960-95 period it would have experienced about one percentage point faster real per capita GDP growth per annum over this period.

The regression results pass a battery of diagnostic and sensitivity tests. The results are robust to modifications in the conditioning information set and alterations in the sample period. Outliers are not producing the results. Specification tests support the appropriateness of the instrumental variables. This gives credence to the conclusion that the estimated positive link between finance and growth is not due to simultaneity bias or insufficient control for other determinants of growth.

The results favor the growth-enhancing view of financial intermediation espoused by Hamilton (1781), Bagehot (1873), and Schumpeter (1912). In turn, the results are less consistent with those that minimize the positive role of financial intermediaries in the growth process (Adams, 1819; Robinson, 1952; Lucas, 1988). Similarly, this paper's findings are consistent with theoretical models that predict that better functioning financial intermediaries accelerate economic growth. Our results do not favor models that emphasize the potentially growth-retarding impact of financial development. Finally, this paper's findings highlight financial reform. If economists can identify legal, regulatory, and policy reforms that promote financial development, this may positively influence economic growth.

Consequently, we also examine whether cross-country differences in particular legal and regulatory system characteristics help

explain cross-country differences in the level of financial intermediary development. The degree to which financial intermediaries can acquire information about firms, write contracts, and have those contracts enforced will fundamentally influence the ability of those intermediaries to identify worthy firms, exert corporate control, manage risk, mobilize savings, and ease exchanges. Thus, as argued by LLSV (1997, 1998), the legal and regulatory system will fundamentally influence the ability of the financial system to provide high-quality financial services. LLSV (1997) examine securities markets. In contrast, we combine their data on the legal and regulatory environment with our data on financial intermediation to study the links between financial intermediary development and cross-country differences in legal and accounting systems.

The results provide useful information to policymakers. The data suggest that countries with legal and regulatory systems that give a high priority to creditors receiving the full present value of their claims on corporations have better functioning financial intermediaries than countries where the legal system provides weaker support to creditors. Moreover, contract enforcement seems to matter even more than the formal legal and regulatory codes. Countries that efficiently impose compliance with laws tend to have better developed financial intermediaries than countries where enforcement is more lax. The paper also shows that information disclosure matters for financial development. Countries where corporations publish relatively comprehensive and accurate financial statements have better developed financial intermediaries than countries where published information on corporations is less reliable. Finally, we confirm these findings when using the legal origin dummy variables (English, French, German, Scandinavian) as instrumental variables to extract the exogenous component of the legal, enforcement, and accounting environment: the legal/regulatory system exerts a powerful influence on financial sector development. While considerable research remains, taken together, this paper's findings provide support for the view that legal and regulatory changes that strengthen creditor rights, contract enforcement, and accounting practices boost financial intermediary development with positive repercussions on economic growth.

The rest of the paper is organized as follows. Section 1 presents the results using purely cross-sectional data, while section 2 discusses and presents the *difference* and *system* dynamic panel results. Section 3 provides information on how the legal and accounting

environment explain cross-country differences in financial development. Section 4 concludes.

1. Finance and Growth: Cross-Sectional Analyses

This section examines the relationship between financial intermediation and growth using a pure cross-sectional estimator. We begin with the pure cross-sectional estimator because it more directly follows from the large cross-country growth literature. The next section uses GMM dynamic panel procedures that more comprehensively confront problems induced by country-specific effects, endogeneity, and the routine use of lagged dependent variables in growth regressions.

1.1 Financial Intermediary Development

As discussed above, numerous theoretical models show that economic agents may form financial intermediaries to mitigate the economic consequences of information and transaction costs. More specifically, financial intermediaries emerge to lower the costs of researching potential investments, exerting corporate control, managing risk, mobilizing savings, and conducting exchanges. Theory further suggests that, by providing these services to the economy, financial intermediaries influence savings and allocation decisions in ways that may alter long-run growth rates.[5] Thus, modern economic theory provides an intellectual framework for understanding how financial intermediaries influence long-run rates of economic growth.

To evaluate the empirical predictions advanced by a variety of theoretical models regarding the relationship between finance and growth, therefore, we would ideally like to construct measures of the ability of different financial systems to research and identify profitable ventures, monitor and control managers, ease risk management and facilitate resource mobilization. It is impossible, however, to construct accurate, comparable measures of these financial services for a broad cross-section of countries over the past 35 years. Consequently, to measure the provision of financial services, this paper constructs three indicators of financial intermediary development.

5. For example, see Greenwood and Jovanovic (1990), Bencivenga and Smith (1991), and King and Levine (1993b).

(We also consider two additional measures in the sensitivity section.) While each has particular strengths and weaknesses, we improve upon past measures of financial intermediary development.[6]

LIQUID LIABILITIES equals liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries) divided by GDP. This is a typical measure of "financial depth" and thus of the overall size of the financial intermediary sector (King and Levine, 1993a). This commonly used measure of financial sector development has shortcomings. It may not accurately gauge the effectiveness of the financial sector in ameliorating informational asymmetries and easing transactions costs. Also, LIQUID LIABILITIES includes deposits by one financial intermediary in another, which may involve "double counting." Under the assumption that the size of the financial intermediary sector is positively correlated with the provision and quality of financial services, many researchers use this measure of financial depth (Goldsmith, 1969; King and Levine, 1993a; McKinnon, 1973). Thus, we include it as one measure of financial intermediary development.

COMMERCIAL-CENTRAL BANK equals the ratio of commercial bank assets divided by commercial bank plus central bank assets. COMMERCIAL-CENTRAL BANK measures the degree to which commercial banks versus the central bank allocate society's savings. Again, this measure of financial intermediary development does not directly measure the effectiveness of banks in researching firms, exerting corporate control, mobilizing savings, easing transactions, and providing risk management facilities to clients. Thus, COMMERCIAL-CENTRAL

6. One way this paper improves upon past measures of financial intermediary development is by accurately deflating nominal measures of financial intermediary liabilities and assets. Specifically, while financial intermediary balance sheet items are measured at the end of the year, GDP is measured over the year. Some authors try to correct for this problem by using an average of financial intermediary balance sheet items in year t and $t - 1$ and dividing by GDP measured in year t (King and Levine, 1993a). This however does not fully resolve the distortion, especially in highly inflationary environments. This paper deflates end-of-year financial balance sheet items by end-of-year consumer price indices (CPI) and deflates the GDP series by the annual CPI. Then, we compute the average of the real financial balance sheet item in year t and $t - 1$ and divide this average by real GDP measured in year t. This is described more fully in appendix table A2. Although we have attempted to be as careful as possible in constructing the data, measurement errors undoubtedly remain. We could not identify any reasons to believe, however, that this would systematically influence this paper's findings since we control for a variety of factors—including the level of economic development—and use instrumental variable procedures.

BANK is not a direct measure of the quality and quantity of financial services provided by financial intermediaries. The intuition underlying this measure is that banks are more likely to identify profitable investments, monitor managers, facilitate risk management, and mobilize savings than central banks. Thus, King and Levine (1993a, b) recommend including COMMERCIAL-CENTRAL BANK as an additional measure of financial intermediary development.

PRIVATE CREDIT equals the value of credits by financial intermediaries to the private sector divided by GDP. This measure of financial development is more than a simple measure of financial sector size. PRIVATE CREDIT isolates credit issued to the private sector, as opposed to credit issued to governments, government agencies, and public enterprises. Furthermore, it excludes credits issued by the central bank and development banks. PRIVATE CREDIT is our preferred indicator because it improves on other measures of financial development used in the literature. For example, King and Levine (1993a,b) use a measure of gross claims on the private sector divided by GDP. But this measure includes credits issued by the monetary authority and government agencies, whereas PRIVATE CREDIT includes only credits issued by banks and other financial intermediaries. Also, Levine and Zervos (1998) and Levine (1998) use a measure of deposit money bank credits to the private sector divided by GDP over the period 1976-93.[7] That measure, however, does not include credits to the private sector by non-deposit money banks and it only covers the period 1976-93. PRIVATE CREDIT is a broader measure of credit issuing financial intermediation and its time dimension is twice as long, 1960-95. We should also emphasize here that these financial intermediary measures are not simply

7. Levine and Zervos (1998) also examine whether equity markets substitute for credit issuing intermediaries. They find that the answer is no. Measures of banking sector development and stock market development both enter significantly when included together in simple cross-country growth regressions. Evidently, banks provide different financial services from those provided by securities markets. Specifically, theory suggests that securities markets are particularly good at augmenting liquidity and allowing agents to custom design risk management tools. Theory suggests that intermediaries have a comparative advantage in reducing informational asymmetries. This paper is very different from Levine and Zervos (1998) because we are trying to control formally for simultaneity and omitted variable biases, which they do not do. To do this, we rely on the GMM dynamic panel procedures and use the pure cross-sectional estimator to confirm our results. Unfortunately, there do not exist securities market data over a sufficiently long period and across a sufficiently large number of countries to conduct our analyses with securities market data from Levine and Zervos (1998).

picking up the relative importance of state-owned enterprises and the overall level of nationalization. In the analysis below, we control for the role of state-owned enterprises and this does not affect the conclusions. While PRIVATE CREDIT does not directly measure the amelioration of information and transaction costs, we interpret higher levels of PRIVATE CREDIT as indicating higher levels of financial services and therefore greater financial intermediary development.

Table 1 provides summary statistics on the financial intermediary development indicators. The data are listed country-by-country in appendix table A3. (Summary statistics and correlations with other variables used in this paper are provided in tables A4 and A5.) There is considerable variation across countries. For example, PRIVATE CREDIT is less than 10 percent of GDP in Zaire, Sierra Leone, Ghana, Haiti, and Syria. PRIVATE CREDIT, however, is greater than 85 percent of GDP in Switzerland, Japan, the United States, Sweden, and the Netherlands. Real per capita GDP growth also exhibits considerable cross-country variation. For instance, Korea, Malta, Taiwan, and Cyprus all enjoyed growth rates greater than 5 percent per annum over the 35 year period, while Zaire, Niger, Ghana, Venezuela, Haiti, and El Salvador all suffered growth rates of less than *negative* 0.5 percent per year from 1960 to 1995. Thus, the dataset offers rich cross-country variation for exploring the link between growth and financial intermediary development.

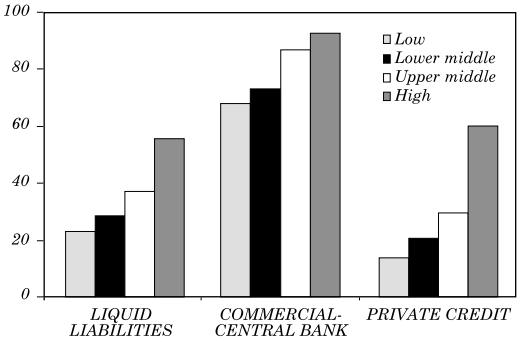
The positive relationship between income per capita and financial development is illustrated in figure 1. Figure 1 shows that all three financial intermediary development indicators tend to increase as we move from low- to high-income countries. Since conditional

Table 1. Summary Statistics on Financial Intermediary Development, 1960-95

Statistic	*LIQUID LIABILITIES*[a]	*COMMERCIAL-CENTRAL BANK*[b]	*PRIVATE CREDIT*[c]
Mean	43.44	78.16	38.29
Median	37.48	83.89	27.01
Maximum	143.43	98.99	141.30
Minimum	9.73	23.72	4.08
Standard deviation	25.61	18.26	28.71
No. of observations	71	71	71

Source: Authors' calculations.
a. Liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries) divided by GDP, times 100.
b. Assets of deposit money banks divided by assets of deposit money banks plus central bank assets, times 100.
c. Credit by deposit money banks and other financial institutions to the private sector divided by GDP, times 100.

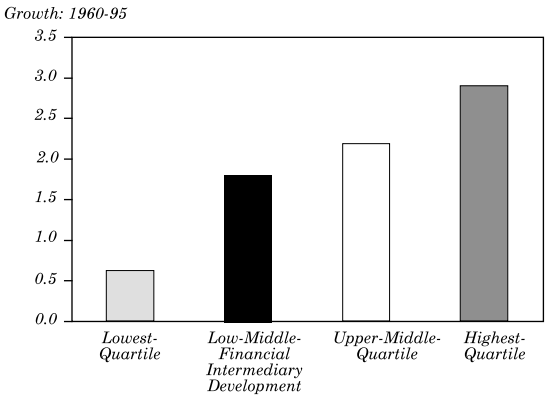
Figure 1. Financial Development across Income Groups, 1960-95



convergence is a feature of cross-country data sets over the post-1960 period (Barro and Sala-i-Martin, 1995), the positive correlation between income per capita and financial development may then suggest a relationship between financial development and economic growth. Indeed, four out of the five countries with the highest level of PRIVATE CREDIT have slower than average growth rates (Japan is the lone exception). In any case, these summary statistics highlight the importance of controlling for the level of real per capita GDP—as well as a host of other economic and political factors—in assessing the independent relationship between financial intermediary development and economic growth.

Figure 2 illustrates that countries with higher levels of PRIVATE CREDIT tend to enjoy faster growth rates over the 1960-95 period than countries with lower levels of financial intermediary development. Indeed, of the ten fastest growing countries over this 35-year period, all of them had larger-than-average values of PRIVATE CREDIT. Many well-known "Asian Miracles," such as Malaysia, Thailand, Japan, Taiwan, and Korea, were in the top quartile of countries as ranked by financial intermediary development. It is worth noting that four European countries (Greece, Ireland, Portugal, and Cyprus) were also among the ten fastest growing countries during this sample period. Each of these countries also had comparatively well-developed financial systems. Certainly, many factors may account for these economic success stories. At the other end of the spectrum, seven of the ten countries with negative growth rates over the 35-year period were in the lowest quartile of countries as defined by financial intermediary development (Zaire, Niger, Ghana, Haiti, Liberia, Sierra Leone, and Guyana). The banking systems of these

Figure 2. Economic Growth and Financial Intermediary Development, 1960-95



countries have been in disarray for much of the last 35 years (see, for example, Gelbard and Leite 1999, Mehran 1998, Sheng 1996, and Caprio, Atiyas and Hanson 1994 for discussions of the individual countries). Government ownership of banks, massive official intervention in credit allocation, high levels of nonperforming loans, controls on interest rates, and numerous restrictions impede the ability of the financial systems in these countries from mobilizing and allocating capital efficiently.[8] But these countries suffer many other economic policy and political maladies. Thus, we now turn to regression analyses where we control for an array of factors associated with economic growth (including country-specific factors) and also confront potential biases induced by simultaneity.

1.2 Legal Origin

To confront the issue of simultaneity, we identify instrumental variables for financial intermediary development. Here, we follow LLSV (1998) in looking to legal origin. Comparative legal scholars place countries into four major legal families —English, French, German, or Scandinavian— that descended from Roman law (Reynolds

8. Some countries have effectively improved their financial systems through a range of financial reforms, e.g., Ghana, as documented in Gelbard and Leite (1999). Thus, it is important to exploit the time-series dimension of the data. We do this below.

and Flores, 1996). As described by Glendon, Gordon, and Osakwe (1982), Roman law was compiled under the direction of the Byzantine Emperor Justinian in the sixth century. Over subsequent centuries, the Glossators and Commentators interpreted, adapted, and amended the Law (Berman, 1997). In the 17th and 18th centuries the Scandinavian countries formalized their own legal codes. The Scandinavian legal systems have remained relatively unaffected from the far reaching influences of the German and especially the French Civil Codes.

Napoleon directed the writing of the French Civil Code in 1804. He made it a priority to secure the adoption of the Code in France and all conquered territories, including Italy, Poland, the Low Countries, and the Habsburg Empire. Also, France extended her legal influence to parts of the Near East, Northern and Sub-Saharan Africa, Indochina, Oceania, French Guyana, and the French Caribbean islands during the colonial era. Furthermore, the French Civil Code was a major influence on the Portuguese and Spanish legal systems, which helped spread the French legal tradition to Central and South America.

The German Civil Code (*Bürgerliches Gesetzbuch*) was completed almost a century later in 1896. The German Code exerted a big influence on Austria and Switzerland, as well as China (and hence Taiwan), Czechoslovakia, Greece, Hungary, Italy, and Yugoslavia. Also, the German Civil Code heavily influenced the Japanese Civil Code, which helped spread the German legal tradition to Korea. Unlike these Civil Law countries, the English legal system is common law, where the laws were primarily formed by judges trying to resolve particular cases.

This paper takes national legal origin as an exogenous "endowment" since the English, French, and German systems were spread primarily through conquest and imperialism. It is critical to recognize, however, that exogeneity is not a sufficient condition for economically meaningful instrumental variables. It must also be the case that there are good reasons for believing that legal origin is closely connected to factors that directly affect the behavior of financial intermediaries. LLSV (1998) trace differences in legal origin through to differences in the legal rules covering secured creditors, the efficiency of contract enforcement, and the quality of accounting standards. Thus, legal origin is connected to legal and regulatory characteristics defining financial intermediary activities.

Table 2 presents regressions of the financial intermediary development indicators on the dummy variables for English, French, and German legal origin, relative to Scandinavian origin (which is captured in the constant). We extend the LLSV (1998) data set from 44 countries (with financial intermediary data) to 71 using Reynolds and Flores (1996). The data are listed in appendix table A3. Some of the regressions also control for the level of real per capita GDP. The major message is that countries with a German legal origin have better developed financial intermediaries. While countries with a French legal tradition tend to have less well-developed institutions than other countries on average, this result does not hold when controlling for the overall level of economic development. Also, as indicated by the p values of the *F* test, the legal origin variables explain a significant fraction of the cross-country variation of the financial intermediary development indicators.

Table 2. Legal Origin and Financial Intermediary Development, 1960-95[a]

	LIQUID LIABILITIES[b]		*COMMERCIAL-CENTRALBANK*[c]		*PRIVATE CREDIT*[d]	
Legal Origin	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Constant	3.829	0.958	4.506	3.063	4.027	–0.674
	(0.000)	(0.081)	(0.000)	(0.000)	(0.000)	(0.386)
ENGLISH	–0.134	0.249	–0.170	0.022	–0.717	–0.090
	(0.325)	(0.038)	(0.002)	(0.716)	(0.002)	(0.646)
FRENCH	–0.434	–0.052	–0.270	–0.078	–0.894	–0.268
	(0.001)	(0.703)	(0.000)	(0.152)	(0.000)	(0.190)
GERMAN	0.477	0.683	0.048	0.152	0.401	0.738
	(0.016)	(0.000)	(0.100)	(0.010)	(0.076)	(0.002)
INCOME[e]	...	0.330	...	0.166	...	0.541
	...	(0.000)	...	(0.000)	...	(0.000)
Summary statistic						
P value (*F* statistic)	0.001	0.000	0.040	0.000	0.000	0.000
R^2	0.23	0.44	0.12	0.30	0.26	0.55
No. of observations	71	71	71	71	71	71

Source: Authors' calculations.

a. Scandinavian legal origin is the omitted category. Values for the financial intermediary development indicators are averages over the 1960-95 period. Numbers in parentheses are p values.

b. Liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries) divided by GDP, times 100.

c. Assets of deposit money banks divided by assets of deposit money banks plus central bank assets, times 100.

d. Credit by deposit money banks and other financial institutions to the private sector divided by GDP, times 100.

e. Logarithm of real GDP per capita in 1960.

1.3 Legal Origin and Growth in a Pure Cross-Section of Countries

Cross-sectional estimator. The pure cross-sectional analysis uses data averaged over 1960-95, such that there is one observation per country. The basic regression takes the form:

$$GROWTH_i = \alpha + \beta FINANCE_i + \gamma' (CONDITIONING\ SET)_i + \varepsilon_i ,$$

where the dependent variable, GROWTH, equals real per capita GDP growth, FINANCE equals either LIQUID LIABILITIES, COMMERCIAL-CENTRAL BANK, or PRIVATE CREDIT, and CONDITIONING SET represents a vector of conditioning information that controls for other factors associated with economic growth.[9]

To examine whether cross-country variations in the exogenous component of financial intermediary development explain cross-country variations in the rate of economic growth, the legal origin indicators are used as instrumental variables for FINANCE. Our method of estimation is the generalized method of moments (GMM).[10] In estimation we have only used *linear* moment conditions, which amount to the requirement that the instrumental variables (Z) be uncorrelated with the error term (ε). The economic meaning of these conditions is that the instrumental variables can only affect the dependent variable through the explanatory variables, that is, they cannot have an independent effect on the dependent variable. In the context of the cross-sectional growth regressions, the moment conditions mean that *legal origin* may affect per capita GDP growth only through the financial development indicators *and* the variables in the conditioning information set (that is, the other determinants of growth). We test this condition.

Testing the validity of the moment conditions is crucial to ascertaining the consistency of GMM estimates. The specification test we use is the test of overidentifying restrictions introduced in the context of GMM by Hansen (1982) and further explained in Newey and

9. Due to the potential nonlinear relationship between economic growth and the assortment of economic indicators, we use natural logarithms of the regressors.

10. Two-stage instrumental variable procedures produce the same conclusions.

West (1987).[11] If the regression specification "passes" the test, then we can safely draw conclusions taking the moment conditions as given. That is, we cannot reject the statistical and economic significance of the estimated coefficient on financial intermediary development as indicating an effect running from financial development to per capita GDP growth. We can safely discard the possibility that the relationship between financial intermediary development and growth is due to simultaneity bias or to omitted variables linked to *legal origin*.

Conditioning information set. To examine the sensitivity of the results, we experiment with different conditioning information sets. We seek to reduce the chances that the cross-country growth regression either omits an important variable or includes a select group of regressors that yields a favored result. We report the results with three conditioning information sets. The *simple conditioning information set* includes the constant, the logarithm of initial per capita GDP and initial level of educational attainment. The initial income variable is used to capture the convergence effect and school attainment is used to control for the level of human capital. The *policy conditioning information set* includes the simple conditioning information set plus measures of government size, inflation, the black market exchange rate premium, and openness to international trade.[12] The *full conditioning information set* includes the policy conditioning information set plus measures of political stability (the number of revolutions and coups and the number of assassinations per thousand inhabitants; Banks, 1994) and ethnic diversity (Easterly and Levine, 1997). Thus, for each of the three financial

11. Intuitively, the fact that we have more moment conditions (instruments) than parameters to be estimated means that estimation could be done with fewer conditions. We can use this fact to estimate the error term under a set of moment conditions that excludes one instrumental variable at a time; we can then analyze if each estimated error term is uncorrelated with the instrumental variable excluded in the corresponding instrument set. The null hypothesis of Hansen's test is that the overidentifying restrictions are valid, that is, the instrumental variables are not correlated with the error term. The test statistic is simply the sample size times the value attained for the objective function at the GMM estimate (called the *J statistic*). Hansen's test statistic is distributed as χ^2 with degrees of freedom equal to the number of moment conditions minus the number of parameters to be estimated. We report this statistic in the tables.

12. The black market exchange rate premium is frequently used as an overall index of trade, exchange rate, and price distortions (Easterly, 1994; Levine and Zervos, 1998). The inflation rate and size of the government serve as indicators of macroeconomic stability (Easterly and Rebelo, 1993; Fischer, 1993).

intermediary development indicators, we present regression results for the (i) simple, (ii) policy, and (iii) full conditioning information sets.

Regression results. The results indicate a very strong connection between the exogenous component of financial intermediary development and long-run economic growth. Table 3 summarizes the purely cross-sectional instrumental variable results for nine regressions, where the instrumental variables are the legal origin variables. For brevity, we report only the coefficients on the financial development indicators. Each of the three financial intermediary development indicators (PRIVATE CREDIT, COMMERCIAL-CENTRAL BANK, LIQUID LIABILITIES) is significantly correlated with economic growth at the 5 percent significance level in the simple, policy, and full conditioning information set regressions. The exogenous component of financial intermediary development is closely tied to long-run rates of per capita GDP growth. Furthermore, the data do not reject the orthogonality conditions at the 10 percent level in any of the nine regressions. The inability to reject the orthogonality conditions plus the result that the instruments are highly correlated with financial intermediary development (table 2)

Table 3. Financial Intermediation and Growth: Cross-Sectional Regressions, 1960-95[a]

Explanatory variable	*Coefficient*	*Standard error*	*t statistic*	p *value*	*No. of observations*	*J statistic*	*Hansen test*[e]
Regression set 1: simple conditioning information set[b]							
PRIVATE CREDIT	2.515	0.814	3.090	0.003	71	0.001890	0.13
COMMERCIAL-CENTRAL BANK	10.861	3.086	3.520	0.001	71	0.016261	1.15
LIQUID LIABILITIES	1.723	0.844	2.041	0.045	71	0.034906	2.48
Regression set 2: policy conditioning information set[c]							
PRIVATE CREDIT	3.222	1.245	2.589	0.012	63	0.007993	0.50
COMMERCIAL-CENTRAL BANK	9.641	4.039	2.387	0.021	63	0.037304	2.35
LIQUID LIABILITIES	2.173	0.908	2.394	0.020	63	0.037989	2.39
Regression set 3: full conditioning information set[d]							
PRIVATE CREDIT	3.356	1.150	2.918	0.005	63	0.022386	1.41
COMMERCIAL-CENTRAL BANK	11.289	3.258	3.465	0.001	63	0.003253	0.20
LIQUID LIABILITIES	2.788	0.903	3.089	0.003	63	0.039013	2.46

Source: Authors' calculations.
a. Explanatory variables are defined in the notes to table 2.
b. Logarithm of initial income per capita and schooling.
c. Simple set plus government size, inflation, black market premium, and openness to trade.
d. Policy set, plus indicators of revolutions and coups, political assassinations, and ethnic diversity.
e. Hansen test of overidentifying restrictions; critical values (2 d.f.) are 10 percent, 4.61, and 5 percent, 5.99.

suggest that the instruments are appropriate. These results indicate that the strong link between financial development and growth is not due to simultaneity bias. The estimated coefficient can be interpreted as the effect of the exogenous component of financial intermediary development on growth.

The regression results also indicate an economically large impact of financial development on growth. For example, India's value of PRIVATE CREDIT over the 1960-95 period was 19.5 percent of GDP, while the mean value for developing countries was 25 percent of GDP. The results suggest that an exogenous improvement in PRIVATE CREDIT in India that had pushed it to the sample mean for developing countries would have accelerated real per capita GDP growth by an additional 0.6 of a percentage point per year.[13] Similarly, if Argentina had moved from its value of PRIVATE CREDIT (16) to the developing country sample mean, it would have grown more than 1 percentage point faster per year. This is large considering that growth only averaged about 1.8 percent per year over this period. These types of conceptual experiments, however, must be treated as illustrative only; they do not account for *how to increase financial intermediary development*.

1.4 Sensitivity Analyses

We have conducted a wide array of sensitivity analyses to gauge the robustness of these findings.[14] First, consider the partial scatter plot of the growth regressions involving PRIVATE CREDIT.[15]

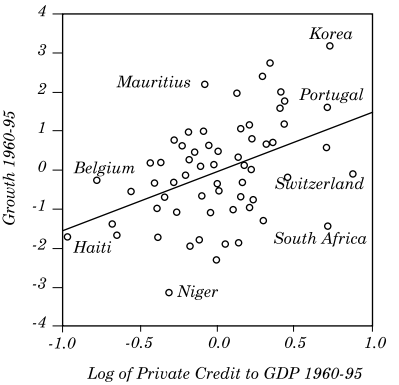
Figure 3 illustrates the relationship between growth and financial intermediary development after controlling for the full conditioning information set. Since Korea, South Africa, and Niger fall

13. To get this, recall that the regressors are in logs and note that ln(25) - ln(19.5) = 0.25. Then, use the smallest parameter on PRIVATE CREDIT from table 3, which equals 2.5, so that 2.5*(0.25) = 0.63.

14. These sensitivity results are available on request.

15. The partial scatter plot involves the two-dimensional representation of the relationship between growth and PRIVATE CREDIT controlling for the other regressors. Thus, we regress real per capita GDP growth against the full conditioning information set and collect these growth residuals. Then, we regress PRIVATE CREDIT against the full conditioning information set and collect these PRIVATE CREDIT residuals. The figures in the text plot the growth residuals against the PRIVATE CREDIT residuals along with the regression line. Thus, this regression line is the two-dimensional projection in growth – PRIVATE CREDIT space of the multivariate OLS regression.

Figure 3. Partial Scatter Plot of Growth vs Private Credit



particularly far from the regression line, we removed these countries and redid the estimation. The new GMM results are not substantially different from the table 3 results.[16] To further check for the potential influence of outliers, we examined the residuals from the GMM estimator. We removed all countries with residuals more than three standard deviations away from zero (South Africa and Switzerland) and reran the regressions. This did not alter the results. Then, we removed seven additional countries with residuals more than two standard deviations away from zero (Belgium, El Salvador, Guyana, Jamaica, Mauritius, Niger, and Senegal). This did not change the conclusions either.[17] We followed the same procedures in checking for the effect of outliers for COMMERCIAL-CENTRAL BANK and LIQUID LIABILITIES. In no case did removing outliers

16. Specifically, PRIVATE CREDIT enters with a coefficient of 2.98 and a t statistic of 2.10 and the regression passes all the diagnostic tests discussed above. Furthermore, removing Switzerland, Japan, and Portugal in addition to Niger, South Africa, and Korea did not alter the conclusion either, that is, PRIVATE CREDIT enters with a coefficient of 4.27 and a t statistic of 2.64.

17. Specifically, when we remove South Africa and Switzerland the coefficient on PRIVATE CREDIT rises to 4.72 and the t statistics equals 3.65 while the GMM estimate satisfies the litany of diagnostic tests. Similarly, when the seven additional countries are removed, PRIVATE CREDIT enters with a value of 4.53 and a t statistic of 3.91, while passing the diagnostic tests.

alter the results.[18] The strong positive connection between the exogenous component of financial intermediary development and economic growth does not seem to be driven by outliers.

Second, in assessing the independent link between financial development and economic growth, we considered a broad collection of additional control variables. We included measures of the efficiency of the bureaucracy, the level of corruption, the role of the state owned enterprises in the economy, an index of the strength of property rights, an index of the costs of business regulation, a measure of the risk of expropriation, a measure of the degree to which the country follows the rule of law, and a measure of the accounting standards employed in the country (Knack and Keefer, 1995; Mauro, 1995; LLSV, 1998, 1999). These did not alter our findings.

Third, we considered as instrumental variables measures of the religious composition of each country and the distance of the country from the equator, which have been used in a recent study of the quality of government by LLSV (1999). This did not alter our results. Furthermore, if we use the LLSV (1998) indicators of creditor rights, contract enforcement efficiency, and accounting standards as instrumental variables, we again find that the exogenous component of financial development is positively associated with faster economic growth. These alternative instrumental variable estimations pass the test of the overidentifying restrictions, which implies that these variables, measuring the quality of the legal and accounting environment, affect growth through financial development and the other regressors.[19]

18. For the COMMERCIAL-CENTRAL BANK regressions, Haiti's level of financial development is much less than predicted by its country characteristics. Nonetheless, removing Haiti increases the estimated coefficient on COMMERCIAL-CENTRAL BANK to 13.4 (with a t statistic of 3.35). Moreover, when removing other potential outliers such as Korea, Niger, and Peru, the results are unchanged (coefficient estimate of 9.6 on COMMERCIAL-CENTRAL BANK and a t statistic of 2.44). When examining the GMM residuals, Niger, Honduras, Jamaica, Korea, Mauritius, Pakistan, Senegal, and Taiwan are more than two standard deviations from zero. Removing these countries produces an estimated coefficient of 7.71 on COMMERCIAL-CENTRAL BANK, with a t statistic of 2.92, and the regression passes the battery of diagnostic tests discussed in the text. In terms of LIQUID LIABILITIES, the robustness checks produce similar results. The partial scatter plots point to Niger and Korea as potential outliers. Removing these countries does not affect the results (the estimated coefficient becomes 2.24 with a t statistic of 2.71). Similarly, when using the GMM residual criteria, Korea, Jamaica, Switzerland, Taiwan, and Zaire fall more than two standard deviations away from zero. Removing these countries produces a coefficient estimate of 2.63 on LIQUID LIABILITIES, with a t statistic of 4.24, and a regression that passes the various diagnostic tests used in this paper.

19. This result is consistent with the fact that *legal origin* is a proper instrument for financial development in a growth regression, insofar as the judicial and accounting environment depends on *legal origin*.

Fourth, as in King and Levine (1993a), we use the measures of financial intermediary development at the beginning of the period (1960) to forecast growth. We find that financial intermediary development in 1960 significantly predicts economic growth over the next 35 years after controlling for an array of country characteristics.[20] We have also restricted the sample to those countries for which LLSV (1998) collect legal data. This did not alter the results. Furthermore, we conduct the estimation over the 1980-95 period. We find the same results: the exogenous component of financial development is positively, significantly, and robustly linked with economic growth.

Fifth, we experimented with two additional measures of financial intermediary development. One measure equals deposit money bank credit to the private sector divided by GDP. This is smaller than PRIVATE CREDIT, which also includes other financial intermediaries. The second additional measure equals the ratio of deposit money bank domestic assets to GDP (and so does not distinguish between credits issued to the private sector and those issued to the public sector). These two additional measures also suggest that the exogenous part of financial intermediary development is positively and robustly associated with economic growth.

2. Finance and Growth: Panel Procedures

2.1 GMM Estimators for Dynamic Panel Models

Motivation. Estimation using panel data, that is pooled cross-section and time-series data, has several advantages over purely cross-sectional estimation. First, besides considering the cross-country relationship between financial development and growth, we also

20. While we make the results on the relationship between growth over the 1960-95 period and financial intermediary development measured in 1960 available to readers, there are econometric reasons for using values of the financial development indicators averaged over the entire sample period as we do in the body of the paper. First, the specification tests support the validity of the instruments. This supports the interpretation of the estimated coefficients as being free from endogeneity bias. Second, the instrumental variables procedures address the issue of endogeneity. Thus, there is no reason to discard the informational gain provided by using observations over the entire sample period. Theory stresses the potential connection between growth and the contemporaneous provision of financial services. Third, by using initial values of the explanatory variables, there is not only an efficiency (informational) loss but also a potential consistency loss. Theory suggests that what matters for current growth is the contemporaneous behavior of the explanatory variables. By using initial values, we run the risk of grossly mismeasuring the "true" explanatory variables, which could bias the coefficient estimates.

would like to take into account how financial development over time within a country may have an effect on the country's growth performance. Working with a panel, we gain degrees of freedom by adding the variability of the time-series dimension. Specifically, the within-country standard deviation of PRIVATE CREDIT in our panel data set is 15 percent, which in the panel estimation is added to the between-country standard deviation of 28 percent. Similarly, the within-country standard deviation for growth is 2.4 percent and the between-country standard deviation is 1.7 percent. Thus, adding the time-series dimension of the data substantially augments the variability of the data.

Second, in a pure cross-sectional regression, any unobserved country-specific effect would be part of the error term, potentially leading to biased coefficient estimates. This problem plagues previous studies of the growth-finance relationship. However, in a panel context, we are able to control for unobserved country-specific effects and thereby reduce biases in the estimated coefficients.

Third, our panel estimator controls for the potential endogeneity of all explanatory variables, while the cross-sectional estimator presented previously only controls for the endogeneity of financial development. The way our panel estimator controls for endogeneity is by using "internal instruments," that is, instruments based on lagged values of the explanatory variables. This method does not allow us to control for full endogeneity but for a weak type of it. To be precise, we assume that the explanatory variables are only "weakly exogenous," which means that they can be affected by current and past realizations of the growth rate but must be uncorrelated with future realizations of the error term. Thus, the weak exogeneity assumption implies that future *innovations* of the growth rate do not affect current financial development. This assumption is not particularly stringent conceptually and we can examine its validity statistically. Weak exogeneity does not mean that economic agents do not take into account expected future growth in their decision to develop the financial system; it just means that future (unanticipated) shocks to growth do not influence current financial development. It is the *innovation* in growth that must not affect financial development. Finally, we statistically assess the validity of the weak exogeneity assumption below.

Methodology. We use the GMM estimators developed for dynamic models of panel data that were introduced by Holtz-Eakin, Newey, and Rosen (1990), Arellano and Bond (1991), and Arellano and Bover (1995). Our panel consists of data for 74 countries over the period

1961-95. We average data over non-overlapping, five-year periods, so that, data permitting, there are seven observations per country (1961-65; 1966-70; 1971-75; etc.). Thus, the subscript "*t*" designates one of these five-year averages. Consider the following regression equation:

$$y_{i,t} - y_{i,t-1} = (\alpha - 1)y_{i,t-1} + \beta' X_{i,t} + \eta_i + \varepsilon_{i,t} \ , \tag{1}$$

where y is the logarithm of real per capita GDP, X represents the set of explanatory variables (other than lagged per capita GDP), η is an unobserved country-specific effect, ε is the error term, and the subscripts i and t represent country and time period, respectively.[21] We can rewrite equation (1):

$$y_{i,t} = \alpha\, y_{i,t-1} + \beta' X_{i,t} + \eta_i + \varepsilon_{i,t} \ . \tag{2}$$

Now, to eliminate the country-specific effect, take first-differences of equation (2):

$$y_{i,t} - y_{i,t-1} = \alpha\left(y_{i,t-1} - y_{i,t-2}\right) + \beta'\left(X_{i,t} - X_{i,t-1}\right) + \left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right). \tag{3}$$

The use of instruments is required to deal with (1) the likely endogeneity of the explanatory variables and (2) the problem that by construction the new error term, $\varepsilon_{i,t} - \varepsilon_{i,t-1}$ is correlated with the lagged dependent variable, $y_{i,t-1} - y_{i,t-2}$. Under the assumptions that (a) the error term, ε, is not serially correlated, and (b) the explanatory variables, X, are weakly exogenous (i.e., the explanatory variables are assumed to be uncorrelated with future realizations of the error term), the GMM dynamic panel estimator uses the following moment conditions:

$$\mathrm{E}\left[\, y_{i,t-s} \times \left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right)\right] = 0 \qquad \text{for } s \geq 2\,; \qquad t = 3,...,T\,. \tag{4}$$

$$\mathrm{E}\left[\, X_{i,t-s} \times \left(\varepsilon_{i,t} - \varepsilon_{i,t-1}\right)\right] = 0 \qquad \text{for } s \geq 2\,; \qquad t = 3,...,T\,. \tag{5}$$

We refer to the GMM estimator based on these conditions as the *difference* estimator.

21. We also include time dummies to account for time-specific effects.

There are, however, conceptual and statistical shortcomings with this difference estimator. Conceptually, we would also like to study the cross-country relationship between financial development and per capita GDP growth, which is eliminated in the *difference* estimator. Statistically, Alonso-Borrego and Arellano (1996) and Blundell and Bond (1997) show that when the explanatory variables are persistent over time, lagged levels of these variables are weak instruments for the regression equation in differences. Instrument weakness influences the asymptotic and small-sample performance of the difference estimator. Asymptotically, the variance of the coefficients rises. In small samples, Monte Carlo experiments show that the weakness of the instruments can produce biased coefficients.[22]

To reduce the potential biases and imprecision associated with the usual difference estimator, we use a new estimator that combines in a *system* the regression in differences with the regression in levels (Arellano and Bover, 1995; Blundell and Bond, 1997). The instruments for the regression in differences are the same as above. The instruments for the regression in levels are the lagged *differences* of the corresponding variables. These are appropriate instruments under the following additional assumption: although there may be correlation between the levels of the right-hand side variables and the country-specific effect in equation (2), there is no correlation between the *differences* of these variables and the country-specific effect. This assumption results from the following stationarity property,

$$\mathrm{E}\left[y_{i,t+p} \times \eta_i\right] = \mathrm{E}\left[y_{i,t+q} \times \eta_i\right] \qquad \text{and}$$

$$\mathrm{E}\left[X_{i,t+p} \times \eta_i\right] = \mathrm{E}\left[X_{i,t+q} \times \eta_i\right] \qquad \text{for all } p \text{ and } q. \tag{6}$$

22. An additional problem with the simple *difference* estimator relates to measurement error: differencing may exacerbate the bias due to errors in variables by decreasing the signal-to-noise ratio (see Griliches and Hausman, 1986).

The additional moment conditions for the second part of the system (the regression in levels) are:[23]

$$\mathrm{E}\left[\left(y_{i,t-s} - y_{i,t-s-1}\right)\times\left(\eta_i + \varepsilon_{i,t}\right)\right] = 0 \qquad \text{for } s = 1. \tag{7}$$

$$\mathrm{E}\left[\left(X_{i,t-s} - X_{i,t-s-1}\right)\times\left(\eta_i + \varepsilon_{i,t}\right)\right] = 0 \qquad \text{for } s = 1. \tag{8}$$

Thus, we use the moment conditions presented in equations (4), (5), (7), and (8) and employ a GMM procedure to generate consistent and efficient parameter estimates.

Consistency of the GMM estimator depends on the validity of the instruments. To address this issue we consider two specification tests suggested by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1997). The first is a Sargan test of overidentifying restrictions, which tests the overall validity of the instruments by analyzing the sample analog of the moment conditions used in the estimation process. The second test examines the hypothesis that the error term $\varepsilon_{i,t}$ is not serially correlated. In both the difference regression and the system difference-level regression we test whether the differenced error term is second-order serially correlated (by construction, the differenced error term is probably first-order serially correlated even if the original error term is not).[24]

2.2 Results

The dynamic panel estimates suggest that the exogenous component of financial intermediary development exerts a large, positive impact on economic growth. Table 4 presents the results using the *difference* and *system* estimators described above. We also present the results when the panel estimation is performed purely in *levels* for comparative purposes. In table 4, only the results on the financial

23. Given that lagged levels are used as instruments in the differences specification, only the most recent difference is used as instrument in the levels specification. Using other lagged differences would result in redundant moment conditions. (see Arellano and Bover, 1995).

24. In addition, we used the "difference-Sargan test," presented in Blundell and Bond (1997), to examine the null hypothesis that the lagged differences of the explanatory variables are uncorrelated with the residuals (which are the additional restrictions imposed in the system estimator with respect to the difference estimator). Giving further support to the system estimator, we could not reject this null hypothesis at usual levels of significance.

Table 4. Financial Intermediation and Growth: Summary of Dynamic Panel Regressions[a]

Estimator	Conditioning information set[c]	Explanatory variable[b] LIQUID LIABILITIES	COMMERCIAL-CENTRAL BANK	PRIVATE CREDIT	No. of observations
System estimator	Simple	2.163 (0.001) [0.313]	4.642 (0.001) [0.278]	2.185 (0.001) [0.183]	359
	Policy	2.952 (0.001) [0.713]	2.437 (0.001) [0.626]	1.522 (0.001) [0.581]	359
First differences	Simple	1.135 (0.035) [0.319]	2.007 (0.002) [0.184]	1.699 (0.001) [0.192]	285
	Policy	1.446 (0.249) [0.080]	2.065 (0.010) [0.330]	0.663 (0.001) [0.315]	285
Levels	Simple	1.848 (0.012) [0.472]	4.813 (0.011) [0.445]	1.838 (0.001) [0.345]	359
	Policy	2.958 (0.001) [0.346]	3.267 (0.001) [0.155]	2.073 (0.001) [0.180]	359

Source: Authors' calculations.
a. Numbers in parentheses are p values for the coefficient, and numbers in brackets are p values for the Sargan test.
b. Defined in the notes to table 2.
c. Defined in the notes to table 3.

indicators are given. Table 5 gives the full results from *system* dynamic-panel estimation. The analysis was conducted with two conditioning information sets. The first uses the simple conditioning information set, which includes initial income and educational attainment. The second uses the policy conditioning information set, and includes initial income, educational attainment, government size, openness to trade, inflation, and the black market exchange rate premium.[25] Table 5 also presents (1) the Sargan test, where the null hypothesis is that the instrumental variables are uncorrelated with the residuals and (2) the serial correlation test, where the null hypothesis is that the errors in the differenced equation exhibit no second-order serial correlation.

25. We do not use the full conditioning information set with data on political and institutional variables in the panel estimates. These variables frequently have very limited, if any, time dimension.

Table 5. Financial Intermediation and Growth: Dynamic Panel Regressions, System Estimator[a]

	Regression		
Regressor	*(1)*	*(2)*	*(3)*
Constant	0.06 (0.954)	–5.677 (0.001)	4.239 (0.001)
Log of initial income per capita	–0.742 (0.001)	–0.117 (0.223)	–0.364 (0.001)
Government size[b]	–1.341 (0.001)	–1.13 (0.001)	–1.987 (0.001)
Openness to trade[b]	0.325 (0.169)	0.497 (0.002)	0.442 (0.010)
Inflation[c]	1.748 (0.001)	–1.772 (0.001)	–0.178 (0.543)
Years of secondary schooling	0.78 (0.001)	0.638 (0.001)	0.639 (0.001)
Black market premium[c]	–2.076 (0.001)	–1.044 (0.001)	–1.027 (0.001)
LIQUID LIABILITIES[b]	2.952 (0.001)	... ...	... ...
COMMERCIAL - CENTRAL BANK[b]	... ...	2.437 (0.001)	... ...
PRIVATE CREDIT[b]	... ...	... ...	1.522 (0.001)
Dummy 1971–75	–1.074 (0.001)	–0.792 (0.001)	–0.959 (0.001)
Dummy 1976–80	–1.298 (0.001)	–0.825 (0.001)	–1.177 (0.001)
Dummy 1981–85	–3.328 (0.001)	–2.616 (0.001)	–3.179 (0.001)
Dummy 1986–90	–2.614 (0.001)	–1.894 (0.001)	–2.434 (0.001)
Dummy 1991–95	–3.631 (0.001)	–2.770 (0.001)	–3.308 (0.001)
Summary statistic			
P value (sargan test)[d]	0.713	0.626	0.581
P value (serial correlation test)[e]	0.588	0.957	0.764

Source: Authors' calculations.
a. P values are in parentheses.
b. Included in the regression as log (variable).
c. Included in the regression as log (1 + variable).
d. The null hypothesis is that the instruments used are not correlated with the residuals.
e. The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation.

The three financial intermediary development indicators (LIQUID LIABILITIES, COMMERCIAL-CENTRAL BANK, and PRIVATE CREDIT) are significant at the 0.05 significance level in the *levels*, *difference*, and *system* dynamic panel growth regressions, with one exception. The coefficient on LIQUID LIABILITIES is insignificant

in the *difference* dynamic panel growth regression with the policy conditioning information set. While this may indicate a somewhat less robust link when using a purely "size" measure of financial intermediary development, LIQUID LIABILITIES enters the levels and system dynamic panel growth regressions significantly in all specifications. Put differently, after controlling for country-specific effects, endogeneity, and potential problems associated with lagged dependent variables and weak instruments, the data suggest a strong, positive link between financial intermediary development and economic growth.

The regressions satisfy the specification tests. There is no evidence of second order serial correlation and the regressions pass the Sargan specification test. It is also worth noting that many of the other regressors enter significantly with the expected signs (table 5).

The regression estimates are also economically large. As shown the coefficients that emerge from the dynamic panel estimation are very close to those that we obtain from the purely cross-section, instrumental variable estimation. For example, PRIVATE CREDIT has a coefficient of 2.5 in the cross-section results (the simple conditioning information set regression in table 3), while PRIVATE CREDIT has a coefficient of 2.2 in the system dynamic-panel results reported in table 4.[26] As noted earlier, these coefficients suggest that exogenous changes in financial intermediary development imply large changes in economic growth.

2.3 Sensitivity Analyses and Discussion

The dynamic panel results are also robust to a variety of sensitivity analyses. For instance, when we use alternative measures of financial intermediary development (deposit money bank credit to the private sector divided by GDP; and the ratio of total deposit money bank domestic assets to GDP), we still find a strong of finance on growth. Furthermore, if we control for terms of trade changes and

26. There is some divergence in coefficient estimates between the *system* dynamic panel estimates, table 4, and the cross-sectional instrumental variables regressions, table 3, when the conditioning information set is expanded to include the policy conditioning information set. The cross-section regression produces a coefficient estimate of 3.2 on PRIVATE CREDIT, while the panel yields a coefficient of 1.4. Besides exploiting the time-series dimension of the data, the dynamic-panel also recognizes the endogeneity of the other regressors, which may help account for the different coefficient estimates.

population growth, we obtain virtually identical results to those reported in tables 4 and 5.[27] Finally, when we include the legal origin variables as instruments in the dynamic panel estimates, we still find a strong, positive relationship between the exogenous component of financial intermediary development and economic growth.[28]

3. Searching for Determinants of Financial Intermediary Development

This section undertakes a limited search of potential legal and accounting determinants of financial intermediary development. We use LLSV's (1998) data. Instead of examining the links between the legal/regulatory environment and measures of bond market and equity market development as in LLSV (1997, 1998), we study the ties between the legal environment and measures of financial intermediary development. Moreover, unlike earlier studies, we use instrumental variables to assess whether the positive association between legal/regulatory indicators and financial development is due to simultaneity bias.

3.1 The Legal and Accounting Environment

We use three LLSV (1998) indicators of national legal and regulatory systems: the legal rights of creditors, the soundness of contract enforcement, and the level of corporate accounting standards.

Creditor rights. The degree to which the legal system supports the rights of creditors will fundamentally influence financial contracting

27. Note that in the *system* dynamic panel regressions with the policy conditioning information set, the number of instrumental variables is larger than the number of cross-sectional observations (i.e., countries). This "over-fitting" of the data can bias the *t* statistics upwards. This arises when the variance-covariance matrix is constructed from the first-stage residuals in order to allow for nonspherical distributions of the error term – and thereby get more efficient estimates in the second stage. However, this "over-fitting" problem does not plague (a) the simple conditioning information set regressions, or (b) the *level* or *difference* estimators because there are many more countries than instruments in these specifications. More generally, the two-step GMM estimator sometimes converges to its asymptotic distribution only slowly. Thus, we also considered the first-stage results, which assume homoskedasticity and independence of the error terms. These first-stage results also indicate that financial intermediary development exerts a causal impact on economic growth.

28. These results are available on request.

and the functioning of financial intermediaries. Specifically, legal systems differ in terms of the rights of creditors to (i) repossess collateral or liquidate firms in the case of default, (ii) remove managers in corporate reorganizations, and (iii) have a high priority relative to other claimants in corporate bankruptcy.

AUTOSTAY equals one if a country's laws impose an automatic stay on the assets of firms upon filing a reorganization petition. AUTOSTAY equals 0 if this restriction does not appear in the nation's legal codes. The restriction would prevent creditors from gaining possession of collateral or liquidating a firm to meet a loan obligation. Thus, all else equal, AUTOSTAY should be negatively correlated with the activities of credit issuing intermediaries.

MANAGES equals one if firm managers continue to administer the firm's affairs pending the resolution of reorganization processes, and zero otherwise. In some countries, management stays in place until a final decision is made about the resolution of claims. In other countries, a team selected by the creditors replaces management. If management stays pending resolution, this reduces pressure on management to pay creditors. Thus, MANAGES should be negatively correlated with the activities of credit issuing intermediaries.[29]

The third measure of the legal rights of credits is SECURED1, which equals one if secured creditors are ranked first in the distribution of the proceeds that result from the disposition of the assets of a bankrupt firm. SECURED1 equals zero if nonsecured creditors, such as the government or workers, get paid before secured creditors. In cases where SECURED1 equals zero, this certainly reduces the attractiveness of lending secured credit. SECURED1 should be positively correlated with activities of intermediaries engaged in secured transactions, holding everything else constant.

CREDITOR is a cumulative index of these creditor rights indicators and equals CREDITOR = SECURED1 – AUTOSTAY – MANAGES.

29. Here it is important to highlight a substantive weakness with AUTOSTAY and MANAGES. They do not measure the efficiency of the legal and regulatory system in coping with bankruptcy. For instance, two countries could have very similar legal codes, such that management stays in place pending the resolution of a bankruptcy hearing and there is an automatic stay on the assets of a firm until the bankruptcy courts process the reorganization petition. However, the two countries' legal and regulatory systems may process bankruptcy and reorganization very differently. One country's system may take a long-time and be subject to great uncertainty. The other may be very rapid, efficient, and transparent. Thus, a major difference across countries may be the quality of the bankruptcy system, not the laws themselves. Currently, there do not exist cross-country measures of the speed, transparency, and fairness of bankruptcy systems.

CREDITOR takes on values between 1 (best) and – 2 (worst).[30] One would expect countries with higher values of CREDITOR to have stronger creditor rights and better-developed financial intermediaries, all else equal.

Table 6 gives summary statistics on CREDITOR, and the data are listed in appendix table A3. As shown there is substantial cross-country variation in CREDITOR, where the maximum value is 1, the minimum value is –2, and the standard deviation is about 1. Brazil, Colombia, France, Mexico, Peru, and the Philippines (all countries with a French legal origin) are countries where CREDITOR = –2, indicating that their legal systems do not stress the rights of creditors. In contrast, the legal codes of Egypt, Hong Kong, India, Indonesia, Israel, Korea, Malaysia, Nigeria, Pakistan, Singapore, Thailand, United Kingdom, and Zimbabwe stress the rights of creditors, such that CREDITOR = 1. CREDITOR is an indicator of legal codes, however, it does not incorporate information regarding enforcement.

Enforcement. The effectiveness of the legal system in enforcing contracts will materially influence financial sector activities. RULELAW, from LLSV (1998), is an assessment of the law and order

Table 6. Summary Statistics on the Legal and Accounting Environment[a]

Statistic	*CREDITOR*[b]	*ENFORCE*[c]	*ACCOUNT*[d]
Mean	–0.3	7.5	61.2
Median	0	8.2	64.0
Maximum	1	10.0	83.0
Minimum	–2	3.6	24.0
Standard deviation	1.1	2.0	13.5
No. of observations	44	44	40

Source: Authors' calculations.
a. Values for the legal environment indicators are averages over 1982-95. Values of accounting quality are assessments of company reports in 1990.
b. Index of secured creditor rights.
c. Index of law and contract enforcement.
d. Index of the comprehensiveness and quality of company reports.

30. We could have redefined AUTOSTAY and MANAGES such that values of one indicated stronger (instead of weaker) creditor rights. This would have produced values of CREDITOR between 0 and 3 and would not have altered the results. We did not do this for consistency: the variables in this paper are defined the same as the variables in LLSV (1997, 1998).

tradition of the country that ranges from 10, strong law and order tradition, to 1, weak law and order tradition. This measure was constructed by the *International Country Risk Guide* (ICRG) and is an average over the period 1982-95. Given the contractual nature of banking, higher values of RULELAW are likely to positively influence banking development. CONRISK, also from LLSV (1998), is an assessment of the risk that a government will–and therefore can–modify a contract after it has been signed. CONRISK ranges from 10, low risk of contract modification, to 1, high risk of contract modification. Specifically, "modification" means repudiation, postponement, or reducing the government's financial obligation. This measure was constructed by ICRG and is an average over the period 1982-95. Legal systems that effectively enforce contracts will tend to support banking activities.

ENFORCE equals the average of RULELAW and CONRISK. The empirical analyses focus on this aggregate index of the efficiency of the legal system in enforcing contracts. Summary statistics on ENFORCE are given in table 6, and the data are listed in appendix table A3. As shown, there is substantial cross-country variation in ENFORCE, where the maximum value is 9.99, the minimum value is 3.55, and the standard deviation is 2.2. The countries with very high values of enforcement, values of ENFORCE greater than 9, are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Japan, Netherlands, New Zealand, Norway, Sweden, and Switzerland. In contrast, countries where contract enforcement is poor, values of ENFORCE less than 5, include Colombia, Nigeria, Pakistan, Philippines, Peru, and Zimbabwe.

Accounting standards. Information about corporations is critical for exerting corporate governance and identifying the best investments. Accounting standards that simplify the interpretability and comparability of information across corporations will simplify financial contracting. Furthermore, financial contracts that use accounting measures to trigger particular actions can only be enforced if accounting measures are sufficiently clear. ACCOUNT, from LLSV (1998), is an index of the comprehensiveness of company reports. The maximum possible value is 90 and the minimum is 0. The Center for International Financial Analysis and Research assessed general accounting information, income statements, balance sheets, funds flow statements, accounting standards, and stock data in company reports in 1990. We expect ACCOUNT to be positively

correlated with financial intermediary development.[31] As shown in table 6, ACCOUNT exhibits substantial cross-country variation. The data are listed in appendix table A3. The maximum value is 83, Sweden, while the minimum value in our sample is Egypt (24). The United States has a value of 71, which is well above the mean value of 61.

3.2 Determinants of Financial Intermediary Development

Table 7 shows that cross-country differences in creditor rights, enforcement quality, and accounting standards help explain cross-country differences in financial intermediary development, even after controlling for the level of income per capita. Jointly, the variables CREDITOR, ENFORCE, and ACCOUNT explain a significant amount of the cross-country variation in the three financial intermediary indicators (PRIVATE CREDIT, LIQUID LIABILITIES, and COMMERCIAL-CENTRAL BANK). Each of the legal/accounting indicators, however, is not significantly correlated with all of the intermediary measures. For instance LIQUID LIABILITIES is most closely associated with ENFORCE and CREDITOR. In turn, PRIVATE CREDIT is very strongly linked with ENFORCE and ACCOUNT.[32]

Simultaneity bias does not seem to be driving these results. As instrumental variables, we use the legal origin dummy variables for

31. This is not necessarily true and raises the need for a general conceptual qualification. An economy with perfect information, perfect contract enforcement and perfect legal codes (i.e., an economy with essentially zero transaction and information costs) would have little reason for financial intermediaries. Put differently, market frictions motivate the emergence of financial intermediaries, e.g., Boyd and Prescott (1986). Conceptually, this implies that at very high levels of legal system development and information dissemination, a marginal increase in legal efficiency or information quality may cause a *reduction* in the role and importance of financial intermediaries. However, quadratic expressions for ACCOUNT and CONRISK never entered significantly.

32. Since CREDITOR, ENFORCE, and ACCOUNT are measured over the 1980s and 1990s, we use financial intermediary measures over the same period. However, we get very similar results when the analysis uses financial intermediary measures over the period 1960-95. These results are available on request.

Table 7. Legal Environment and Financial Intermediary Development, 1980-95[a]

Explanatory variable	*LIQUID LIABILITIES*[b]				*COMMERCIAL-CENTRAL BANK*[b]				*PRIVATE CREDIT*[b]			
	OLS	*OLS*	*OLS*	*IV*	*OLS*	*OLS*	*OLS*	*IV*	*OLS*	*OLS*	*OLS*	*IV*
Constant	2.830	3.880	4.830	4.402	3.950	3.640	4.200	4.403	1.480	2.557	4.368	4.322
	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.020)	(0.001)	(0.003)
CREDITOR[c]	0.216	0.179	...	...	0.009	0.020	...	...	0.125	0.088	...	...
	(0.001)	(0.027)	...	...	(0.641)	(0.504)	...	...	(0.033)	(0.173)	...	...
ENFORCE[c]	0.178	0.229	...	...	0.008	0.014	...	...	0.200	0.253	...	...
	(0.000)	(0.003)	...	...	(0.022)	(0.454)	...	...	(0.000)	(0.000)	...	...
ACCOUNT[c]	–0.002	–0.001	...	...	0.005	0.004	...	...	0.017	0.018	...	...
	(0.745)	(0.866)	...	...	(0.024)	(0.042)	...	...	(0.005)	(0.002)	...	...
INCOME[b]	...	–0.174	–0.099	–0.05	...	0.052	0.031	0.007	...	–0.179	–0.044	–0.039
	...	(0.395)	(0.387)	(0.672)	...	(0.236)	(0.325)	(0.844)	...	(0.262)	(0.711)	(0.804)
LEGAL[d]	...	...	0.412	0.361	...	...	0.091	0.115	...	...	0.606	0.600
	...	...	(0.003)	(0.009)	...	...	(0.014)	(0.002)	...	...	(0.001)	(0.001)
Summary statistic												
P value (F test)	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.57	0.59	0.39	0.39	0.51	0.52	0.51	0.50	0.68	0.69	0.66	0.66
No. of observations	36	36	36	36	36	36	36	36	36	36	36	36

Source: Authors' calculations.
a. Numbers in parentheses are p values. OLS, ordinary least-squares method; IV, instrumental variables method.
b. Defined in the notes to table 2.
c. Defined in the notes to table 6.
d. Index of the legal environment. Specifically, it is the first standardized principal component of CREDITOR, ENFORCE, and ACCOUNT.

countries with French, English, and German legal origins.[33] Since we only have three instruments, we construct a general index of the legal and regulatory environment. We compute the first standardized principal component of CREDITOR, ENFORCE, and ACCOUNT and use this as the index of the legal/regulatory environment governing financial transactions. We call this index LEGAL. In the simple OLS regression, LEGAL explains a substantial amount of the cross-country variation in *all* of the financial intermediary development indicators, even after controlling for the level of real per capita GDP. When we use an instrumental variables estimator to control for simultaneity bias, the results are unchanged.[34] The basic message that emerges from table 7 is that countries with (i) laws that give a high priority to secured creditors, (ii) legal systems that rigorously enforce contracts, and (iii) accounting standards that produce comprehensive and comparable corporate financial statements tend to have better developed financial intermediaries.[35]

3.3 Discussion of Causes

These findings—in conjunction with those in LLSV (1998)—are *consistent* with the view that countries with particular legal origins tend to create particular types of laws, regulations, and enforcement mechanisms. These laws, regulations, and enforcement mechanisms

33. First, note that the legal origin variables help explain cross-country differences in creditor rights, enforcement quality, and accounting standards. As shown by LLSV (1998), English legal tradition countries have laws that emphasize the rights of creditors to a greater degree than the French, German, and Scandinavian countries. French civil law countries protect creditors the least, with German and Scandinavian civil law countries falling in the middle. In terms of enforcement quality, countries with a French legal heritage have the lowest quality of law enforcement, while countries with German and Scandinavian legal traditions tend to be the best at enforcing contracts. Finally, LLSV (1998) show that countries with an English legal tradition tend to have much better accounting standards than French or German civil law countries.

34. None of these findings changes when the instrumental variable set is expanded to include the LLSV (1999) exogenous variables, i.e., religious composition of the population, ethnic diversity, and distance from the equator. These results are available on request.

35. The evidence we provide suggests that the strong link between financial sector development on the one hand and the legal/regulatory environment on the other is not due to simultaneity bias. These results do not suggest that the legal/regulatory environment only impacts growth through financial intermediary development. Rather, these results imply that the legal/regulatory environment has an important impact on financial intermediary development.

directly influence the functioning of financial intermediaries. Financial intermediaries that are better at ameliorating information and transactions costs induce a more efficient allocation of resources and faster growth.[36] While it is difficult to change legal origin, the results offer a strategy for boosting financial development and accelerating long-run growth. Countries can target reforms that ensure that lenders have confidence that the legal system will quickly, transparently, and effectively enforce their claims against borrowers and that outside investors have easy access to high-quality, comprehensive, and comparable information about firms.

4. Conclusions

This paper first examined the nature of the effect of financial intermediary development on economic growth. We used two econometric approaches. The first, GMM dynamic panel estimators, are specifically designed to deal with key problems plaguing past studies of the finance-growth nexus: simultaneity bias and omitted variable bias, including that derived from unobserved country-specific effects. As a consistency check, we also used a pure cross-sectional, instrumental variable. The panel and cross-sectional results tell the same story: the exogenous component of financial intermediary development is positively associated with economic growth; specifically, the large, positive link between financial intermediary development and economic growth is not due to potential biases induced by omitted variables, simultaneity or reverse causation. In a sequel to this paper, Beck, Levine, and Loayza (1999) examine the channels through which financial intermediary development is associated with growth. In that paper, we argue that the finance-growth nexus runs primarily through total factor productivity growth and not through savings and physical capital accumulation.

36. Put differently, when countries are endowed with a certain legal heritage, this produces a probability distribution regarding the laws, regulations, and enforcement mechanisms that they are likely to adopt. Thus, for example, the data suggest that countries with a French Civil Code have a lower probability of selecting laws that give a higher priority to secured credits, selecting accounting standards that produce high-quality corporate financial statements, and enforcing contracts than countries with English, German, and Scandinavian legal systems. The resultant laws, regulations, and enforcement mechanisms then affect the ability of the financial system to research firms, exert corporate control, mobilize savings, and provide risk management and transactions services.

Next, we investigated whether cross-country differences in the legal rights of creditors, the efficiency of contract enforcement, and accounting system standards help explain cross-country differences in the level of financial intermediary development. The results are clear: countries with (1) laws that give a high priority to secured creditors getting the full present value of their claims against firms, (2) legal systems that rigorously enforce contracts, including government contracts, and (3) accounting standards that produce high-quality, comprehensive and comparable corporate financial statements tend to have better developed financial intermediaries. The paper's findings are consistent with the view that legal and accounting reforms that strengthen creditor rights, contract enforcement, and accounting practices can boost financial intermediary development and thereby accelerate economic growth. Due to data limitations, however, we do not conduct a comprehensive evaluation of the regulatory determinants of financial intermediary development (e.g., see Calomiris, 1989; Kane, 1985, 1989; Barth, Nolle, and Rice, 1997; BIS, 1997; Calomiris and Gorton, 1991; Kroszner and Rajan, 1994; Kroszner and Strahan, 1996; Barth, Caprio, and Levine, 1999). Future work would substantially broaden and deepen our understanding of the determinants of financial intermediary development by obtaining additional measures of the legal, supervisory, and regulatory factors that determine the level of financial intermediary development.

APPENDIX

Table A1. Countries in the Sample

Algeria[a]	Greece	Norway
Argentina	Guatemala	Pakistan
Australia	Guyana[b]	Panama
Austria	Haiti	Papua New Guinea
Bangladesh[b]	Honduras	Paraguay
Barbados[b]	Iceland[b]	Peru
Belgium	India	Philippines
Bolivia	Indonesia[a]	Portugal
Brazil	Iran[a]	Rwanda[a]
Cameroon[a]	Ireland	Senegal
Canada	Israel	Sierra Leone
Central African Republic[a]	Italy	South Africa
Chile	Jamaica	Spain
Colombia	Japan	Sri Lanka
Costa Rica	Kenya	Sudan[a]
Cyprus	Korea	Sweden
Denmark	Lesotho[a]	Switzerland
Dominican Republic	Liberia[b]	Syria
Ecuador	Malawi[a]	Taiwan[b]
Egypt[a]	Malaysia	Thailand
El Salvador	Malta[b]	Togo
Fiji[b]	Mauritius	Trinidad and Tobago
Finland	Mexico	United States
France	Nepal[b]	Uruguay
Gambia[a]	Netherlands	Venezuela
Germany	New Zealand	Zaire
Ghana	Nicaragua[a]	Zimbabwe
Great Britain	Niger	

a. Not in the 71-country pure cross-sectional data set.
b. Not in the 74-country panel data set.

Table A2. Variables and Sources

Variable	*Definition*	*Original source*	*Secondary source*
Level and growth rate of GDP	Real GDP per capita	World Bank, *World Development Indicators* (Penn World Tables for initial GDP in cross-section regressions)	Loayza and others (1998)
Government size	Government expenditure as share of GDP	World Bank, *World Development Indicators*	Loayza and others (1998)
Openness to trade	Sum of real exports and imports as share of real GDP	World Bank, *World Development Indicators*	Loayza and others (1998)
Growth rate of terms of trade	Log difference of the terms of trade, divided by 5	World Bank, *World Development Indicators*	Loayza and others (1998)
Population growth rate	Log difference of the total population, divided by 5	World Bank, International Economics Department	Loayza and others (1998)
Inflation rate	Log difference of consumer price index (CPI)	International Monetary Fund, *International Financial Statistics* (IFS), line 64	
Average years of schooling	Average years of schooling in the population over 25	Barro and Lee (1996)	
Average years of secondary schooling	Average years of secondary schooling in the population over 15	Barro and Lee (1996)	
Black market premium	Ratio of black market exchange rate to official exchange rate minus 1	*Pick's Currency Yearbook* through 1989; *World Currency Yearbook* thereafter	
LIQUID LIABILITIES	$\{(0.5)*[F(t)/P\_e(t) + F(t-1)/P\_e(t-1)]\}/[\mathrm{GDP}(t)/P\_a(t)]$, where F is liquid liabilities (line 55l), GDP is line 99b, P_e is end-of-period CPI (line 64), and P_a is average annual CPI	IFS	
COMMERCIAL-CENTRAL BANK	$\mathrm{DBA}(t)/[\mathrm{DBA}(t) + \mathrm{CBA}(t)]$, where DBA is assets of deposit money banks (lines 22a-d), and CBA is central bank assets (lines 12 a-d).	IFS	

Table A2. (continued)

Variable	*Definition*	*Original source*	*Secondary source*
PRIVATE CREDIT	{(0.5)*[$F(t)/P\_e(t) + F(t-1)/P\_e(t-1)$]} /[GDP($t$)/$P\_a(t)$], where F is credit by deposit money banks and the other financial institutions to the private sector (lines 22d + 42d), GDP is line 99b, P_e is end-of-period CPI (line 64), and P_a is the average CPI for the year.	IFS	
Bank assets	{(0.5)*[$F(t)/P\_e(t) + F(t-1)/P\_e(t-1)$]} /[GDP($t$)/$P\_a(t)$], where F is domestic assets of deposit money banks (lines 22a-d), GDP is line 99b, P_e is end-of-period CPI (line 64), and P_a is the average CPI for the year.	IFS	
Bank credit	{(0.5)*[$F(t)/P\_e(t) + F(t-1)/P\_e(t-1)$]} /[GDP($t$)/$P\_a(t)$], where F is credit by deposit money banks (line 22d), GDP is line 99b, P_e is end-of-period CPI (line 64), and P_a is the average CPI for the year.	IFS	
Legal origin	Dummy variables for British, French, German, and Scandinavian legal origin	Reynolds and Flores (1996)	LLSV (1998) and own coding
Accounting	Index created by examining and rating companies' 1990 annual reports on their inclusion or omission of 90 items in balance sheets and income statements. The maximum is 90, the minimum 0.	Center for International Financial Analysis & Research, Inc.	LLSV (1998)
RULELAW	Measure of the law and order tradition of a country. It is an average over 1982-95. It ranges from 10 (strong tradition) to 1 (weak tradition).	Political Risk Services, *International Country Risk Guide* (ICRG).	LLSV (1998)
CONRISK	Measure of the risk that a government will modify a contract after it has been signed. It ranges from 10 (low risk) to 1 (high risk) and is averaged over 1982-95.	ICRG	Knack and Keefer (1995)

Table A2. (continued)

Variable	*Definition*	*Original source*	*Secondary source*
AUTOSTAY, MANAGES, SECURED1	AUTOSTAY equals 1 if a country's laws impose an automatic stay on the assets of firms upon filing a reorganization petition, and 0 otherwise. MANAGES equals 1 if firm managers continue to administer the firm's affairs pending the resolution of reorganization processes, and 0 otherwise. SECURED1 equals 1 if secured creditors are ranked first in the distribution of the proceeds that result from the disposition of the assets of a bankrupt firm, and 0 otherwise.	National bankruptcy and reorganization laws	LLSV (1998)
Revolutions and coups	A revolution is defined as any illegal or forced change in the top governmental elite, any attempt at such a change, or any successful or unsuccessful armed rebellion whose aim is independence from central government. A coup d'etat is defined as an extraconstitutional or forced change in the top government elite and/or its effective control of the nation's power structure in a given year. Unsuccessful coups are not counted. Data are averaged over 1960-90.	Banks (1994)	
Assassinations	Number of assassinations per thousand inhabitants. Data are averaged over 1960-90.	Banks (1994)	
Ethnic fractionalization	Average value of five indices of ethnolinguistic fractionalization, with values ranging from 0 to 1, where higher values denote greater fractionalization.	*Atlas Narodov Mira* (1964), Muller (1964), Roberts (1962), Gunnemark (1991)	Easterly and Levine (1997)
Bureaucratic efficiency	Average of three indices published by Business International Corporation: efficiency of the judiciary system, red tape, and corruption. Data are averages over 1980-83.	Business International Corporation (1984)	Mauro (1995)

Table A2. (continued)

Variable	*Definition*	*Original source*	*Secondary source*
Corruption	Measure of corruption, with the scale readjusted to 0 (high corruption) to 10 (low corruption). Data are averages over 1982-95.	ICRG	Knack and Keefer (1995)
Index of state-owned enterprises	Measures the role of state-owned enterprises in the economy, ranging from 0 to 10, with data averaged over 1975-95. Higher scores denote countries with fewer such enterprises, which are estimated to produce less of the country's output.	Gwartney, Lawson, and Block (1996)	LLSV (1999)
Property rights	Rating of property rights on a scale from 1 to 5. The more protection private property receives, the higher the score.	Holmes, Johnson, and Kirkpatrick (1997)	LLSV (1999)
Cost of business regulation	Rating of regulation policies related to opening and keeping open a business. The scale ranges from 0 to 5, with higher scores meaning that regulations are straightforward and applied uniformly to all businesses and that regulations are less of a burden to business.	Holmes, Johnson, and Kirkpatrick (1997)	LLSV (1999)
Risk of expropriation	Assessment of risk of outright confiscation or forced nationalization. It ranges from 0 to 10, with lower scores indicating a higher risk. Data are averages over 1982-95.	ICRG	Knack and Keefer (1995)
Religious composition	Percentages of the population that were Roman Catholic, Protestant, or Muslim in 1980.	Barrett (1982), *Worldmark Encyclopedia of Nations* 1995, *Statistical Abstract of the World* (1995), *United Nations Demographic Yearbook* (1995), *CIA World Factbook* (1996).	LLSV (1999)
Distance from equator	The distance of the country from the equator, scaled between 0 and 1.	*CIA World Factbook* (1996).	LLSV (1999)

Table A3. Economic Growth, Financial Development, and Policies across Countries[a]

Country code	Country	Average annual GDP growth rate, 1960-95 (percent)	Financial development indicators			Legal origin[e]	Policy variables		
			LIQUID LIABILITIES[b]	COMMERCIAL-CENTRAL BANK[c]	PRIVATE CREDIT[d]		CREDITOR[f]	ENFORCE[g]	ACCOUNT[h]
ARG	Argentina	0.62	18.34	74.16	15.69	F	–1	5.13	45
AUS	Australia	1.98	51.73	92.67	54.82	E	–1	9.36	75
AUT	Austria	2.89	67.50	98.44	65.30	G	0	9.80	54
BGD	Bangladesh*	0.71	24.69	86.38	13.55	E	...	...	...
BRB	Barbados*	2.65	51.59	91.85	40.79	E	...	...	...
BEL	Belgium	2.65	49.02	92.01	25.65	F	0	9.74	61
BOL	Bolivia*	0.36	16.39	31.60	13.14	F	...	...	...
BRA	Brazil	2.93	19.16	61.68	22.10	F	–2	6.31	54
CAN	Canada	2.39	56.50	89.00	60.86	E	–1	9.48	74
CHL	Chile	1.45	22.96	52.81	27.81	F	–1	6.91	52
COL	Colombia	2.23	22.41	80.16	22.08	F	–2	4.55	50
CRI	Costa Rica*	1.61	29.38	72.82	21.77	F	...	...	...
CYP	Cyprus*	5.38	74.49	92.72	62.39	E	...	...	...
DNK	Denmark	2.18	49.48	88.10	42.45	S	0	9.66	62
DOM	Dominican Republic*	2.50	20.58	73.34	19.11	F	...	...	...
ECU	Ecuador	2.39	20.05	62.16	17.99	F	1	5.93	...
SLV	El Salvador*	–0.61	26.94	72.04	22.85	F	...	...	...
FJI	Fiji*	1.85	37.48	96.95	23.65	E	...	...	...
FIN	Finland	2.80	45.35	97.22	51.78	S	–1	9.58	77
FRA	France	2.43	63.37	96.54	75.47	F	–2	9.09	69
DEU	Germany	2.45	57.46	97.57	76.46	G	0	9.50	62
GHA	Ghana*	–0.96	17.58	39.78	5.07	E	...	...	...
GRC	Greece	3.22	53.34	74.36	36.72	F	–1	6.40	55
GTM	Guatemala*	0.93	20.22	75.16	13.32	F	...	...	...
GUY	Guyana*	–0.28	52.96	58.02	20.52	E	...	...	...
HTI	Haiti*	–0.66	22.60	23.72	7.71	F	...	...	...

Table A3. (continued)

Country code	Country	Average annual GDP growth rate, 1960-95 (percent)	Financial development indicators			Legal origin[e]	Policy variables		
			LIQUID LIABILITIES[b]	COMMERCIAL-CENTRAL BANK[c]	PRIVATE CREDIT[d]		CREDITOR[f]	ENFORCE[g]	ACCOUNT[h]
HND	Honduras*	0.60	23.04	76.54	23.86	F	...	...	...
ISL	Iceland*	3.01	31.76	88.94	34.79	S	...	...	...
IND	India	1.92	32.95	63.68	19.53	E	1	5.14	57
IRL	Ireland	3.25	54.74	94.73	49.14	E	–1	8.38	...
ISR	Israel	2.81	51.95	84.28	37.43	E	1	6.18	64
ITA	Italy	2.93	77.48	87.77	59.03	F	–1	8.75	62
JAM	Jamaica*	0.42	36.85	78.09	24.55	E	...	...	...
JPN	Japan	4.30	125.94	96.72	128.38	G	0	9.34	65
KEN	Kenya	1.96	35.74	81.27	23.93	E	1	5.54	...
KOR	Korea, Republic of	7.16	41.02	83.95	66.52	G	1	6.97	62
LBR	Liberia*	–0.47	9.73	37.90	10.16	E	...	...	...
MYS	Malaysia	4.11	63.74	96.45	47.20	E	1	7.11	76
MLT	Malta*	6.65	143.43	92.57	43.97	E	...	...	...
MUS	Mauritius*	3.02	46.87	82.21	24.36	F	...	...	...
MEX	Mexico	1.97	25.57	69.38	22.89	F	–2	5.95	60
NPL	Nepal*	0.77	20.27	57.86	7.72	E	...	...	...
NLD	Netherlands	2.20	71.41	98.10	86.69	F	–1	9.68	64
NZL	New Zealand	1.12	49.63	82.43	37.59	E	0	9.65	70
NER	Niger*	–2.75	14.43	83.89	13.05	F	...	...	...
NOR	Norway	3.18	54.04	90.02	81.62	S	–1	9.86	74
PAK	Pakistan	2.70	38.68	67.89	20.77	E	1	3.95	...
PAN	Panama*	2.03	33.37	71.97	40.22	F	...	...	...
PNG	Papua New Guinea*	1.12	31.05	89.12	20.84	E	...	...	...
PRY	Paraguay*	2.38	17.62	65.29	14.52	F	...	...	...
PER	Peru	0.06	18.52	86.04	13.32	F	–2	3.59	38
PHL	Philippines	1.16	27.50	81.40	27.01	F	–2	3.77	65
PRT	Portugal	3.65	78.02	90.35	55.01	F	–1	8.63	36
SEN	Senegal*	–0.44	22.80	84.54	27.51	F	...	...	...
SLE	Sierra Leone*	–0.34	16.83	49.55	5.07	E	...	...	...

Table A3. (continued)

Country code	Country	Average annual GDP growth rate, 1960-95 (percent)	Financial development indicators			Legal origin[e]	Policy variables		
			LIQUID LIABILITIES[b]	COMMERCIAL-CENTRAL BANK[c]	PRIVATE CREDIT[d]		CREDITOR[f]	ENFORCE[g]	ACCOUNT[h]
ZAF	South Africa	0.39	51.44	94.77	71.94	E	0	5.85	70
ESP	Spain	2.88	70.31	92.74	65.05	F	0	8.10	64
LKA	Sri Lanka	2.70	30.34	57.80	17.11	E	0	3.58	...
SWE	Sweden	1.89	53.49	88.94	89.11	S	–1	9.79	83
CHE	Switzerland	1.42	123.41	98.99	141.30	G	–1	9.99	68
SYR	Syrian Arab Rep.*	2.51	43.32	46.93	8.83	F	...	...	...
TWN	Taiwan, China	6.62	66.97	95.72	57.32	G	0	8.84	65
THA	Thailand	4.88	47.79	84.66	48.52	E	1	6.91	64
TGO	Togo*	0.46	32.90	82.05	21.88	F	...	...	...
TTO	Trinidad and Tobago*	1.12	37.46	91.72	31.20	E	...	...	...
GBR	United Kingdom	1.96	48.63	83.55	46.31	E	1	9.10	78
USA	United States	1.71	62.12	93.11	113.07	E	–1	9.50	71
URY	Uruguay	1.03	29.47	59.24	21.21	F	0	6.15	31
VEN	Venezuela	–0.88	36.84	90.90	33.12	F	...	6.34	40
ZAR	Zaire*	–2.81	16.03	28.58	4.08	F	...	...	...
ZWE	Zimbabwe	0.84	46.92	75.80	23.04	E	1	4.36	...

a. Asterisks indicate countries added to the LLSV (1998) sample. Values for the financial intermediary development indicators are averages over the 1960-95 period.
b. Liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries) divided by GDP, times 100.
c. Assets of deposit money banks divided by assets of deposit money banks plus central bank assets, times 100.
d. Credit by deposit money banks and other financial institutions to the private sector divided by GDP, times 100.
e. E = English, F = French, G = German, S = Scandinavian.
f. Index of secured creditor rights.
g. Index of law and contract enforcement.
h. Index of the comprehensiveness and quality of company reports.

Table A4. Descriptive Statistics and Correlations, Cross-Sectional Data, 1960-95

Descriptive statistic	*GDP growth*	*Initial income per capita*	*Average years of schooling*	*PRIVATE CREDIT*	*COMMERCIAL-CENTRAL BANK*	*LIQUID LIABILITIES*	*Government size*	*Openness to trade*	*Inflation rate*	*Black market premium*	*Revolution and coups*	*Assassinations*	*Ethnic fractionalization*
Mean	1.95	3120	4.06	40.86	79.26	45.21	14.75	59.46	15.56	23.34	0.16	0.29	0.29
Median	1.98	2019	3.65	27.81	83.89	41.02	13.16	54.33	9.08	5.36	0.07	0.10	0.19
Maximum	7.16	9895	10.07	141.30	98.99	143.43	31.37	231.69	90.78	277.42	0.97	2.47	0.87
Minimum	–2.81	367	0.20	4.08	23.72	14.43	6.68	14.05	3.63	0.00	0.00	0.00	0.00
Standard deviation	1.92	2519	2.50	29.16	17.37	26.26	5.23	36.43	18.25	49.31	0.22	0.50	0.27
No of observations	63	63	63	63	63	63	63	63	63	63	63	63	63
Correlations													
GDP growth	1.00												
Initial income per capita	0.04	1.00											
Average years of schooling	0.30	0.82	1.00										
PRIVATE CREDIT	0.43	0.63	0.57	1.00									
COMMERCIAL–CENTRAL BANK	0.46	0.48	0.43	0.64	1.00								
LIQUID LIABILITIES	0.56	0.39	0.45	0.77	0.59	1.00							
Government size	0.21	0.36	0.46	0.30	0.38	0.30	1.00						
Openness to trade	0.19	–0.18	–0.04	–0.09	0.08	0.30	0.31	1.00					
Inflation rate	–0.28	–0.15	–0.10	–0.38	–0.48	–0.42	–0.24	–0.28	1.00				
Black market premium	–0.38	–0.28	–0.30	–0.37	–0.54	–0.26	–0.11	0.36	0.27	1.00			
Revolution and coups	–0.24	–0.35	–0.30	–0.40	–0.46	–0.44	–0.42	–0.23	0.41	0.20	1.00		
Assassinations	–0.15	–0.09	–0.14	–0.14	–0.07	–0.17	–0.31	–0.27	0.24	0.02	0.51	1.00	
Ethnic fractionalization	–0.35	–0.43	–0.47	–0.34	–0.20	–0.29	–0.06	0.07	0.03	0.20	0.16	0.01	

Table A5. Descriptive Statistics and Correlations, Panel Data, 1960-95

Descriptive statistic	*GDP growth*	*Initial income per capita*	*Average years of schooling*	*PRIVATE CREDIT*	*COMMERCIAL-CENTRAL BANK*	*LIQUID LIABILITIES*	*Government size*	*Openness to trade*	*Inflation rate*	*Black market premium*
Mean	1.56	4710	1.30	42.71	77.67	45.14	14.83	54.44	17.80	74.31
Maximum	9.86	20135	5.15	205.95	99.98	191.44	38.02	180.09	344.40	10990.70
Minimum	–10.02	188	0.04	1.56	14.02	6.72	4.89	9.29	–3.06	–3.68
Standard deviation	2.76	5229	0.95	35.16	20.07	27.07	5.36	27.57	33.03	608.65
No. of observations	359	359	359	359	359	359	359	359	359	359
Correlations										
GDP growth	1.00									
Initial income per capita	0.12	1.00								
Average years of schooling	0.13	0.69	1.00							
PRIVATE CREDIT	0.20	0.76	0.62	1.00						
COMMERCIAL–CENTRAL BANK	0.33	0.54	0.34	0.60	1.00					
LIQUID LIABILITIES	0.22	0.61	0.47	0.84	0.51	1.00				
Government size	–0.04	0.45	0.27	0.24	0.27	0.21	1.00			
Openness to trade	0.13	0.05	0.09	0.09	0.22	0.13	0.20	1.00		
Inflation rate	–0.29	–0.18	–0.08	–0.26	–0.26	–0.26	–0.05	–0.22	1.00	
Black market premium	–0.20	–0.08	–0.06	–0.09	–0.11	–0.03	0.10	–0.10	0.54	1.00

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Politics and the Determinants of Banking Crises: The Effects of Political Checks and Balances

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There is likely to be little disagreement with the observation that political interference has exacerbated the problems associated with bank insolvencies. Nevertheless, most of the analytical attention given to bank crises has focused on technocratic mistakes (inappropriate regulatory choices), exogenous shocks, contagion effects, and other purely economic determinants of crisis. The implicit political economy assumption underpinning this work is that politicians in different countries generally respond similarly to political opportunities in the financial sector, and to crises in the financial sector, so that one need not control for political parameters when examining financial sector crises. This assumption is helpful in isolating the relationships among economic variables. However, as a factual matter, the incentives of political actors differ significantly across countries. One way in which they differ, and which is the focus of this paper, is in the extent of checks and balances that they exhibit in government decisionmaking.[1]

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1. Numerous other institutional differences among countries could matter for the speed with which they respond to bank insolvencies, the ease with which they adjust to exogenous events that could precipitate crisis, and the credibility with which their actions are viewed by markets. These include whether the electoral systems of countries exert severe or moderate fundraising pressures on candidates and parties; the extent to which political decisionmakers respond to narrow or broad constituencies; the horizons of political leaders; the extent to which political leaders or society as a whole are ideologically polarized; and the distribution of different economic constituencies among key decisionmakers.

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Differences such as these have implications both for the speed with which political actors respond to incipient crisis situations, and for the sorts of regulatory and economic policies that they follow that influence whether crises develop in the first place.

Politicians and government officials in all countries have found it convenient, for a number of reasons, to protect imprudent banks, but the extent to which they do this varies significantly across countries. In Venezuela the governor of the central bank was allowed to maintain his ownership of Banco Latino, whose rapid growth eventually precipitated that country's massive crisis. In the United States, members of Congress exercised influence on regulators to protect their savings and loan constituents, but with much more modest effects. The Albanian pyramid schemes, certainly a phenomenon that flowered with significant government support, generated a financial collapse that, relative to that country's GDP, dwarfed the consequences of even the worst-case predictions for the Japanese banking sector. These examples suggest that institutional and social differences between countries certainly do affect how politicians handle the financial sector. Nevertheless, this less-than-adventurous claim has not been examined in any detail.[2]

The extent of checks and balances affects the probability of bank crisis in two ways. First, checks and balances may directly influence the magnitude and probability of financial crises, for example through their effect on intragovernmental negotiating costs that slow the response to an incipient crisis. Second, checks and balances may indirectly influence the probability of banking crises by changing the effects of other determinants of crisis, such as interest rate liberalization. Evidence reported in the empirical section of this paper suggests a strong indirect effect of checks and balances on banking crises: policy variables such as fiscal deficits, deposit insurance, and interest rate controls have a substantially different effect on crisis outcomes in countries where checks and balances are extensive than in countries where they are not.

2. This is not to say that the politics of financial sector reforms in different countries has not been the focus of attention. Considerable work has identified the political causes of crisis in the United States (for example, Romer and Weingast, 1991), but there has been little or no analysis of whether the political causes of crisis differ systematically across countries.

1. Checks and Balances as an Aggravating Factor in Financial Crisis

Checks and balances prevail in a country when multiple players with different interests, each of whom holds veto power, must approve policies as a condition of their implementation. A variety of institutional arrangements give rise to multiple veto players. One common example is that of coalition governments, which are composed of different parties each of which can, by withdrawing its support, cause a government to fall. A second is systems where executive and legislative power are divided, or where the legislature has two chambers, so that the cooperation of multiple bodies is required for legislation to be approved.[3]

This section summarizes several bodies of research that predict a negative influence of checks and balances on economic outcomes. The following section considers arguments that conclude that the presence of checks and balances may mitigate financial sector crises. The third section evaluates the indirect effects.

One literature argues that multiple veto players confront a collective action problem in devising a response to shocks, since none of them bears all of the costs of large deficits, but all bear the full costs of budget cuts incurred by their constituencies. McCubbins (1991) and others argue that spending will fall less in response to shocks when a party in favor of more spending controls one of the veto gates (the decisionmaking bodies charged with approving spending decisions). Since an increase in the number of veto gates (checks and balances) raises the probability that such a party will control at least one of the veto gates, checks and balances should delay the response to crisis.

Alesina and Drazen (1991) also begin with the collective action problem confronting multiple actors.[4] They argue that information asymmetries among the actors delay their response to shocks. Decisionmakers have asymmetric information about the costs of adjustment of their opposition; waiting to respond to a crisis therefore has value, because it reveals additional information about the opposition. Outside of their model, however, it is plausibly the case that

3. Differences in interests can emerge from numerous sources: the constituencies that they represent, their time horizons, their personal financial activities, and so forth.

4. Although they do not explicitly discuss divided government, they do assume that agreement on policy change must be approved by two groups with different interests.

problems of asymmetric information worsen with the number of decisionmakers, exacerbating the delay. Spolaore (1993) shows explicitly that inefficiency in the reaction to budget shocks increases with the number of veto players.[5]

The conclusions of this literature, if not its specific assumptions, have found empirical support. Roubini and Sachs (1989) find that most member countries of the Organization for Economic Cooperation and Development (OECD) held to relatively sound fiscal policies until the oil crisis of the early 1970s. With the onset of that crisis, those governments that were divided failed to make rapid fiscal adjustments and experienced higher inflation. Roubini and Sach do not address the overall efficiency of fiscal policy except to observe that, before the crisis, most countries, with or without divided government, tended to have fairly balanced fiscal policies, albeit with significantly different levels of government spending as a fraction of GDP.

The extension of the conclusions of this literature to the analysis of government responses to bank insolvencies is straightforward. All of the different conditions that in the literature are argued to generate delay in responding to fiscal crisis are generally present as well in financial sector crises. First, a delayed response to financial sector insolvencies, like that to fiscal shocks, is detrimental. Unresolved insolvencies create opportunities for insolvent or near-insolvent banks to "gamble for resurrection," as Akerlof and Romer describe it. Second, as with fiscal policy, a response to financial crisis generally requires the agreement of all primary government decisionmakers; more checks and balances increase the likelihood that the interests of imprudent banks will be protected by at least one of the checks, delaying intervention in insolvent institutions. Third, decisions must also be made in the face of considerable uncertainty not only about which institutions are insolvent, but also about the costs and benefits for the constituencies of decisionmakers and their political opponents.

Since the initial conditions in the analysis of banking crises match those assumed in the literature on fiscal adjustment and checks and balances, the predictions of this literature ought to apply as well to banking crises. Governments that operate with more numerous checks and balances are likely to delay in responding to early warning signs of bank crisis, intervening late in insolvent institutions and leaving inappropriate regulatory frameworks intact for too long. For example, prudent financial regulation often demands that regulators

5. A social planner, implicitly representing the median voter in a country, responds ideally to the shock.

shut insolvent financial institutions down. This typically requires financial resources, for which regulators may have to appeal to the political authorities. Approval for such resources is likely to be delayed when checks and balances are extensive and more political actors must agree on them. This effect of checks and balances should raise the probability of a severe or systemic bank crisis.

To summarize, the existing literature implies that more numerous checks and balances should increase the probability of bank crisis.

2. Checks and Balances as a Mitigating Factor in Financial Crisis

Although checks and balances may introduce bargaining costs that exacerbate the costs of a crisis, they may also have the opposite effect of making it more difficult for governments to shift the costs of financial sector crises onto unrepresented sectors in society. By this logic, checks and balances can give rise to pressures, which would not otherwise exist, to correct regulatory shortcomings or to intervene in insolvent institutions.

There is ample evidence that the absence of checks and balances, particularly outside of the OECD, is associated with lack of political representation for large segments of society. There is good reason to expect such an association, since institutional checks are a (usually explicit) constitutional device to ensure that no single interest can control the reins of government. Multiple groups attempt to ensure that, in postconstitutional lawmaking, their interests will not be prejudiced. They do this by granting themselves or their representatives veto power over legislation. If a single interest group controlled the constitutional process and desired to govern exclusively, it would find it counterproductive to introduce checks and balances.

The importance of this for economic policymaking is straightforward. Since political decisionmakers in any system first seek to have their projects paid for by groups with no representation in the policymaking process, the larger are any unrepresented constituencies, the easier it is to adopt highly inefficient policies. Excess inefficiencies can be shifted to the unrepresented groups, raising the net benefits of these policies to those constituencies that do exercise influence over veto players in the government.

This suggests that the existence of checks and balances, because of their association with more complete representation of

interests in a society, can also moderate inefficiencies such as those that give rise to bank crises.[6] Decisionmakers who cannot shift a sufficiently large share of the costs of their policies onto unrepresented interests are less likely to approve inefficient fiscal or regulatory decisions than decisionmakers that can.

The notion that checks and balances are benign, or even beneficial, is not foreign to the political economy literature. Spolaore (1993) uses logic similar to that presented above to conclude that a single veto player—a single-party government—will protect its constituency and overreact to crisis, imposing excessive costs on the economy. His model, nevertheless, yields the result that multiple decision makers are less efficient. Alesina and Rosenthal (1995) suggest that divided government is a mechanism used by voters to ensure that parties, even though polarized by the activists that control them, pursue moderate goals. They take for granted the existence of multiple veto points and suggest that voters rationally distribute control of government to multiple parties with different preferences. To the extent that moderate goals are consistent with prudent regulation of the financial sector, their arguments are also consistent with the conclusions of this section.

To summarize, then, there are reasons to expect checks and balan-ces to have both positive and negative effects on the probability of bank crises. This paper examines whether, as an empirical matter, the net effect of these offsetting influences is zero, or whether one or the other set of effects predominates.

3. The Interaction among the Political, Economic, and Financial Causes of Bank Crises

Policymakers and researchers have typically focused on economic and financial sector variables and policy instruments in the analysis of financial sector crises. The effect of most of these, however, can be influenced by government decisions, in at least two ways. First, financial sector regulators can potentially mitigate the impact of these

6. McGuire and Olson (1996) argue that stable dictators with an encompassing interest in their domain (for example, complete ability to tax all economic activity) will approve, as they describe it, surprisingly efficient taxation policies. The assumption in this paper is that the extent to which governments collectively have an encompassing interest over the whole country is related to the number of decisionmakers. The evidence presented regarding the financial sector is, in any case, consistent with this assumption.

variables on the probability of banking crises. The presence of checks and balances, in turn, affects the discretion with which financial sector regulators can act. For this reason, one would expect the specific impact of different financial and economic sector variables on a crisis to vary depending on the level of checks and balances.

Second, the belief of private sector actors that government policies will be sustained into the future also influences whether these policies have a large or a small effect on the probability of banking crises. Checks and balances have a significant impact on the ability of governments to reverse policies or to renege on policy announcements. Again, checks and balances should significantly influence the effects of those variables for which the credibility of government matters.

Private credit provides an example of the regulatory effect of checks and balances. An increase in private credit as a fraction of GDP is more likely to result in an increased volume of high-risk loans in the absence of sound prudential regulation. Similarly, the liberalization of interest rates permits bankers to attract funds by raising deposit rates of interest and to use these funds to make high-interest, high-risk loans that they otherwise would not extend, increasing the probability of bank crisis. Their ability to do this is restricted when regulators are free to limit the risk of bank portfolios and to shut down insolvent institutions. The impact of both of these variables on the probability of bank crisis should therefore be different in countries that exhibit extensive checks and balances than in countries that do not.[7]

Exchange rate changes offer an example of the credibility effects of checks and balances. Bankers are unlikely to take on substantial liabilities denominated in foreign currency if their government cannot make credible promises regarding the exchange rate. Consequently, exchange rate movements should have less of an impact on banking crises when governments exhibit few checks and balances.

The remainder of this section presents in greater detail the different economic and financial sector variables that are thought to influence crises, and the likely effects that regulatory independence

7. Two assumptions underlie this conclusion. The first is that the regulators do not need to appeal to political authorities for additional funding to carry out their regulatory function. The second is that regulators are more interested than political actors in maintaining the solvency of the financial system. In many countries, of course, regulators have been found to have a financial interest in the institutions they regulate. This naturally dulls their incentive to act vigorously in defense of the solvency of the system.

(and therefore checks and balances) are likely to have on them. The various economic and financial determinants of systemic bank crises are comprehensively reviewed in Demirgüç-Kunt and Detragiache (1997). Economic variables thought to be important for the financial sector include those that describe the general health of the economy. Among these are real GDP growth, inflation, and income per capita; shocks, such as movements in the terms of trade; and macroeconomic variables that are more directly susceptible to policy intervention. These include exchange rate movements, short-term interest rates, budget deficits, and the ratio of the money supply to foreign reserves held by the central bank. Specific financial sector variables include the ratio of credit to the private sector as a fraction of GDP, the growth of credit to the private sector, the presence or absence of deposit insurance, and the presence or absence of controls on interest rates.

The remainder of this section reviews each of the different economic and financial sector variables used in the analysis, their predicted effect on financial crisis, and the influence of checks and balances on this predicted effect.

3.1 Real GDP Growth

Faster real GDP growth is generally predicted to reduce the probability of banking crises, since borrowers are less likely to default when growth is rapid and their activities are more profitable. Ideal-ly, a regulatory system would mute the effects of the business cycle on the quality of lending portfolios, so that the effects of real GDP growth would be greater in countries with poor regulatory systems (for example, where checks and balances are few) and weaker in more stringent regulatory environments, where regulators keep a tight rein on portfolio risk. However, economy-wide risks are the most difficult to diversify against, and this limits the effectiveness of regulatory intervention. It is certainly a well-observed phenomenon that portfolio risk moves with the business cycle even in the best-regulated countries. Therefore one expects the presence of checks and balances to make little difference to the impact of growth on crisis.

3.2 Inflation

Inflation increases the risk that banks will be forced to raise nominal deposit rates to attract funds. If their nominal returns on

long-term assets are fixed or respond sluggishly to the increased cost of funds, an increase in deposit rates reduces profitability, increasing the threat of systemic insolvency. The perfect bank regulator would ensure that portfolios are not excessively weighted with long-term fixed-rate loans, to minimize the effect of inflation. As with GDP growth, this is a formidable regulatory challenge. We would therefore expect the effect of inflation on a crisis in the absence of checks and balances to be the same as or greater than the effect of inflation in the presence of checks and balances.

3.3 Real Income per Capita

Higher real income per capita is expected to reduce the threat of banking crises in several ways. First, wealthier countries are more likely to be able to afford the costs of efficient financial sector regulation. Second, banks in these countries are more likely to be able to diversify their lending portfolios, in part because wealthier countries are more attractive locations for (better diversified) international banks.

Checks and balances have an ambiguous effect here. On one hand, the presence of checks and balances drives up the incentives of political actors to adopt good regulation, independent of the wealth of a country. Consequently, in countries that already exhibit more extensive checks and balances, the effect of additional wealth on the establishment of sound prudential regulation could be modest. This would suggest that the impact of wealth on banking crises should be greater in countries that lack checks and balances.

On the other hand, property rights are stronger in the presence of checks and balances (see, for example, North and Weingast, 1989, and Keefer and Knack, 1997). International banks are therefore more likely to move into wealthy countries where checks and balances prevail (and where they can therefore be more confident that government policies will not be changed in ways that might devalue their investment). This would suggest that the moderating effect of income per capita on banking crises should be stronger where checks and balances are greater.

3.4 Budget Deficits

Larger government budget deficits are expected to increase the probability of crisis for at least two reasons. First, when the

budget deficit increases, countries are less able to undertake fiscally costly interventions in insolvent banks. By failing to intervene in scattered insolvent institutions early, they increase the chances of a systemic crisis later. Second, governments confronting severe fiscal difficulties are more likely to use the financial sector as an off-budget source of funding for government objectives, by pressuring banks to direct loans to favored borrowers. Since securing repayment of loan obligations from these borrowers is typically a difficult proposition for banks, these pressures can translate into solvency difficulties for the financial system.

For reasons set out earlier, the effect of checks and balances on the impact of budget deficits is ambiguous. On one hand, as the literature on divided government suggests, governments that exhibit more checks and balances always confront greater intragovernmental bargaining costs before making the decision to intervene; these costs conceivably rise with the magnitude of fiscal deficits. In this case, the effect of deficits on raising the probability of financial crisis would be exacerbated where checks and balances are more extensive.

On the other hand, checks and balances can also mitigate the effects of budget deficits on the probability of crisis. Governments with more extensive checks and balances are likely to be more credible and therefore better positioned to issue debt to finance public sector deficits. They can more easily avoid raids on the resources of the financial sector to finance fiscal exigencies. In addition, advocates of a sound financial system, who are more likely to be in the government when checks and balances are more extensive, can block government actions that threaten banks. They can stop coercive government actions meant to persuade banks to lend to particular risky borrowers. They can also insulate regulators from pressure to overlook imprudent banking practices that would flow from decisions to lend to government-favored risky borrowers. For either reason, then, increased checks and balances might reduce the impact of budget deficits on the probability of a bank crisis. The net influence of checks and balances on the relationship between deficits and banking crises is therefore ambiguous.

3.5 Short-Term Interest Rates

Rising short-term real interest rates increase the probability of bank crises in two ways. First, like inflation, they raise the cost of short-run funds to banks, hurting profits when returns on long-term assets are fixed. Second, they may presage a deterioration in the

quality of bank assets if the increases are the result of interbank competition to finance risky loans. In either case, successful regulation (and therefore checks and balances) should mitigate the effect of changes in interest rates on the probability of bank crisis.

3.6 Currency Devaluation

Devaluation makes foreign currency obligations more expensive, triggering crises among those banks or bank borrowers with significant offshore exposure. The effects of checks and balances on this variable are mixed, however. On one hand, in a lax regulatory environment banks are more likely to be insufficiently diversified against the risk of devaluation. This would suggest that devaluation would have a greater effect where there are fewer checks and balances. On the other hand, devaluation has serious implications for the financial sector only to the extent that firms or financial institutions take on foreign currency liabilities to acquire local currency-denominated assets in the first place. They will do this only if they believe the exchange rate guarantees announced by the government. Since governments with checks and balances are likely to be more credible, this would argue for the opposite effect: devaluation would have a greater effect where there are more checks and balances.

3.7 Ratio of the Money Supply to Foreign Reserves Held by the Central Bank

The argument for an effect of the money supply-reserves ratio is similar to the argument regarding exchange rates. An increase in the money supply (M2) relative to foreign reserves increases the vulnerability of countries to sudden capital outflows and, ultimately, to a rapid collapse of the exchange rate. This can precipitate a financial crisis when the financial sector holds substantial liabilities denominated in foreign currency. The effect of checks and balances on this variable is identical to its effect on currency devaluation: that is, the effect is ambiguous.

On one hand, excessive holdings of foreign currency-denominated liabilities can be viewed as a product of regulatory failure, which should be more likely in countries with fewer checks and balances. This suggests that the effect of this ratio on the probability of bank crisis should be lower when checks and balances are strong. However, sudden capital outflows are most likely to occur when previously credible governments, and in particular the promises of government to

maintain a particular exchange rate, come to be seen as noncredible. Governments with few checks and balances are less likely to be viewed as credible in the first place, so the amount of hard currency that private actors will risk in such countries is lower for every level of the M2-reserves ratio. This suggests that the effect of this ratio would be *greater* in countries with more checks and balances.

3.8 Terms-of-Trade Changes

Even prudent banks find it difficult to diversify against the threat of terms-of-trade shocks, which are expected to increase the risk of bank crisis. However, the potential for diversification and prudent management to mitigate these shocks is never zero (see Wilson, Caprio, and Saunders, 1997, on Mexico), and countries that exhibit checks and balances are likely to encourage greater diversification for two different reasons.

First, where checks and balances are greater, governments are more credible, and better-diversified international banks are more likely to enter countries that are more vulnerable to terms-of-trade shocks. Second, where checks and balances are greater, the quality of regulation is likely to be better, and the extent of bank preparation against the eventuality of a shock is likely to be greater. This again mitigates the influence of shocks on bank crises. Although terms-of-trade shocks should have a positive association with bank crises in all countries, this association should be still higher in countries with few checks and balances.

3.9 Lending to the Private Sector and the Rate of Credit Growth

Since banks would normally prefer low-risk loans to high-risk loans, both an increase in lending to the private sector as a fraction of GDP and an increase in the rate of credit growth might be associated with growing risk in bank portfolios, increasing the risk of systemic insolvency. However, following earlier arguments, where checks and balances are more extensive, and regulation therefore is presumably stronger, these effects should be mitigated.

3.10 Ratio of Bank Cash and Reserves to Bank Assets

The ratio of bank cash and reserves to bank assets is an important policy lever used by regulators to control the risk of bank failure.

The vulnerability of banks to crisis is usually predicted to fall when this ratio rises, since greater cash reserves presumably cushion a bank against a rash of nonperforming loans. The effect of political structure on this variable is ambiguous, however.

Banks always gain by overstating their cash reserves, since this builds up the confidence of depositors and other bank creditors. Checks and balances and a stronger regulatory structure are likely to inhibit banks from such overstatement, however. On the other hand, if regulators require banks to maintain larger cash holdings than they prefer, banks, in response, may attempt to offset the low profits from these holdings by extending more risky, high-return loans than they otherwise would have. The net effect of this portfolio shift can, in principle, be a net increase in the riskiness of the portfolio.

In addition, a spurious positive relationship between cash holdings and crisis probability is possible if regulators, in response to other signals of impending systemic insolvency, require a significant increase in the cash holdings of banks. Since this action will be followed by, or coincide with, bank crises in many instances, empirical work could reveal (and does reveal in the regressions that follow) a contemporaneous association between high cash reserves and the probability of bank crises.

3.11 Deposit Insurance

Two policy variables specific to the financial sector have also been used as predictors of financial crisis. One of these is the presence of deposit insurance, and the other, discussed below, is the liberalization of interest rates. Theory suggests two offsetting effects of deposit insurance. On one hand, it can lower the probability of bank crisis by reducing the likelihood of bank runs. However, deposit insurance also increases moral hazard problems in the financial sector by relieving depositors of the need to monitor the operations of their bank, in turn encouraging bank owners to make imprudent loans. The effects of deposit insurance on bank crisis are therefore ambiguous.

The effect of checks and balances is similarly ambiguous. On one hand, if the absence of checks and balances means that governments are not credible, depositors will be disinclined to rely on government promises to indemnify their savings in the event of bank failure. The introduction of deposit insurance should therefore have more modest effects when checks and balances are absent than when they are present.

On the other hand, there are two reasons to expect a stronger positive association between deposit insurance and bank crises when checks and balances are absent. First, the regulatory environment is more likely to be deficient when checks and balances are few, increasing the possibilities for abuse of the deposit insurance system by banks. Second, the announcement of a deposit insurance program is one possible response to bank crisis, intended to build depositor confidence and forestall bank runs (see Cull, 1998). However, such an announcement is more difficult in the presence of significant checks and balances. This would lead to a stronger association of deposit insurance with bank crises in the absence of checks and balances.

3.12 Financial Liberalization

Recent research has also examined the role of financial liberalization in triggering bank crises (see especially Demirgüç-Kunt and Detragiache, 1998). Liberalization (defined as the lifting of interest ceilings on deposits) increases the risks to banks that the nominal costs of short-term liabilities will exceed their nominal returns from long-term assets. Liberalization also allows banks to compete for funds by raising deposit rates. This facilitates attempts by banks to expand their lending portfolios to include high-risk, high-interest loans, raising the probability of bank crisis in any given year.

Once again, political institutions are likely to affect whether financial liberalizations are associated with crisis. Demirgüç-Kunt and Detragiache (1998) point out that countries with poor regulation are more likely to suffer from the ill effects of financial regulation, and they find evidence of this. However, countries with fewer checks and balances are likely to have worse regulation. Financial liberalization should therefore be more strongly associated with bank crises in these countries.

All of the predictions reviewed above are summarized in the far right-hand column of table 1.

4. Testing Approach

4.1 Measurement of Crisis and Specification Issues

The hypotheses reviewed above have implications both for the magnitude of bank crises, measured for example by the magnitude of

Table 1. Financial and Economic Determinants of Bank Crises under Alternative Institutional Settings[a]

Independent variable	*Countries sorted according to score on executive constraints (EC) variable*		*Countries sorted according to score on party fractionalization (PF) variable*		*Predicted results*
	(1a) EC < median	*(2a) EC > median*	*(1b) PF ≤ median*	*(2b) PF > median*	
Real GDP growth	–0.0049 (0.033)	–0.0166 (0.0004)	–0.003 (0.169)	–0.013 (0.005)	|1| ≥ |2|
Change in terms of trade	–0.001 (0.22)	0.00003 (0.99)	–0.002 (0.029)	0.001 (0.637)	|1| > |2|
Inflation	0.0021 (0.03)	0.0024 (0.054)	0.0021 (0.068)	0.0012 (0.153)	|1| ≥ |2|
Fiscal deficit or surplus/GDP	0.00016 (0.34)	0.0002 (0.49)	0.0001 (0.46)	0.0024 (0.24)	Ambiguous
Real short-term interest rate	0.0028 (0.014)	0.0038 (0.02)	0.00204 (0.034)	0.0019 (0.126)	|1| > |2|
Rate of devaluation of exchange rate	0.00061 (0.09)	0.00049 (0.40)	0.0004 (0.15)	0.0004 (0.43)	Ambiguous
M2/foreign reserves held by central bank	0.00008 (0.90)	0.0023 (0.0001)	0.000004 (0.99)	0.0025 (0.0001)	Ambiguous
Cash and other liquid reserves/total bank assets	–0.0012 (0.23)	0.0062 (0.0017)	–0.0009 (0.26)	0.0028 (0.1182)	Ambiguous
Credit to the private sector/GDP	0.0048 (0.0001)	–0.00072 (0.331)	0.0047 (0.0001)	0.0011 (0.037)	|1| > |2|
Credit growth (two-year lag)	–0.0007 (0.38)	0.00119 (0.40)	0.00004 (0.58)	–0.0002 (0.916)	|1| > |2|
Real income per capita	–0.089 (0.001)	0.016 (0.0009)	–0.075 (0.0022)	–0.0044 (0.205)	Ambiguous
Deposit insurance (yes = 1)	0.097 (0.0003)	0.016 (0.684)	0.091 (0.0008)	0.0382 (0.33)	Ambiguous
Duration (time since last crisis)	–0.009 (0.0012)	–0.01 (0.0165)	–0.0087 (0.0135)	–0.011 (0.013)	None
Summary statistic					
No. of crises	52	59	39	72	...
No. of observations	232	351	188	395	...
Model chi-square (-2 log likelihood)	98.32	99.37	78.0	92.2	...

Source: Author's calculations. See text.

a. Results of a logistic estimation; the dependent variable is a dummy set to equal 1 in the presence of a bank crisis in a given year and 0 otherwise. Marginal effects at the means are reported in place of slope coefficients. Numbers in parentheses are p values.

unrecoverable loans in the banking system, and for whether a crisis occurs or not in a particular year. Since better data are available on the occurrence of crises, this paper focuses on the probability of crisis in any given year. Both the data on crises and the testing methodology are taken from Demirgüç-Kunt and Detragiache (1997). These authors classify any country as experiencing a financial sector crisis in a given year if, according to a series of other studies, the country meets at least one of the following four conditions:

- The ratio of nonperforming assets to total assets in the banking system exceeds 10 percent.
- A rescue operation is mounted costing at least 2 percent of GDP.
- Banking sector problems result in a large-scale nationalization of banks, or
- Extensive bank runs take place, or emergency measures such as deposit freezes, prolonged bank holidays, or generalized deposit guarantees are enacted by the government in response to the crisis.

The crisis data run from 1980 to 1994 and are available for sixty-five countries.

Since the dependent variable is dichotomous, with many zero observations (years in which no crisis occurs) and relatively few ones (years in which crises do occur), these authors adopt a multivariate logistic estimation strategy. Essentially they estimate a hazard model that indicates how the probability of a crisis occurring in any one year depends on a set of independent variables. Their approach is followed in this paper.

One notable difference between their work and the analysis here is in the treatment of years following the onset of crisis. Demirgüç-Kunt and Detragiache argue, reasonably, that the behavior and interaction of some explanatory variables may be fundamentally different during crises and that crises may influence these variables. Consequently, in their baseline regressions they eliminate all observations after the onset of the crisis. The approach in this paper is different because the entire sample is used, including both crisis and noncrisis years. The most important reason for this is that the arguments developed earlier generate predictions about whether crises will be resolved rapidly or not. To examine these, it is necessary to look at crisis as well as noncrisis years. In addition, although crises certainly can feed back into the political structure, this effect is likely to be less severe than with economic and financial variables.

In any case, most of the results below are robust to the use of a sample that omits all but the first crisis year in countries.

The earlier discussion suggests that checks and balances influence the probability of bank crises through many of the other independent variables. Such indirect effects can be captured with interaction terms, but these are impractical when the predicted interactions are as abundant as they are here, as they would give rise to widespread multicollinearity. Two approaches are therefore taken. First, regressions are run with the full set of economic and financial variables, but with the sample divided according to whether countries exhibit high or low values of the particular checks and balances variable under consideration. The experiment here asks whether the effect of all the economic and political changes is substantially different in countries with high than in countries with low checks and balances. The second experiment examines the direct and indirect effects of checks and balances, for the whole sample of countries, in a single regression with a more limited number of control variables.

4.2 Measuring Checks and Balances

The remaining empirical issue to be discussed is the measurement of checks and balances. Ideally we would want to know which decisionmakers in each country control financial sector policy, their incentives and their independence from each other, and whether or not each decisionmaker has veto power over any changes of policy. Such data are not available on a cross-country basis. Instead two proxy variables are used. One, called "executive constraints," is a subjective evaluation of the extent to which the executive branch of government is constrained. Collected by political scientists, this varia-ble comes from the Polity II data set compiled by Gurr, Jaggers, and Moore (1989). Its usefulness as a proxy for checks and balances is straightforward to describe. The variable ranges from 1 to 7, with 1 indicating that "there are no regular limitations on the executive's actions (as distinct from irregular limitations such as the threat or actuality of coups and assassinations),"and 7 indicating that groups such as a legislature or a ruling party have "effective authority equal to or greater than the executive in most areas of activity."

The second proxy for checks and balances in government used in this paper is called "party fractionalization." The presumption here is that, where parties are fractionalized, building coalitions for policy change requires the agreement of a greater number of independent

actors. That is, each party is a potential veto player; where the party system is fractionalized, the number of such veto players potentially rises. This is another form of checks and balances. The party fractionalization variable is assembled by Banks (1993) and is computed as the probability that any two legislators drawn from the legislature will not come from the same party. Thus a value of 0 would indicate no fractionalization, and a value of 1 complete fractionalization.

These variables are inevitably imperfect proxies for checks and balances. Apart from the issues raised earlier, the party fractionalization variable does not distinguish between countries with a fractionalized government and unitary opposition and countries with the reverse. Only the former would be predicted to lead to greater checks and balances. However, the inherent measurement error in the proxy biases the results against a finding that checks and balances matter for policy outcomes.

5. The Effect of Checks and Balances on the Economic Determinants of Crisis

The first experiment, then, is to observe the effect of the standard economic and financial determinants of bank crises under different institutional environments. Table 1 presents the results of this experiment. Rather than the slope parameters, this and all the tables in the paper report the marginal effects of the variables at their means (that is, the percentage increase in the probability of banking crises for a one-unit increase in the independent variable, measured at the means of all the variables).[8]

The first conclusion to be drawn from table 1 emerges from two rows near the bottom of the table, which report the number of crises and the number of observations. The ratio of crises to observations is nearly the same in columns 1b and 2b (20.7 percent versus 18.2 percent), and only slightly higher in column 1a than column 2a (22.4 percent versus 16.8 percent). This suggests that the effect of checks and balances is both to handicap and to assist countries in defusing bank crises. In practice, the offsetting effects appear to balance out.

8. Using ordinary least squares, the standardized estimate is simply the slope parameter estimate divided by the ratio of the standard deviation of the dependent variable to the standard deviation of the explanatory variable. However, since a nonlinearity multinomial logistic estimation strategy is used, the standardized estimate is the standard deviation of the underlying distribution (the inverse of the logistic function), evaluated at the mean of the independent variable.

The second conclusion to be drawn from table 1, and the central point of this paper, is that the determinants of bank crises are quite different in countries that exhibit checks and balances from those in countries that do not. In particular, movements in the terms of trade, the ratio of M2 to foreign reserves, the ratio of cash reserves held by banks to their assets, credit to the private sector, and the presence of deposit insurance have a much different impact across the two groups of countries.

Changes in the terms of trade are predicted to have a greater impact on the probability of bank crises in the absence of checks and balances, whether checks and balances are proxied by executive constraints or by party fractionalization. The effect of the terms of trade is insignificant in countries with more extensive checks and balances. In countries with few checks on the executive, improvements in the terms of trade have a statistically significant and negative impact on the probability of banking crises. The effect is not large, however: a 50-point decline in the terms of trade (the sample values range from –50 to 53) is associated in column 1a with a 5 percent increase in the probability of a bank crisis.

No unambiguous prediction about the ratio of money to foreign reserves in the central bank was possible, but the evidence suggests a significant difference across countries. One predicted effect was that the regulatory advantages of checks and balances would impede banks from overexposing their portfolios to foreign currency-denominated liabilities. This effect, however, turns out to be dominated by the second predicted influence: only where governments are credible do banks and firms build up large foreign currency liabilities in the first place. These large liabilities make substantial capital outflows possible when governments begin to lose the confidence of investors, increasing the ratio of money to foreign reserves. As a consequence, this variable is positive and highly significant only in countries exhibiting more extensive checks and balances: a 1-standard-deviation (40-point) increase in the ratio of money to foreign reserves is associated with a 10-point increase in the probability of crisis in the two subsamples with strong checks and balances.

The rate of devaluation is a similar variable that, most likely because of multicollinearity, exhibits a different pattern in table 1: in the executive constraints equations, it is borderline significant in the low-constraints subsample. However, the economic and statistical effects are nearly indistinguishable across the high- and low-checks-and-balances samples for both checks-and-balances variables

and are too weak to call into question the strong effects indicated for the money supply and foreign reserves.

The predicted effect of the ratio of cash and liquid reserves to bank assets is also ambiguous. In the absence of checks and balan-ces and sound regulation, one would expect banks to overstate their reserves, leading to a potentially positive relationship between reserves and the occurrence of crises in these countries. On the other hand, in countries with sound regulation, regulators might be effective in demanding higher reserves in the face of a crisis, leading to a spurious positive association between the two, or regulators might enforce the holding of excessive reserves, leading banks to increase the riskiness of their lending portfolio to compensate for the low returns to reserves.

The evidence suggests that some combination of the last two effects is dominant. Cash reserves have a modest, statistically insignificant, negative impact on crisis in countries with few checks and balances, in all likelihood suggesting that both good and bad banks report high returns in such countries, obscuring the statistical connection between reserves and solvency. In countries with extensive checks and balances, however, reserves have a positive and statistically significant association with bank crises.

Credit to the private sector and credit growth were both predicted to have a stronger positive association with crises in poorly regulated financial sectors of countries that exhibit few checks and balances. Evidence reported in table 1 supports this. Although all the coefficients for credit growth are statistically insignificant, the extent of credit to the private sector has a positive and statistically significant association with crisis in countries lacking checks and balances. An increase of 50 points in this variable (less than 1 standard deviation) is associated with a 25 percent increase in the probability of banking crises in the low-executive-constraints equation; a 1-standard-deviation increase in the low-fractionalization equation is associated with a 12 percent increase in the probability of crisis. In the case of the party fractionalization sample of countries, both subsample coefficients are statistically significant. However, the magnitude of the effect of credit to the private sector in the low-fractionalization subsample is four times greater than the effect in column 2b. Finally, as with other variables, it is not possible to make unambiguous predictions about the effect of deposit insurance. Two offsetting potential effects were suggested earlier.

On one hand, where regulation is poor (checks-and-balances are absent), we would expect deposit insurance to have a positive

association with crisis. On the other hand, where checks and balances are missing, we would also expect depositors to place less faith in government deposit guarantees, and therefore place fewer assets at risk. This would tend to minimize any crisis that might occur. Results from table 1 suggest that the first effect dominates. The effects of deposit insurance are statistically insignificant in high-checks-and-balances countries. In low-checks-and-balances countries, reinterpreting the results from table 1, the probability of a crisis rises 20 percent when deposit insurance is introduced.[9]

Coefficients on the six remaining variables are either statistically insignificant or insignificantly different across subsamples. Inflation and short-term interest rates were both expected to have a similar effect across subsamples, or a somewhat stronger impact in low-checks-and-balances countries. The evidence in table 1 shows little difference. Contrary to expectations, the effect of real GDP growth is statistically and economically much greater when checks and balances are high.[10] None of the coefficients are statistically significant in the case of fiscal deficits. The evidence is strong that, in countries with low checks and balances, real income per capita matters significantly in preventing crises (every additional $1,000 in income per capita reduces the risk of crisis by approximately 8 percent). The evidence is mixed on the effect of income on crisis in countries with high checks and balances.

6. Robustness Testing and the Direct Effects of Checks and Balances

The results of table 1 support the argument that, although checks and balances do not seem to affect the overall probability of a financial crisis occurring in a country, they do have a substantial effect on the causes of crisis. These results are obtained by splitting the sample according to the level of checks and balances exhibited by countries.

9. The marginal impacts are calculated at the means of the variables, which is awkward for a dummy variable like deposit insurance. The 20 percent figure is obtained instead by subtracting the marginal impact of deposit insurance when it is assumed to be 1 from the marginal impact when it is assumed to be 0.

10. This may be due to a third effect not described earlier but consistent with the main themes of this paper. In a poorly regulated environment, GDP growth is more likely to be associated with excessively risky expansion of lending; this offsets the positive effect that growth has in improving the ability of borrowers to repay loans.

To further examine these conclusions, this section reports the results of regressions that use the entire sample of countries and that include checks-and-balances variables directly, interacting them with key financial sector variables. In particular, the analysis here considers the interaction of the two measures of checks and balances with four financial sector variables: credit to the private sector, credit growth, financial sector liberalization, and cash reserves of banks as a fraction of total bank assets. These four variables are singled out because they are the ones most likely to be targeted by financial sector policymakers either as signals of latent difficulties in the financial sector, or as policy instruments that can be manipulated to avert a crisis.

The earlier discussion suggests that the inclusion of checks-and-balances variables in the full specification of table 1 would create severe multicollinearity problems, since the effects of most independent variables depend in turn on the level of checks and balances in a country. To minimize these, reduced specifications are employed with two additional control variables: income per capita and growth.

Table 2 is the first of two tables that report the results from these reduced specifications. The key variables in the four equations of this table are the interactions of executive constraints and party fractionalization with the ratio of credit to the private sector to GDP, and with the rate of growth of credit lagged two years. From the earlier discussion, one would expect these interaction terms to be negative: at higher levels of checks and balances, tighter regulation is more likely, and the positive association that these variables might have with bank crises is reversed. In all four cases, as predicted, the interaction effect is of the expected sign and from reasonably to very statistically significant.

This mitigating effect of checks and balances is also economically significant. At the highest levels of executive constraints, for example, credit to the private sector actually has a slightly negative impact on the probability of bank crisis, whereas at the lowest value of executive constraints the impact of credit is positive and twenty times greater than at the mean of executive constraints. An increase of 1 standard deviation in the ratio of credit to the private sector to GDP (a 38-point increase) is associated with a 10.7 percent increase in the probability of crisis at the lowest level of executive constraints (a value of 1), but a 3 percent *decline* in the probability of crisis at the highest level of executive constraints (a value of 7). Similarly, a 1-standard-deviation increase in credit growth (15 points) leads to a

Table 2. Results of Regressions with Variables Interacting Private Credit, Credit Growth, and Alternative Checks-and-Balances Measures[a]

	Interaction term			
Independent variable	*Executive constraints x private credit*	*Executive constraints x credit growth*	*Party fractionalization x private credit*	*Party fractionalization x credit growth*
Real GDP growth	–0.0086 (0.0004)	–0.0083 (0.0007)	–0.0068 (0.0056)	–0.0066 (0.009)
Real income per capita	–0.00087 (0.74)	–0.0023 (0.347)	–0.0075 (0.020)	–0.0010 (0.003)
Credit to private sector/GDP	0.0006 (0.02)	0.0006 (0.115)	0.0023 (0.0001)	0.0023 (0.001)
Credit growth (two-year lag)	0.0014 (0.047)	0.0008 (0.037)	0.0063 (0.483)	–0.00026 (0.038)
Executive constraints	–0.021 (0.75)	–0.016 (0.24)	... ...	... ...
Party fractionalization	... ...	... ...	0.02 (0.026)	0.025 (0.27)
Interaction (column heading)	–0.0006 (0.047)	–0.0009 (0.114)	–0.0046 (0.010)	–0.006 (0.031)
Summary statistic				
No. of crises	131	131	60	60
No. of observations	821	821	495	495
Model chi-square (-2 log likelihood)	30.77	28.7	29.83	26.44

Source: Author's calculations.

a. The dependent variable is a dummy set to equal 1 in the presence of a bank crisis in a given year and 0 otherwise. Coefficient estimates are marginal effects at the means; the direct effect of each component of an interaction term is calculated at the mean of the other; for example, in the first column, the direct effect of executive constraints is calculated as –0.021 –0.0006 * mean(credit to the private sector/GDP). Calculation of the significance level of direct components (for example, executive constraints, credit to the private sector/GDP) assumes, to the contrary, that the other interacted term is set to zero, not to its mean. Numbers in parentheses are p values.

4 percent increase in the probability of bank crisis when party fractionalization is at its lowest level (zero), but a 4 percent *decline* in the probability of crisis when party fractionalization is at its highest level (0.99).

At the same time, the table confirms the mixed picture in table 1 of the effect of checks and balances themselves on financial sector crises. At mean values of the financial sector variables, a 1-standard-deviation increase in executive constraints is associated with an approximately 3 percent reduction in the probability of banking crises. The effect of party fractionalization is equally slight, but in the opposite direction, when evaluated at the mean values of the financial sector variables. At the same time, it is notable that the effects of

checks and balances rise with the levels of the financial sector variables. That is, in situations that are most likely to give rise to a crisis (explosive growth in credit, for example), the independent effect of political institutions is most noticeable and economically significant.

The remaining two financial sector variables, interest liberalization and the ratio of cash reserves held by banks to bank assets, are examined in table 3. Like table 2, table 3 presents regressions that control for growth and income per capita; credit growth lagged two years is retained from the last table as an additional control. Interest liberalization was not included in table 1; it is a variable that captures whether or not there are ceilings on interest rates (as presented in Demirgüç-Kunt and Detragiache, 1998).

The evidence is once again consistent with the earlier discussion and with the results in table 1. Interest liberalization has a significant association with the probability of crisis, with liberalization corresponding to a 22.7 percent increase in the probability of crisis when the executive constraints variable is at its mean value, and a 16.6 percent increase when party fractionalization is at its mean value. The effect of checks and balances is also economically significant. Moving from the highest to the lowest value of executive constraints, the association of interest liberalization with crisis increases from 20.9 percent to 27.4 percent. The effect is much larger with party fractionalization. At the lowest value of party fractionalization, interest liberalization is associated with a 39.6 percent increase in the probability of financial crisis; at the highest value of party fractionalization, liberalization is associated with a 6.0 percent decline in the probability of crisis.

The odd effect of cash reserves observed in table 1 is confirmed in table 3. The explanation, as before, is that, in countries with effective checks and balances, effective regulators are quicker to impose higher reserve requirements in the face of a crisis threat. This leads to a positive (and spurious) correlation between cash reserves and crisis.

7. Other Robustness Checks

The results in tables 1 through 3 embed a series of robustness checks. These include very different specifications and measures of checks and balances. The main finding of the paper, that the causes of bank crises vary with political institutions, are robust to these differences. The results are also robust to two other permutations.

Table 3. Results of Regressions with Variables Interacting Interest Liberalization, Cash Reserves, and Alternative Checks-and-Balances Measures[a]

	Interaction term			
Independent variable	*Executive constraints* x *interest liberalization*	*Executive constraints* x *cash reserves*	*Party fractionalization* x *interest liberalization*	*Party fractionalization* x *cash reserves*
Real GDP growth	–0.0104 (0.0006)	–0.00872 (0.001)	–0.0634 (0.027)	–0.0049 (0.05)
Real income per capita	–0.00035 (0.88)	0.00089 (0.74)	–0.0045 (0.06)	–0.0011 (0.70)
Credit growth (two-year lag)	0.0018 (0.014)	0.0015 (0.034)	0.00042 (0.68)	0.0016 (0.054)
Interest liberalization (1=yes)	0.227 (0.0002)	... ...	0.166 (0.0001)	... ...
Cash reserves/bank assets	... ...	0.000318 (0.021)	... ...	0.000181 (0.0439)
Executive constraints	–0.0076 (0.235)	–0.0052 (0.043)	... ...	... ...
Party fractionalization	... ...	... ...	0.0682 (0.0815)	0.096 (0.045)
Interaction (column heading)	–0.00035 (0.24)	0.0011 (0.016)	–0.0682 (0.0001)	0.011 (0.020)
Summary statistic				
No. of crises	122	130	58	59
No. of observations	659	758	418	501
Model chi-square (-2 log likelihood)	58.9	23.3	70.1	16.92

Source: Author's calculations.
a. The dependent variable is a dummy set to equal 1 in the presence of a bank crisis in a given year and 0 otherwise. Coefficient estimates are marginal effects at the means; the direct effect of each component of an interaction term is calculated at the mean of the other; for example, in the first column, the direct effect of executive constraints is calculated as –0.0076 –0.00035*mean(interest liberalization). The significance level of direct components (for example, executive constraints, interest liberalization) assumes, to the contrary, that the other interacted term is set to zero, not to its mean. Numbers in parentheses are p values.

The effects reported in table 1 are insensitive to the use of the median instead of the mean values of the checks-and-balances variables. They are also relatively insensitive to the exclusion of crisis observations after the first year of crisis (there is a loss of significance of the coefficients, but the magnitude and direction of differences between coefficients under high and low levels of checks are repeated).[11]

11. This test is in any case extreme, since it implies that subsequent crises are entirely determined by earlier crises.

8. Conclusion and Implications for Policy

The argument that "institutions matter" is an important one, but it is often difficult to translate into policy, particularly if one believes that the only policy advice that emerges from institutional analysis is that the institutions themselves must change. The analysis here points to a different implication of institutions: that traditional policy instruments and indicators used in the financial sector should be viewed differently in different institutional environments. Financial sectors in countries with strong checks and balances seem to respond very differently to changes in economic and financial variables that are widely considered to be important in the analysis of banking crises.

The major question confronting financial sector policymakers is the following: should they encourage the growth of the financial sector, for example by liberalizing interest rates, or should they reduce the risks of financial sector crisis by, for example, controlling interest rates? The evidence suggests that the dilemma confronted by policymakers is much greater in countries that lack checks and balances. On one hand, interest liberalization is substantially more risky in countries that lack checks and balances. On the other, credit growth and the amount of private credit relative to GDP are both more strongly associated with impending crisis in countries that lack checks and balances. Deposit insurance, intended to facilitate increased intermediation in a country and forestall the risk of banking crises, has instead been found to be associated with a significantly higher probability of bank crises in countries where checks and balances are weak.

The influence of economic variables, which policymakers might track in an attempt to anticipate crisis, also varies across political institutions. Terms-of-trade shocks, found to be of minor importance in previous literature, have a significant and discernible impact on the probability of crisis in countries lacking checks and balances. Conversely, precisely because of their lack of credibility, in countries lacking checks and balances the ratio of the money supply to foreign reserves is a weak indicator of impending crisis, but it is a very good indicator in countries that exhibit strong checks and balances.

Not only do political institutions have a significant effect on the causes of banking crises, but the effect is of a magnitude that frequently exceeds the effects of the more standard financial and economic variables that are usually the focus of attention. Taken together, then, the evidence suggests that the political origins of ban-king crises merit significant attention in the design of effective policies to forestall crisis, and to respond to crisis when it occurs.

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Financial Regulation and Performance: Cross-Country Evidence

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The unprecedented number of costly bank failures throughout the world in the last two decades of the twentieth century has focused attention on the need to determine more appropriate ways to improve the performance of countries' financial systems. Indeed, a substantial literature is already emerging on the causes and consequences of banking—crises and on various reforms that might help prevent future crises.[1] Although the proposed reforms differ in important respects, nearly all include changes in existing financial regulations and supervisory standards. This core of agreement is certainly understandable, insofar as financial crises in countries ranging from the United States and Japan, to Korea and Mexico, to Chile and Thailand, to India and Russia, and to Ghana and Hungary have been blamed at least in part on "bad" regulation and supervision.

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The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors and do not necessarily represent the views of the World Bank, its executive directors, or the countries they represent.

1. See, for example, Bank for International Settlements (1998); Barth and others (1998); Caprio (1998a); Demirgüç-Kunt and Detragiache (1997, 1998); García, Lindgren, and Saal (1996); Goldstein and Turner (1996); Goldstein (1998); and Radelet and Sachs (1998).

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In response to this recent and troubling situation, the World Bank, the International Monetary Fund, and other international financial institutions are attempting to promote financial stability and economic development by more vigorously urging countries to adopt and then implement appropriate regulations and supervisory practices for their financial sectors. The World Bank, for instance, in virtually all its financial sector reviews and projects, now stresses more than ever the importance of prudential regulation and supervision. The overwhelmingly widespread belief is that many countries can significantly improve upon their existing financial systems, thereby reducing the likelihood of financial instability and facilitating long-run economic growth. More generally, the belief appears universal among those who have studied these issues that inappropriate regulations and supervisory standards not only retard a country's long-run rate of economic growth but also increase the likelihood of a financial crisis that could spread beyond the country's own borders.

Remarkably, however, despite all the agreement on the need for financial reform, there is relatively little empirical evidence to support any concrete advice regarding either specific or comprehensive regulatory and supervisory reforms. The reason for this awkward situation is that detailed cross-country comparisons of financial regulatory and supervisory systems for developing countries do not yet exist.[2] Without such information, economists have nonetheless been able to conclude that incentives are critical in understanding the behavior of the different agents that comprise the financial sector. In this regard, it is now recognized that the moral hazard problem has become more widespread and hence explains in part the recent worldwide outbreak of banking crises.[3] Economists have not yet been able to reach a conclusion, however, about the most appropriate way to correct the incentive and moral hazard problems facing banks, such as by requiring higher (and more narrowly defined) capital-to-asset ratios, mandating stricter definition and disclosure of nonperforming loans, requiring that subordinated debt be issued, or installing "world-class" supervision.

2. Barth, Nolle, and Rice (1997) provide fairly detailed comparative information on bank regulatory and supervisory systems for nineteen countries: the Group of Ten (G-10) large industrial countries and the other members of the European Union. They provide relatively little analysis, however, of appropriate reforms for these systems.

3. More generally, the moral hazard problem, when not contained, gives rise to an inefficient allocation of resources.

The inability to reach a conclusion about specific ways to resolve these serious problems is not surprising, given that data on the practices of various financial regulatory and supervisory authorities for a wide range of countries have not been assembled and analyzed. This lack of information is quite important because it means that current efforts to reform financial regulation and supervision are occurring without knowing whether or under what circumstances these efforts will be successful. One should realize, moreover, that in situations in which the salaries of supervisors are only 5 to 10 percent of those of the supervised, or in which individuals can easily move (and usually with ample financial gain) from careers as regulators to careers with the regulated firms, reform efforts are unlikely to be truly successful.

To characterize the lack of financial regulatory and supervisory data more concretely, even information on the extent to which banks in different developing countries are allowed to, and do, engage in various securities, insurance, and real estate activities has not yet been compiled and analyzed. Nor is there any systematic compilation and analysis of information, for a broad cross section of countries, on whether they allow banks to own or be owned by nonfinancial firms. Yet the extent to which these specific banking activities or banking and commerce interrelationships inhibit or promote the development of an efficient and stable financial system, or increase or decrease the likelihood of a banking crisis, is largely unknown without such information. In short, many important and pressing questions regarding the appropriate way to reform financial sector regulation and supervision in many countries throughout the world cannot today be adequately answered.

Research on these types of issues, therefore, is of critical importance because it will enable researchers to better identify the particular mix of regulations and supervisory standards that promotes well-functioning financial systems. With this identification, one would then be in a position to provide better guidance to policymakers on appropriate financial sector reforms. Ongoing research is already significantly improving our understanding of the broad relationships between the type of legal system existing within a country and its financial sector development.[4] The somewhat narrower research discussed here complements this other work.

4. See La Porta and others (1997, 1998), Levine (1998), and Levine, Loayza, and Beck (2000).

This paper focuses on the regulation and supervision of the banking sector.[5] Efforts to collect detailed and comprehensive information on the different financial regulatory and supervisory environments that exist in the approximately 200 countries throughout the world are just beginning, and at present only partial information is available for about fifty countries. Given this situation, we make use of the information that is available. Fortunately, the recently obtained data include information on the degree to which regulatory restrictions are imposed on several important and even controversial activities of banks. This newer information, together with that previously gathered, enables us to examine empirically for the first time, albeit in a preliminary manner, the interrelationships among some important regulatory, governmental, and financial variables.

Specifically, the following three questions are examined—and briefly answered—in this paper:

- Do countries with relatively weak government or bureaucratic systems impose harsher regulatory restrictions on the activities of banks? We find that the answer to this question is yes.
- Do countries with more restrictive regulatory systems have poorly functioning banking systems? The evidence is mixed.
- Do countries with more restrictive regulatory systems have a lower probability of suffering a banking crisis? The answer is no. In fact, the results indicate that the opposite is the case: In countries in which the securities activities of banks are restricted, the likelihood of a banking crisis is greater, ceteris paribus.

The third finding contradicts those who believe that stricter restrictions on the allowable activities of banks constrains excessive risk-taking behavior, partly by making banks easier for both the supervisory authorities and market participants to monitor.[6] Two forces may be at work to produce such a result. First, to the extent that more narrowly defined banking activities (such as making loans) and broader financial activities (such as securities and insurance

5. It should be noted, however, that in many developing and emerging market economies the banking sector is the most important component of the financial system.

6. In the case of the U.S. savings and loan debacle, despite the fact that unitary thrift holding companies had comparatively few restrictions on their activities, including the mixing of banking and commerce, these broader powers were not found to be a significant factor. See, for example, Barth (1996).

activities) are not highly and positively correlated, banks in countries that allow broader powers are able to benefit by being more diversified in their operations. This reduces the likelihood of both failures and crises.[7] Second, Hellmann, Murdoch, and Stiglitz (1998) demonstrate that, by imposing one specific restriction—deposit interest rate ceilings—on banks, a country may obtain a more robust banking system, mainly because of the resulting higher franchise value. Our findings, however, indicate that harsher restrictions on those banks' activities considered here are likely to *lower* franchise value, either by limiting profits (by reducing economies of scale and scope) or by increasing the variability of profits (by leaving average profits unchanged but reducing the market value of those profits to the extent that investors prefer less rather than more volatility).[8] This means that reducing, if not totally eliminating, these restrictions would allow greater diversification and thereby enhance franchise value. This regulatory reform, in turn, would induce more incentive-compatible behavior on the part of banks.[9] The gain from allowing broader banking powers appears to more than offset whatever added complications such a move toward "universal banking" would imply for monitoring.[10]

These empirical results, of course, are preliminary. A more extensive data set will be assembled to permit analysis of a wider variety of regulatory issues. An attempt will also be made to obtain indicators of the ability of supervisory authorities and market participants to monitor banks. The database, moreover, will be expanded beyond the fifty countries in our sample, thereby increasing the power of the empirical tests. For a discussion of data and additional analyses, see Barth, Caprio, and Levine (2001, a, b, c).

Despite the preliminary nature of these results, they do seem sufficiently robust that policymakers should consider them, along

7. See Caprio and Wilson (1997) for evidence identifying a link between a lack of diversification and bank failures in selected countries.

8. Bankers frequently lament that restrictions on their ability to engage in investment banking activities excludes them from more profitable lines of business. However, it should not be the case, at least in the long run, that one sector will have a consistently higher profit rate than another, other things equal. For this reason, the argument based on economies of scale and scope is more persuasive with respect to eliminating the restrictions.

9. Some argue, moreover, that bank ownership of nonfinancial firms may improve corporate governance.

10. From an empirical analysis, Puri (1996) concludes that universal banks are better than investment banks at underwriting securities.

with the results of other recent work on banking crises, in deciding upon the most appropriate way in which to reform bank regulation. More specifically, this and other recent research suggests that several initial steps could be taken to reduce significantly the likelihood of banking crises. Countries could, among other things, develop and improve legal systems and information disclosure (see Demirgüç-Kunt and Detragiache, 1997, 1998); impose rate ceilings on bank deposits (Hellmann, Murdoch, and Stiglitz, 1998); establish limits either on the rate at which banks can expand credit or on the rate of increase in their exposure to certain sectors, such as real estate (see Caprio, Atiyas, and Hanson, 1994, and Barth and others, 1998); require greater diversification of bank portfolios (see Caprio and Wilson, 1997); and, on the basis of the results reported in this paper, reduce the restrictions on the range of activities in which banks can engage. Determining which combinations of these recommendations are most appropriate for individual countries at different stages of development should be the subject of future empirical research.

The remainder of the paper proceeds as follows. Section 1 reviews some of the recent literature on the relationship between bank regulation and supervision and banking sector performance, and the reasons why this relationship is the subject of considerable and sometimes heated debate.[11] Section 2 essentially provides a progress report on the linkages that have been found between bank regulatory restrictiveness (or, more accurately, the degree to which there are limits on bank-allowable activities) and bank performance. Section 3 summarizes some issues to be addressed in future research.

1. Regulation and Performance: Some Issues

All the attention currently being given to the role of government in the financial sector—its participation as owner of financial intermediaries, its intervention in pricing and allocating credit, and its role in regulating and supervising financial intermediaries—is not surprising in view of recent events around the world. Yet for decades the size, composition, and functioning of the financial system were

11. In March 1997, for instance, U.S. House Banking Committee Chairman James Leach said that "Mixing commerce and banking simply doesn't fit our kind of democracy." See Barth, Brumbaugh, and Yago (1997, p. 47).

generally considered to be unimportant for economic development and growth, and therefore usually omitted from standard macroeconomic models and development texts.[12] This neglect of the financial system enabled governments more easily to use it for their own, sometimes relatively narrow, purposes. In many developing countries, for example, collecting taxes, issuing government debt at low cost, and allocating subsidized credit to accomplish various government goals were the primary tasks assigned to the financial system. The resulting, severe financial repression in countries that operated their financial systems in this way was a widely recognized sign of failure. The response was greater financial liberalization, beginning in the industrial countries and in a few developing countries in the 1970s (although in the former group the degree of financial repression had been negligible) and spreading more broadly in the 1980s and 1990s.

The trend toward more liberalized financial systems, however, has not been the only development. More than 130 countries have suffered from very costly episodes of banking problems in the past two decades, culminating in the financial crisis in East Asia in 1997-98. Indeed, the costs of resolving bank failures have amounted to 10, 20, and even 30 percent of GDP in various countries in recent years.[13] Current attention is focused mainly on Japan, where the nonperforming loans of banks in 1998 were estimated to be as high as $1 trillion, with associated losses amounting to 40 to 50 percent of this figure, according to some press reports.

Given these recent and disturbing developments, it is quite understandable that the government's role with respect to the financial system is receiving unprecedented attention throughout the world. It has long been established that every government will be significantly involved in the money supply process and, in particular, in assigning lender-of-last-resort responsibilities to a central bank.[14] The involvement of governments in the financial system in nearly all countries has expanded beyond these areas, however. Most recently, for example, governments in many countries have been establishing explicit deposit insurance schemes. Overwhelmingly, governments

12. Importantly for the focus of this paper, Freixas and Rochet (1998), state "that a microeconomic theory of banks could not exist before the foundations of the economics of information were laid [in the early 1970s]."

13. See Caprio and Klingebiel (1997, p. 80, and 1996, p. 15) and García, Lindgren, and Saal (1996, p. 30).

14. In this regard, see the discussion of free banking in Freixas and Rochet (1998, pp. 260-65).

have centered on the banking sector for substantial involvement.[15] But nonbanking financial institutions have also received growing attention since the adoption of auditing and disclosure standards by British authorities over 100 years ago and the subsequent growth in securities market activity.

Bank regulation used to be relatively straightforward: authorities simply decided whether or not to grant charters, to limit geographical expansion, to prescribe some activities (such as the holding of government securities), and to proscribe others (such as fraud). Apart from these kinds of regulations, banks were largely self-regulating. But even these relatively few regulations were not always entirely benign. In the United States, for example, banking failures were more widespread in the nineteenth century than in other countries, mainly because of limits on intrastate and interstate branching.[16] These limits on geographical expansion led to more bank failures than would otherwise have occurred. In effect, this adverse outcome was due to faulty regulation, namely, the restriction on the ability of banks to diversify their loan portfolios geographically.[17]

Bank failures occurred elsewhere, of course, but in those countries in which banks were allowed to branch and belonged to clearinghouses, there was better diversification and greater cooperation in protecting banks against loan losses. This combination provided more appropriate incentives for bankers, and in some cases for private bank supervision (with financial incentives for supervisors), which helped keep failure rates low even during recessions. Moreover, bank failure rates in these types of countries (as in Canada, which allows nationwide branching) were significantly lower than in those with the most restrictive policies on branching.[18] As Benston and others (1986) point out, moreover, the bank failure rate in the

15. There is disagreement, however, as to whether the central bank, a separate agency, or some combination thereof should regulate and supervise banks.

16. Some states even limited banks to a single office and were known as unit banking states.

17. A Dutch banker's maxim from earlier times was the "watchtower" theory: bankers should lend only as far as they could see from the top of the watchtower in the center of town. The reason is that such loans would be subject to risks that the banker understood. However, the benefits of geographical diversification of lending ultimately proved to outweigh this consideration, as the failure of unit banks seems to indicate. Similarly, a major factor in the U.S. savings and loan debacle was poor regulation in the form of the restriction that institutions fund their long-term, fixed-rate home mortgage loans with shorter-term deposits. Furthermore, restrictions prevented them from hedging the resulting interest rate risk.

18. See Calomiris (1992), Gorton and Mullineaux (1987), and Bordo (1997).

United States during 1875-1919 was lower than the failure rate for nonfinancial firms.

Yet regardless of the fundamental causes of bank failures, it is unlikely that the view that banking should be largely self-regulated was any more popular in the early 1870s—when what used to be called the Great Depression began with a financial crisis reminiscent of the East Asian financial crisis in 1997 (see DeLong, 1998)—than in the 1930s, when the entire U.S. banking system collapsed. Indeed, few governments are willing to let the banking system suffer a systemic run, or even to allow any of the largest banks to close. The latter situation gives rise to the "too-big-to-fail" problem.[19] When a country's banking system suffers a systemic run, or when insolvent banks are allowed to remain open without any overt run, the adverse impact on the economy is substantial. In the case of widespread bank insolvency, even without a run, the credit system typically grinds to a halt, and unprofitable firms are usually able to roll over their loans. The result is a lack of funds for worthwhile investment projects and an inefficient allocation of capital. In the case of widespread bank runs, both the payments system and the credit system collapse, with the economy turning to barter and standards of living plummeting further.[20] Residents of East Asia, including Japan, discovered the direct and dire consequences of a malfunctioning credit system.

Even proponents of laissez-faire admit that, if they themselves held policymaking positions during a crisis affecting large banks, they most likely would ignore their own advice that no bank is too big to fail. This situation suggests that perhaps one should consider a framework for financial regulation in which one set of rules would operate during normal times, and which would be designed to minimize the likelihood of a financial crisis, and another set of rules would operate when a crisis emerges. Except at the level of generalities (such as Bagehot's rule to discount freely and at a penalty rate), the set of rules governing a crisis would unlikely be specific, so that its effect both on financial sector development and on the occurrence of a financial crisis is problematic.

19. See Baer and Klingebiel (1995) for a discussion of and evidence on the favorable outcomes that result when depositors are allowed to incur losses from bank failures.

20. The payments system may not collapse with insolvent banks remaining open but not experiencing runs. If interbank exposures are covered by implicit or explicit deposit insurance, the payments system will likely continue to function. When interbank exposures are not covered, solvent banks will curtail and avoid exposure to insolvent banks, thereby impeding the efficient operation of the payments system.

The design of an appropriate regulatory environment during normal times, however, is more tractable. Nevertheless, the issue is certainly not simple. The existence of information asymmetries, coupled with intertemporal transactions, introduces complexities into a financial system. Indeed, without problems of incomplete and imperfect information, a financial system would be easy to regulate because it would be quite trivial. But this is not the case. Banks are therefore quite difficult to regulate: information problems affect all participants, whether they be creditors, shareholders, senior bank managers, or even regulators.

A consensus does appear to be emerging that, because of the inherent difficulty of monitoring financial intermediaries, the regulatory environment needs to change in such a way that there will be several "watchful eyes," that is, participants in the financial marketplace with information about banks available to them and the incentives to act on it. Some countries have already found merit in this approach and operationalized it. Argentina, for example, has increased capital requirements and set a minimum that is tied to indicators of credit and market risk; required banks to issue subordinated debt; strengthened accounting and disclosure requirements; mandated external bank audits; and, more generally, improved supervision. Collectively, these reforms in bank regulation mean that owners, creditors, and supervisors are more likely to monitor banks effectively.

Although the general direction in which many countries need to move with respect to banking reforms is clear, the appropriate mix of all the different components of regulation and supervision is only now becoming a subject of research. For a relatively few countries, some attempts have been made to provide a comparative ranking of selected features of bank regulation.[21] There is some indication, although necessarily significantly qualified because of limited data availability, that a tighter regulatory environment (that is, one with tougher capital and liquidity standards, stricter definitions of capital and nonperforming loans, more widespread mandatory provisioning once a loan is nonperforming, a greater presence of foreign banks, and a more transparent and better operating environment) will help banking systems survive crises.

Another important aspect of regulation that has received even less attention recently, and which the next section attempts to address, is the allowable activities of banks. For example, do banks that

21. See, for example, Caprio (1998b) and JP Morgan (1997).

are allowed to engage in financial activities beyond less traditional commercial banking activities—such as securities underwriting and dealing, insurance underwriting and brokerage, real estate investment and development, and ownership and control of nonfinancial firms—intermediate more efficiently, and are they less prone to crisis? The answer is not clear. Proponents of the separation of commercial and investment banking in the United States during the 1930s argued that there are inherent conflicts of interest between the two businesses, notwithstanding the fact that anything other than arm's-length transactions would be bad for business over the long term. Kroszner and Rajan (1994), however, find no empirical evidence to support the view that problems arise from the potential conflict of interest.

Furthermore, White (1986), among others, maintains that universal banks may be better diversified and hence more stable. Yet some bank supervisors argue that combining traditional and nontraditional activities makes banks harder for the regulatory authorities to supervise. In addition, Rajan (1998) suggests that allowing banks to engage in a wide range of activities increases the difficulty of monitoring by market participants. The implication of this view is that harder-to-monitor banks are more likely to pose problems. Indeed, Rajan more generally urges emerging market countries that are considering allowing universal banking to proceed cautiously, while also indicating the need for further empirical research in this area. This paper attempts to begin this research effort by investigating the impact of selected bank regulatory restrictions on various measures of performance. We defer to future research an assessment of the linkages between the broader regulatory environment and the financial sector and, more generally, economic outcomes.

2. Regulatory Restrictions, Governmental Bureaucracy, and Banking Sector Performance

This section empirically examines the interrelationships among regulatory restrictions on the activities of banks, the ability of governments and bureaucratic systems to operate effectively, the level of development and efficiency of the banking sector, and the fragility of the banking system. This examination is based upon newly assembled data for a cross section of forty-five countries. The following three questions are addressed:

• Do countries with relatively weak governmental or bureaucratic systems (measured in terms of corruption, bureaucratic red tape, and the degree to which a country holds to the rule of law) impose harsher regulatory restrictions on the activities of banks (measured in terms of allowable securities activities, insurance activities, real estate activities, and ownership of nonfinancial firms)?

• Do countries with relatively restrictive regulatory systems have poorer functioning banking systems, as measured by deposit money bank credit to the private sector relative to GDP, bank overhead expenditure relative to total assets, and net interest income relative to total assets?

• Do countries with relatively restrictive regulatory systems have lower probabilities of suffering a banking crisis (defined as a situation where the estimated losses from bank failures exceed 5 percent of GDP)?

Cross-country evaluations of national regulatory regimes form the basis for answering all three questions. The first subsection describes our assessment of the restrictiveness of national regulatory systems. The second subsection discusses measures of the strength of governmental and bureaucratic systems. The subsequent subsections report the evidence pertaining to each of the above three questions.

2.1 Regulatory Restrictions on Bank Activities

We constructed quantitative data on the allowable nontraditional activities of banks using information from Barth, Nolle, and Rice (1997), Kyei (1995), Akamatsu (1995), the Institute of International Bankers *Global Surveys* (various years), the *Euromoney Banking Yearbook* for 1995, and various central bank and government sources. These data form the basis for our assessment of the restrictiveness of national regulatory systems.

The empirical analysis is based upon the degree to which a country's regulatory system allows banks to engage in the following four nontraditional activities:

• SECURITIES: the ability of banks to engage in the businesses of securities underwriting, brokering, dealing, and all aspects of the mutual fund business.

• INSURANCE: the ability of banks to engage in insurance underwriting and selling

• REAL ESTATE: the ability of banks to engage in real estate investment, development, and management, and

• NONFINANCIAL FIRM OWNERSHIP: the ability of banks to own and control nonfinancial firms.

On the basis of an analysis of available documents, each country's regulations concerning these nontraditional activities have been assessed. These assessments are used to assign a number between 1 and 4 to each of the four activities that indicates the degree of regulatory restrictiveness for that activity in each country. The assigned numbers are interpreted as follows:

1 = *unrestricted*: banks may engage in the full range of the activity directly within the bank
2 = *permitted*: the full range of activities may be conducted, but all or some of the activity must be conducted in subsidiaries
3 = *restricted*: banks may engage in less than the full range of the activity, either in the bank or in subsidiaries, and
4 = *prohibited*: the activity may not be conducted by the bank or by subsidiaries.

The numerical scores assigned to each of the four activities for the countries in our sample are summarized in appendix table A1. A summary index was also computed for the country's overall regulatory restrictiveness toward all four activities. The index, RESTRICT, equals the average of each country's scores for SECURITIES, INSURANCE, REAL ESTATE, and NONFINANCIAL FIRM OWNERSHIP and can therefore take on values between 1 (least restrictive) and 4 (most restrictive). The average value of RESTRICT is 2.2, with a standard deviation of 0.6. Five countries have very restrictive regulatory systems (RESTRICT > 3): Chile, Ecuador, Indonesia, Japan, and Peru. Six countries have very permissive systems (RESTRICT < 1.5): Austria, Israel, Malaysia, Sri Lanka, Switzerland, and the United Kingdom. The United States has a value of 3.

These data on regulatory restrictiveness clearly involve some degree of subjectivity. As more detailed and comprehensive information becomes available, we will therefore update the data and the results that follow. Nonetheless, the currently available data and the

approach taken provide new and useful—although certainly not unassailable—information regarding the interrelationships among regulatory regimes, governmental and bureaucratic systems, banking sector development, and especially banking sector fragility.

2.2 Governmental and Bureaucratic Systems

Information about the effectiveness of governmental and bureaucratic systems is used for two reasons. First, the paper seeks to assess the relationship between the quality of the governmental bureaucracy and the restrictiveness of the regulatory regime. To perform such an assessment, one needs quantitative measures regarding the manner in which the government operates. Second, the paper seeks to assess the relationship between the restrictiveness of the regulatory regime and both banking sector development and the fragility of the banking system. To make this assessment, one needs to control for other factors. Specifically, one needs to control for the overall effectiveness of the governmental and bureaucratic system, to determine the extent to which there is an independent link between a country's regulatory restrictiveness, on one hand, and its banking sector development and the fragility of its banking system, on the other. For these reasons measures of the way in which a governmental and bureaucratic system functions are used in conducting our analyses.

Numerous measures of the functioning of the government were considered, but the focus is on the following three:

- REDTAPE, which represents an assessment of the degree to which the governmental bureaucracy is an obstacle to business. Higher values of REDTAPE represent *less* red tape and a *more* smoothly functioning bureaucracy.[22] REDTAPE takes on values between 1 and 10.
- CORRUPT, which represents an assessment of corruption in government. Higher values of CORRUPT indicate that high government officials are *less* likely to demand special payments for performing various services and signify that illegal payments are generally *less* common throughout government. CORRUPT takes on values between 1 and 10.

22. Data for REDTAPE are obtained from the Business International Corporation and cover the early 1980s. For more information see Mauro (1995).

• RULELAW, which represents an assessment of the law and order tradition in the country as determined by the *International Country Risk Guide*. Higher values of RULELAW indicate that a country adheres to the rule of law to a greater degree than countries with lower values. RULELAW takes on values between 1 and 10.[23]

In addition, we consider GOVERNMENT, which is a composite index of the quality of the governmental and bureaucratic system and equals the average value of REDTAPE, CORRUPT, and RULELAW. This means that higher values of GOVERNMENT indicate better-functioning governments. The average value of GOVERNMENT for the countries in our sample is 7.0, with a standard deviation of 2.3. Three countries have values of 10 for GOVERNMENT: the Netherlands, New Zealand, and Switzerland. The United States has a value of 9.3, and Chile has a value of 7.2. Six countries have values below 4, indicating very poor governmental and bureaucratic systems: Colombia, Egypt, Indonesia, Nigeria, Pakistan, and the Philippines. Other measures of the governmental and bureaucratic system were considered, including assessments of the risk of government repudiation of contracts, assessments of the risk of government expropriation of private property, and assessments of the efficiency of the judiciary system. Incorporating these alternative indicators into the analyses does not change any of the results that follow, however.

2.3 Regulatory Restrictiveness and Quality of the Governmental and Bureaucratic System

This subsection addresses the first question above: Do countries with relatively weak governmental and bureaucratic systems impose harsher regulatory restrictions on the activities of banks?

Table 1 shows that countries with better government systems (higher values of GOVERNMENT) on average have less restrictive regulatory systems (lower values of RESTRICT). The negative relationship between better government and regulatory restrictions is strongest for REAL ESTATE and NONFINANCIAL FIRM

23. Data for CORRUPT and RULELAW cover the period 1982-95 and are taken from LaPorta and others (1998), who obtained the data from the *International Country Risk Guide.*

Table 1. Evidence on the Relationship between Regulatory Restrictiveness and the Quality of Governmental and Bureaucratic Systems[a]

Variable	*RESTRICT*[b]	*SECURITIES*	*INSURANCE*	*REAL ESTATE*	*NONFINANCIAL FIRM OWNERSHIP*
Simple correlations					
Government[c]	–0.436	–0.220	–0.207	–0.364	–0.449
	(0.004)	(0.140)	(0.144)	(0.037)	(0.007)
Regressions					
Constant	3.778	0.977	7.468	3.622	2.323
	(0.006)	(0.579)	(0.000)	(0.052)	(0.322)
ECONOMIC	–0.044	0.215	–0.638	0.047	0.317
DEVELOPMENT	(0.813)	(0.430)	(0.020)	(0.853)	(0.379)
REVOLUTION	–1.009	–0.674	–0.840	–1.376	–1.420
AND COUPS	(0.001)	(0.023)	(0.014)	(0.013)	(0.011)
GOVERNMENT	–0.156	–0.162	0.078	–0.206	–0.370
	(0.008)	(0.083)	(0.323)	(0.008)	(0.007)
Summary statistic					
R^2	0.33	0.12	0.18	0.23	0.29
P value (*F* statistic)	0.00	0.17	0.05	0.01	0.00

Source: Authors' calculations.

a. Numbers in parentheses are p values. Variables not defined below are defined in the text.

b. Average of SECURITIES, INSURANCE, REAL ESTATE, and NONFINANCIAL FIRM OWNERSHIP.

c. Average of REDTAPE, CORRUPT, and RULELAW.

OWNERSHIP.[24] Table 1 also shows that these findings remain unchanged even after controlling both for the level of economic development and for political stability.[25] Thus countries with better-functioning governments—less red tape, less corruption, and a stronger rule of law—on average allow banks the opportunity to provide their customers a wider array of nontraditional services.[26]

These findings suggest that it is possible to substitute among different government mechanisms for overseeing bank behavior. This is consistent with recent work on legal systems. LaPorta and others (1998), for instance, find that countries with legal systems that impede minority shareholders from exerting their rights are more likely to introduce mandatory dividends. Our findings indicate that countries with weak governments—that is, governments

24. We also examined accounting standards. The correlation between accounting standards and regulatory restrictiveness is -0.44, with a p value of 0.005, and the relationship remains significant at the 1 percent level after controlling for GDP per capita and measures of political stability.

25. To measure the level of economic development, the logarithm of real GDP per capita is used. Political instability is a measure of revolutions and coups, obtained from Banks (1994).

26. These results also hold for the individual components of GOVERNMENT.

that are less likely to supervise banks approximately or to create proper incentives for private sector participants to supervise banks—also on average impose harsher restrictions on the activities of banks.[27] Of course, a third factor may be responsible for both effects. Political constraints, for instance, may prevent a government from both improving the operation of the bureaucracy and relaxing regulatory restrictions on the activities of banks.

2.4 Regulatory Restrictiveness and Banking Sector Development and Efficiency

This subsection addresses the second question: Do countries with more restrictive regulatory systems have poorer-functioning banking systems, as measured by deposit money bank credit to the private sector relative to GDP, bank overhead expenditures relative to total assets, and net interest income relative to total assets?

To assess the relationship between regulatory restrictiveness and banking sector development and efficiency, the following commonly employed measures of the latter variables are used:

- PRIVATE CREDIT, which is deposit money bank credit to the private sector relative to GDP
- OVERHEAD, which is bank overhead expenditures relative to total assets, and
- NET INTEREST, which is net interest income relative to total assets.[28]

Levine (1998) and Levine, Loayza, and Beck (2000) find that PRIVATE CREDIT exerts a causal and positive impact on long-run economic growth. Demirgüç-Kunt, Levine, and Min (1998) find that OVERHEAD is also closely associated with more rapid economic growth in a broad cross section of countries. Many researchers, moreover, use various indicators of interest rate margins, such as NET INTEREST, to assess banking sector efficiency.[29]

27. We collected more detailed information on supervisory systems, which is permitting a more precise evaluation of this hypothesis. See Barth, Caprio, and Levine (2001a, b, c).

28. PRIVATE CREDIT is from Levine, Loayza, and Beck (2000). It is an average over the period 1980-95. See also Levine (1998). OVERHEAD and NET INTEREST are from Demirgüç-Kunt, Levine, and Min (1998). The underlying data stem from individual financial statements provided by BankScope and are averaged over the period 1985-95.

29. See, for example, Demirgüç-Kunt and Huizinga (1999).

Table 2. Evidence on the Relationship between Regulatory Restrictiveness and Banking Sector Development[a]

Variable	*PRIVATE CREDIT*	*OVERHEAD*	*NET INTEREST*
Simple correlations			
RESTRICT	–0.37	0.24	0.31
	(0.008)	(0.131)	(0.020)
SECURITIES	–0.21	0.24	0.21
	(0.169)	(0.095)	(0.105)
INSURANCE	–0.10	–0.06	–0.05
	(0.258)	(0.869)	(0.908)
REAL ESTATE	–0.34	0.17	0.32
	(0.012)	(0.153)	(0.009)
NONFINANCIAL FIRM	–0.41	0.33	0.38
OWNERSHIP	(0.017)	(0.038)	(0.006)
Regressions			
Constant	–58.44	–0.84	1.01
	(0.333)	(0.898)	(0.827)
ECONOMIC DEVELOPMENT	15.44	0.16	–0.04
	(0.007)	(0.802)	(0.921)
REVOLUTION AND COUPS	–14.47	2.91	1.62
	(0.195)	(0.180)	(0.172)
RESTRICT	–11.66	1.26	1.22
	(0.196)	(0.106)	(0.023)
Summary statistic			
R^2	0.38	0.13	0.17
P value (F statistic)	0.000	0.152	0.066

Source: Authors' calculations.
a. Numbers in parentheses are p values. Variables are as defined in table 1 and in the text.

Table 2 presents mixed results regarding the relationship between the degree of regulatory restrictiveness and banking sector development and efficiency. Although countries with more restrictive regulations on average have less bank credit, greater overhead expenditures, and greater net interest income, the correlations are not very robust. For instance, even though RESTRICT and PRIVATE CREDIT are significantly negatively correlated, this relationship breaks down when one controls for the level of economic development and political stability. Similarly, of the regulatory restrictiveness indicators, OVERHEAD is significantly correlated only with NONFINANCIAL FIRM OWNERSHIP, but even this relationship becomes insignificant when one controls for the level of economic development and political stability. Greater regulatory restrictiveness does remain positively correlated with NET INTEREST, however, even when one controls for these other factors. Yet this result mainly runs through REAL ESTATE and NONFINANCIAL FIRM

OWNERSHIP. The finding may therefore be simply due to the fact that harsher restrictions on real estate and nonfinancial firm ownership cause total assets of the banking sector to be less than otherwise, thereby increasing NET INTEREST. The relationship may, in other words, have nothing to do with interest rate spreads per se.[30] Thus this preliminary analysis suggests that there is not a reliable and direct link between the degree of regulatory restrictiveness and widely used measures of banking sector development and efficiency. For recent extensions, see Barth, Caprio, and Levine (2001b).

2.5 Regulatory Restrictiveness and Banking Crises

This subsection addresses the third question: Do countries with more restrictive regulatory systems have a lower probability of suffering a banking crisis?

To assess the impact of regulatory restrictiveness on banking sector fragility, two measures of whether a country's banking system has suffered a crisis during the last fifteen years are used. First, a country is considered to have experienced a crisis when the estimated losses to the government due to banking sector problems exceeded 5 percent of GDP. Second, to provide a more general indicator of fragility, a country is considered to have experienced a crisis when the banking system is judged to be insolvent, even if eventual losses are less than 5 percent of GDP. Since both indicators produce similar results, only results based upon the first measure are reported here; that is, a country is considered to have experienced a crisis only when the estimated losses were greater than 5 percent of GDP.

The empirical results indicate a positive relationship between the degree of regulatory restrictiveness—especially restrictions on the securities activities of banks—and banking sector fragility. The relationships between banking crises and both the governmental and bureaucratic system and the regulatory environment are examined using both simple correlations and probit regressions. Table 3 presents the results based on the correlations. A positive link is seen between banking sector crises and the stringency of restrictions on banks' activities in the securities market business. Also, there is a significantly negative correlation between banking sector crises and good governmental and bureaucratic systems.

30. Unfortunately, the BankScope data available to us do not include interest rate spreads, but only interest income and interest expenses.

Table 3. Evidence on the Relationship among Banking Crises, Governmental and Bureaucratic Systems, and Regulatory Restrictiveness[a]

Variable	*GOVERNMENT*	*CRISIS*[b]	*RESTRICT*	*SECURITIES*	*INSURANCE*	*REAL ESTATE*	*NONFINANCIAL FIRM OWNERSHIP*
Correlations							
CRISIS	–0.37	...	0.30	0.39	–0.07	0.30	0.29
	(0.016)	...	(0.047)	(0.009)	(0.872)	(0.065)	(0.089)
Quartile grouping by governmental and bureaucratic system							
Very poor government	...	0.62	2.33	1.82	2.73	2.58	2.18
Poor government	...	0.33	2.12	1.80	2.20	2.80	1.67
Good government	...	0.33	1.89	1.27	2.45	2.09	1.73
Very good government	...	0.17	1.98	1.58	2.17	2.25	1.92
Quartile grouping by regulatory permissiveness							
Very restrictive	5.92	0.63	...	...	...	...	...
Restrictive	5.19	0.56	...	...	...	...	...
Permissive	7.71	0.25	...	...	...	...	...
Very permissive	7.68	0.25	...	...	...	...	...

Source: Authors´ calculations.

a. Numbers in parentheses are p values.

b. Equals 1 when the estimated cost of a banking crisis is greater than 5 percent of GDP, and 0 otherwise. Sample size is eighteen countries.

The empirical results based upon the probit regressions support the contention that countries restricting the securities activities of banks have a significantly higher probability of suffering a banking crisis than do countries that allow banks greater freedom to engage in these activities. Table 4 presents the results based on the probit regressions. The dependent variable is a dummy variable called CRISIS, which equals 1 if a country has suffered a banking crisis and 0 otherwise.

In the probit regressions, a wide array of control variables are included to more accurately assess whether there is an independent link between banking crises and the degree of regulatory restrictiveness on the activities of banks. In particular, we control for the quality of both the governmental and bureaucratic system and accounting standards, since a close connection is observed among poor government systems, poor accounting standards, and harsher regulatory restrictiveness. Importantly, a significant link is found between the harshness of bank securities restrictions and the likelihood of a banking crisis, even after controlling for these institutional

Table 4. Explaining the Likelihood of Banking Crises: Probit Regressions with Bank Securities Restrictions and Bank Composite Regulatory Restrictions[a]

Other explanatory variables	*Coefficient on SECURITIES*	*Coefficient on RESTRICT*
Constant only	0.79 (0.019)	0.88 (0.015)
Constant, GOVERNMENT, ACCOUNT	0.87 (0.024)	0.86 (0.051)
Constant, GOVERNMENT, ACCOUNT, CREDITOR AND SHAREHOLDER RIGHTS	1.05 (0.015)	0.96 (0.043)
Constant, GOVERNMENT, ACCOUNT, CREDITOR AND SHAREHOLDER RIGHTS, PRIVATE CREDIT, INITIAL INCOME, GROWTH	1.02 (0.021)	1.05 (0.041)

Source: Authors' calculations.
a. The dependent variable is CRISIS, which is defined as in table 3. Numbers in parentheses are p values. ACCOUNT is a measure of accounting standards, INITIAL INCOME is based on GDP per capita, and GROWTH is a measure of the recent economic growth rate.

factors. We also control for the degree to which legal codes emphasize the rights of secured creditors and minority shareholders, since the contracting environment may influence the incentives facing bank managers and pressures for regulatory intervention. Even after controlling for these legal characteristics, however, the findings still indicate that greater restrictions on the securities activities of banks produce a significantly higher probability of a banking crisis.

As an additional check on the robustness of this finding, we control for the overall level of economic development and the development of the financial system by including measures of the level of GDP per capita, the recent economic growth rate, and the size of the banking system. After controlling for these economic and financial development indicators, the legal characteristics, and the institutional variables, the results still indicate that countries that restrict the securities activities of banks have a significantly higher probability of suffering a banking crisis than do countries with less restrictive regulatory practices. Furthermore, an attempt was made to control for bank franchise value by including measures of the net interest income of banks (NET INTEREST MARGIN) and the concentration of the banking sector, which equals the percentage of total banking system assets accounted for by the five largest banks. Again, the findings remain unchanged: a positive and statistically significant

relationship exists between the harshness of restrictions on the securities activities of banks and a banking sector crisis.[31]

There may be concerns about endogeneity. Countries with a fragile banking system may adopt restrictive banking sector regulations. Thus the probit results in table 4 may suffer from simultaneity bias. To control for this bias, we use a two-step instrumental variables estimator.[32] We tried a number of different instrumental variables. Here we report the results using the legal origin of each country as an instrumental variable for regulatory restrictiveness. Legal scholars have shown that much of the world can be divided into countries with either an English, French, German, or Scandinavian legal heritage. Since a country's legal heritage was determined far in the past and was frequently driven by colonization and conquest, we can treat legal heritage as exogenous to whether the country has experienced a banking crisis recently. Moreover, the origin of a country's legal system has a profound effect on the specific laws, regulations, and enforcement mechanisms that govern financial sector activities (LaPorta and others, 1998). Thus we use an instrumental variables probit estimator to gauge the causal impact of regulatory restrictiveness on banking sector fragility.

The results in table 5 indicate that simultaneity bias is not driving the positive relationship between restrictions on banks engaging in securities market activities and banking sector fragility. That is, the finding remains that when banks face greater restrictions on their ability to engage in securities market activities, they have a higher probability of suffering a banking crisis. Although the data provide less confident results on bank restrictiveness in general, they are consistent with the view that lowering restrictions on the securities market activities of banks will boost rather than jeopardize banking sector stability.

The relationship between regulatory restrictions on the activities of banks and banking system crises, moreover, is economically quite large. The coefficient estimates suggest that a rise in restrictiveness by 1 index unit (for example, the characterization of

31. We also included a dummy variable indicating whether a country has an explicit deposit insurance scheme, since Demirgüç-Kunt and Detragiache (1997, 1998) find that deposit insurance regimes are positively associated with banking crises. The inclusion of this variable does not change our findings regarding regulatory restrictions on bank securities activities.

32. The instrumental variables estimator is analogous to the two-stage least squares, except that it must be appropriately modified to a limited dependent variable framework. This is described in Maddala (1983).

Table 5. Explaining the Likelihood of Banking Crises: Instrumental Variables Regressions with Bank Securities Restrictions and Bank Composite Regulatory Restrictions[a]

Other explanatory variables	*Coefficient on SECURITIES*	*Coefficient on RESTRICT*
Constant only	0.86 (0.014)	0.52 (0.117)
Constant, GOVERNMENT, ACCOUNT	1.04 (0.010)	0.84 (0.056)
Constant, GOVERNMENT, ACCOUNT, CREDITOR AND SHAREHOLDER RIGHTS	1.24 (0.008)	1.05 (0.035)
Constant, GOVERNMENT, ACCOUNT, CREDITOR AND SHAREHOLDER RIGHTS, PRIVATE CREDIT, INITIAL INCOME, GROWTH	1.24 (0.013)	1.48 (0.027)

Source: Authors' calculations.
a. A variable indicating the origin of the legal system (English, French, German, or Scandinavian) was used as the instrument for the regulatory restrictiveness variables. Other variables in the conditioning information set are treated as exogenous. The dependent variable is CRISIS, which is defined as in table 3. Numbers in parentheses are p values.

regulation on banks' securities activities changes from "permitted" to "restricted") increases the probability of a banking crisis by between 25 and 33 percentage points, depending on the specific control variables included. (This particular evaluation is based upon the mean values of the variables in the regression equation.)[33] Thus, in addition to being statistically significant, the empirical results suggest that restricting the ability of banks to diversify their activities influences their fragility in an economically important manner.

The finding that restrictions on the securities activities of banks on average significantly *increase* the likelihood of banking sector fragility is consistent with evaluations of events during the Great Depression in the United States. White (1983, 1986), for example, shows that banks that were engaged in investment banking activities during the 1930s were better diversified and thus less likely to fail than banks that were not involved in the securities market business.[34]

33. Since the probit technique is a nonlinear estimation procedure, the implied effect of a given change in SECURITIES on the probability of a crisis is nonlinear and depends on the precise characteristics of the individual country involved in the conceptual experiment.

34. Note that in the United States in the period before the enactment of the Glass-Steagall Act, big banks were most likely to be involved in investment banking activities. This confounds some of White's (1983, 1986) analyses. In our study, however, we study the whole regulatory regime, which reduces this complication. Also see Kroszner and Rajan (1994) and Rajan (1998).

Although more research surely is needed, these results suggest that, even after controlling for many relevant features of national economies, allowing banks greater freedom to engage in securities activities reduces the likelihood of banking crises.

3. Directions for Future Research

A more extensive data set, in terms of both the variables included and the range of countries, will enable us to provide better information and thus better advice on appropriate regulatory reforms. For example, our finding that banks with more diversified powers are less likely to suffer a banking crisis may be sensitive to other components of the regulatory environment, which for now are omitted variables in our analysis. It may be that countries that allow broader powers to banks, for example, also have higher capital requirements or better supervision. Or it may be that they are the countries that have more foreign banks, which may well be better at risk management. One should also consider the organizational structure of banks that engage in a wider range of activities. Whether the activities are conducted within the bank itself or through subsidiaries or affiliates may matter. More generally, it seems increasingly clear that the new global and technological environment requires regulation and supervision that focuses on the performance of the financial system as a whole. One should therefore consider the extent to which regulations directed at one specific component of a country's financial system spill over to other components as well as to the financial systems of other countries. In any event, in order to increase the robustness of any policy recommendations, these types of extensions are important and will be the subject of future research. See Barth, Caprio, and Levine (2001a, b, c).

APPENDIX

Table A1. Quantitative Measures of Regulatory Restrictiveness for the Countries in the Sample

Country	*SECURITIES*	*INSURANCE*	*REAL ESTATE*	*NONFINANCIAL FIRM OWNERSHIP*	*RESTRICT*
Argentina	3	2	2	3	2.50
Australia	1	2	3	2	2.00
Austria	1	2	1	1	1.25
Belgium	2	2	3	3	2.50
Brazil	2	2	3	3	2.50
Canada	2	2	2	3	2.25
Chile	2	3	4	4	3.25
Colombia	2	2	2	4	2.50
Denmark	1	2	2	2	1.75
Ecuador	2	4	4	n.a.	3.33
Egypt, Arab Rep.	2	2	3	3	2.50
Finland	1	3	2	1	1.75
France	1	2	2	1	1.50
Germany	1	3	2	1	1.75
Greece	2	3	3	1	2.25
Hong Kong (China)	1	2	2	3	2.00
India	2	4	3	3	3.00
Indonesia	2	4	4	4	3.50
Ireland	1	4	1	1	1.75
Israel	1	1	1	1	1.00
Italy	1	2	3	3	2.25
Japan	3	4	3	3	3.25
Korea, Rep. of	2	2	2	3	2.25
Malaysia	1	1	1	2	1.25
Mexico	2	2	3	4	2.75
Netherlands	1	2	2	1	1.50
New Zealand	2	2	2	1	1.75
Nigeria	1	2	2	2	1.75
Norway	2	2	2	2	2.00
Pakistan	2	4	3	2	2.75
Peru	2	4	3	4	3.25
Philippines	1	2	2	2	1.75
Portugal	1	2	3	2	2.00
Singapore	2	2	2	3	2.25
South Africa	1	2	3	2	2.00
Spain	1	2	3	1	1.75
Sri Lanka			1	1	1.00
Sweden	1	2	3	3	2.25
Switzerland	1	2	1	1	1.25
Thailand	2	2	2	3	2.25
Turkey	1	2	4	3	2.50
United Kingdom	1	2	1	1	1.25
United States	3	3	3	3	3.00
Uruguay	3	2	3	4	3.00
Venezuela	2	2	3	3	2.50

Source: Authors' calculations based on Barth, Nolle, and Rice (1997), Kyei (1995), Akamatsu (1995), Institute of International Bankers *Global Survey* (various years), *Euromoney Banking Yearbook* 1995, and various central bank and government sources.

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Do Depositors Punish Banks for Bad Behavior? Market Discipline, Deposit Insurance, and Banking Crises

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Over the last two decades, both developed and developing countries have endured severe banking crises. The U.S. savings and loans (S&Ls) debacle in the 1980s, the Chilean banking crisis in the 1980s, the Argentine and Mexican crises in the mid-1980s and 1990s, as well as the recent financial turmoil in Asia and Russia are only a few examples. At all times and, particularly, to avoid banking crises, regulators need to find ways to promote prudent behavior by banks. The standard recommendation

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is for countries to tighten supervision and prudential regulation. Alternatively, rather than depending exclusively on regulatory action, banking authorities can also increase their reliance on market discipline to oversee banks.

Market discipline in the banking sector can be described as a situation in which private sector agents (stockholders, depositors, or creditors at large) face costs that increase as banks undertake risks, and take action on the basis of these costs (Berger, 1991). For example, uninsured depositors, who are exposed to bank risk taking, may penalize riskier banks by requiring higher interest rates or by withdrawing their deposits.

Market discipline can be beneficial in several ways. This type of discipline may reduce the moral hazard incentives, which government guarantees create for banks to undertake excessive risks. Also, market discipline may improve the efficiency of banks by pressuring some of the relatively inefficient banks to become more efficient or to exit the industry. Moreover, the social cost of supervising banks may be lowered if regulators cede greater control to market forces that can distinguish between good and bad banks.

The existing literature on market discipline primarily focuses on whether market discipline exists in a particular country during a given period. Most of the papers focus on the U.S. commercial banking industry, supporting the hypothesis that market discipline is at work.[1] Baer and Brewer (1986), Hannan and Hanweck (1988), Ellis and Flannery (1992), and Cook and Spellman (1994), among others, analyze how yields on deposits respond to bank risk taking, as captured by balance sheets and by market measures of risk. Goldberg and Hudgins (1996) and Calomiris and Wilson (1998) examine this question by concentrating on the level or change of deposits. Park (1995) and Park and Peristiani (1998) combine both approaches mentioned above.[2] Calomiris and Mason (1997) study whether bank failures are related to bank risk characteristics. Whereas the literature on market discipline is quite vast for the U.S., there are only a few papers on this subject regarding developing countries. Valdés and Lomakin (1988) examine interest rate changes associated with bank riskiness in Chile in the mid-1980s. Schumacher (1996), D'Amato, Grubisic, and

1. Flannery (1998) provides an excellent survey of this literature.

2. Other studies, like Avery, Belton, and Golberg (1988), Gorton and Santomero (1990), and Flannery and Sorescu (1996), look at the existence of risk premia on subordinated notes and debentures, rather than deposits.

Powell (1997), and Calomiris and Powell (2000) analyze whether market discipline exists in the case of Argentina during the 1990s.

The present paper empirically examines two issues largely unexplored by the literature on market discipline. First, the paper studies the interaction between deposit insurance and market discipline.[3] Second, the paper investigates the impact of banking crises on market discipline. To study these two issues, we focus on the experiences of the Argentine, Chilean, and Mexican banking sectors over the last two decades. The developments in these countries and the unique bank level data we put together enable us to shed new light on the links between market discipline, deposit insurance, and banking crises.

The deposit insurance scheme in place in a country may affect the extent of market discipline. Deposit insurance systems are designed to protect small depositors and to avoid systemic crises. If depositors know that their funds are safe and liquid, they will not have an incentive to withdraw their deposits from their bank when they see other banks fail. Consequently, deposit insurance can lower the probability of systemic bank runs. At the same time, a credible deposit insurance system reduces the incentives of depositors to monitor banks, diminishing the degree of market discipline. However, if the deposit guarantee is not credible or if there are costs associated with the recovery of deposits following a bank failure, insured depositors will be compelled to monitor banks.

Since our data set discriminates between insured and uninsured depositors, we are able to examine the link between market discipline and deposit insurance. In particular, we can test whether both insured and uninsured depositors discipline banks. Furthermore, since in some cases the deposit insurance scheme was introduced or modified during our sample of study, we can examine the extent of market discipline before and after a change in the deposit insurance coverage. Comparing the response of insured and uninsured depositors to changes in bank risk taking is interesting because we are dealing with three countries, each with different deposit insurance schemes.

Banking crises are a unique time to study market discipline. First, during crises, banks tend to be weak and the probability of bank

3. Demirgüç-Kunt and Huizinga (2000) analyze how different design features of deposit insurance schemes affect deposit interest rates and market discipline.

failures rises. Thus, to avoid losing their funds, depositors might increase market discipline during these periods. On the other hand, banking crises tend to be associated with large macroeconomic effects and bank runs (which affect all banks regardless of their fundamentals) and with bank interventions (which, in many cases, temporarily freeze deposits and interest rates). Consequently, during crises, we might observe an increase in the relative importance of the aggregate factors. Second, traumatic episodes may act as wake-up calls for depositors, increasing depositors' awareness of the risk of their deposits. Also, deposit insurance funds might be depleted during a crisis, diminishing the ability of insurance schemes to guarantee deposits.[4] As a consequence, after crises, we might see a rise in market discipline. In this paper, we assess the link between crises and market discipline by studying banking crises in three countries. In particular, we compare the responsiveness of depositors to bank risk taking before, during, and after crises.

The remainder of this paper is organized as follows. Section 1 describes the empirical methodology. Section 2 discusses the data and variables. Section 3 presents the empirical results. Section 4 concludes.

1. Methodology

We estimate two sets of models to study market discipline, one for deposits and one for interest rates. In each model, we test whether bank risk characteristics significantly explain the behavior of deposits and interest rates. We measure the reaction of deposits to bank risk taking with the following reduced-form equation for each country:

$$\Delta Deposits_{i,t} = \mu_i + d_t + \beta' \, Bank\ Fundamentals_{i,t\text{-}1} + \varepsilon_{i,t}, \qquad (1)$$

such that $i = 1,...,N$ and $t = 1,...,T$. N is the number of banks in each country. The panel is unbalanced, so T, the number of observations per bank, varies across institutions.

The left-hand-side variable, $\Delta Deposits_{i,t}$, represents the first difference of the log of time deposits held by bank i at time t.

4. We thank René Stulz for raising this point.

The vector of bank risk characteristics, $Bank\ Fundamentals_{i,t-1}$, is described in the next section. This vector is included with a lag, to account for the fact that balance sheet information is available to the public with a certain delay. The time-specific effect is represented by d_t, included to control for macroeconomic and banking sector developments, common across banks; while μ_i stands for bank-specific or fixed effects.

A common test of market discipline is whether the estimates of β are individually or jointly different from zero. If there is no market discipline, deposit growth should be uncorrelated with bank risk characteristics, and we should fail to reject $\beta = 0$. However, the finding that deposits respond to bank risk is not enough to conclude that market discipline is at work. Depositors can discipline banks by withdrawing their funds or by requiring higher interest rates on their deposits. If market discipline is present, we should observe that risky banks are forced to pay high interest rates or, at least, that those risky banks do not pay lower interest rates (when, at the same time, they face deposit withdrawals).

Even though most of the literature studies market discipline by analyzing either deposits or interest rates, an examination of both variables provides a more complete test of market discipline. The analysis of interest rates can help distinguish between market discipline and other alternative hypotheses, such as regulatory discipline. For example, banks may respond to regulatory pressure to comply with capital standards by reducing their assets, and consequently their liabilities. Thus, risky banks might lower their interest rate to decrease deposits. As a result, under regulatory discipline, interest rates should be negatively correlated with bank risk. On the other hand, a positive correlation between interest rates and risk is a sign of market discipline.

To analyze whether depositors discipline bank risk taking by requiring higher interest rates, we estimate the following equation for each country:

$$Interest\ Rates_{i,t} = \mu_i + d_t + \beta' Bank\ Fundamentals_{i,t-1} + \omega_{i,t}. \qquad (2)$$

The left-hand-side variable, $Interest\ Rates_{i,t}$, is the implicit interest rate paid by bank i on its deposits at time t. We assume that the error terms $\varepsilon_{i,t}$ and $\omega_{i,t}$ are independently distributed with mean zero and variance $\sigma^2_{i,t}$.

We report between and within or pooled estimators of equations (1) and (2). Between estimators are obtained by regressing the mean of deposits of each bank on mean values of the explanatory variables, excluding time effects. Within or fixed-effects estimators highlight the variation of deposits over time, using deviations from each bank's mean. Based on specification tests, we report pooled estimations, which exclude banks' fixed effects, when these effects are jointly insignificant. We only calculate between estimators for the case of Argentina, for which there are a large number of banks.[5] In all the estimations, we conduct and report two additional diagnosis tests. First, we present F tests to evaluate the joint significance of bank fundamentals. Second, we test the joint significance of time effects to determine whether systemic shocks—common across banks—are important in explaining the behavior of deposits and interest rates.

We estimate various versions of equations (1) and (2) for each country. First, we distinguish between insured and uninsured deposits. As discussed before, this distinction is important because, a priori, we expect to find differences in the degree of market discipline across these two types of depositors. Among uninsured deposits, we distinguish between medium-size and large time deposits, to study whether there are different patterns of behavior across deposit size.

Second, using equations (1) and (2), we divide the sample period to test for the presence of market discipline before, during, and after banking crises. As an additional way to evaluate the effects of deposit insurance and banking crises on market discipline, we study the relative importance of bank fundamentals before, during, and after crises, and among insured and uninsured deposits. We calculate the proportion of the variance explained by these variables by estimating equations (1) and (2) with time-specific effects, after removing bank-specific effects. Then, we reestimate these equations, including bank fundamentals. We assign any correlation among the independent variables to the time-specific effects. Namely, to be on the safe side, we potentially bias the results against the bank risk characteristics. For each estimated equation, we report the proportion of the adjusted R^2 captured by bank risk characteristics.

5. Alternative specifications are displayed in the full working paper version of this paper, which can be downloaded from www.worldbank.org/research. The paper displays estimates that use the level of deposits, as other papers have computed. To check whether the results are robust to potential endogeneity, we use generalized method of moments (GMM) estimates, combining variables in levels and first differences. The lessons from the alternative estimates are the same as the ones put forth in this paper.

2. Data and Variables

One important contribution of this paper is the novel data set we put together and analyze. In particular, we work with bank-level data for Argentina, Chile, and Mexico to examine different aspects of market discipline. Some bank-level data have become more easily available in the last few years, and a number of financial services have started to report cross-country data. However, detailed, comprehensive, and reliable panel data sets are still not available. Moreover, existing data do not contain the level of disaggregation necessary to evaluate the behavior of insured and uninsured deposits separately. Also, available data sets do not account for the large number of bank mergers, acquisitions, and privatizations, which took place in the second half of the 1990s. If not handled appropriately, bank panels would distort the evolution of balance sheet information over time.

We collected bank-specific data in close consultation with the financial supervisors and regulators in the countries in our sample. In particular, we put together our data set with the help of the Central Bank of Argentina, the Superintendency of Banking (Argentina), the Central Bank of Chile, the Superintendency of Banking and Financial Institutions (Chile), and the National Banking and Securities Commission (Mexico).[6] These agencies oversee banks in each country. All banks are required to disclose their financial statements to the banking authorities on a regular basis. Bank-specific balance sheet information is collected periodically, but published and available to the public with a lag of around two months. Most bank-specific data are available at a quarterly frequency, although some variables exist on a monthly basis.

For each country, we gathered historical data. We constructed consistent variables over time and built panels for each country. We also controlled for those cases when banks merged, were acquired, or were privatized. Typically, these processes cause a sudden change in the bank accounts. For those cases when a bank merged or was acquired or privatized, we treat the resulting larger bank as a new bank in the sample. For Argentina, the data set covers the period 1993 to 1997. In the case of Chile, we use monthly data for the period

6. We are grateful to Alejandra Anastasi, Tamara Burdisso, Laura D'Amato, Gina Casar, Claudio Chamorro, Leonardo Hernández, Víctor Manuel López, Klaus Schmidt-Hebbel, and Agustín Villar for comments and help in understanding the data.

1981 to 1986, which includes the banking crisis that occurred during the 1980s. For the period 1991 to 1996, we work with quarterly data. Finally, in the case of Mexico, the data are quarterly and cover the sample 1991 to 1996.[7]

Bank-level variables used in this paper include individual bank time deposits, interest rates paid on deposits, and a group of bank risk characteristics. For Argentina and Chile in the 1990s, we have data on time deposits by size. Consequently, we can study the behavior of insured, uninsured, medium-size, and large time deposits. In the case of Argentina, we use data on both peso and U.S. dollar deposits, given that around half of the deposits are in dollars. Also, comparing the behavior of deposits denominated in different currencies is interesting since, in addition to the bank default risk and aggregate factors that affect dollar deposits, peso deposits are also subject to currency risk. For Chile in the 1980s and for Mexico, we only have information on total time deposits. Local currency deposits are expressed in real terms (adjusted by the consumer price index), to control for the potential growth in nominal figures that can be due to inflation. With respect to the interest rates paid on deposits, we use an implicit measure, since marginal rates are not available. This implicit rate is calculated by dividing total interest rate expenses by total interest-bearing deposits. Contrary to the data on deposit flows, we have no information on interest rate expenses by amount of deposits. Therefore, we can only examine the behavior of the interest paid on all deposits.

The measures of risk we calculate are akin to those used in the CAMEL rating system of banks. (CAMEL stands for capital adequacy, asset quality, management, earnings, and liquidity.) Deteriorating CAMEL indicators would signal an increase in the risk profile of banks.

Capital adequacy is measured by the capital-to-assets ratio. We expect the capital adequacy variable to have a positive effect on bank deposits. On the other hand, higher capitalization ratios should, in principle, allow banks to pay lower interest rates on their deposits.

A number of indicators are used as measures of asset quality. A clear signal of asset quality is the ratio of nonperforming to total loans. This ratio measures the percentage of loans a bank might have to write off as losses. We expect this variable to have a negative impact on deposits and a positive effect on interest rates.

7. In March 1997, the accounting system changed, making it difficult to consolidate data from before and after that date.

The concentration of loan portfolios also captures the quality of the assets held by banks. In general, a large exposure to a vulnerable sector, like real estate, raises bank risk. On the other hand, because most real estate loans are mortgage loans (that is, loans for which the assets in question serve as collateral), it is possible that these loans can be considered relatively safe. Thus, it is unclear a priori what impact the proportion of real estate loans should have on deposits and interest rates. We face a similar uncertainty when analyzing personal or consumption loans, which are typically granted without collateral. However, personal loans may be easier to recall than other loans (like mortgage loans), given that they are usually smaller and have a shorter maturity. Consequently, one can expect a rise in this type of lending to indicate either an increase or a decrease in the risk exposure of banks.

We measure bank profitability by the return-on-assets ratio. Assuming we are adequately controlling for risk, we expect this variable to have a positive effect on deposits. On the other hand, we expect higher profitability to enable banks to offer lower interest rates.

The efficiency of banks is measured by the ratio of noninterest expenditures to total assets. Less efficient banks are expected to have higher expenditures. However, it is also the case that banks that offer better services to customers might have higher expenditures to total assets. If we could control for the quality of service, we would expect an increase in noninterest expenditures to have a negative effect on deposits and a positive impact on interest rates. In our case, given that we cannot control for the quality of bank services, the effect of this variable is indeterminate.

The cash-to-assets ratio is included as an indicator of banks' liquidity and risk. In general, banks with a large volume of liquid assets are perceived to be safer, since these assets would allow a bank to meet unexpected withdrawals. In this sense, controlling for other factors, we expect more liquid banks to suffer fewer deposit withdrawals and to be able to pay lower interest rates. To the extent that the ratios of bonds to assets and of (financial) investments to assets can be considered as measures of liquidity, we would expect them to have a positive effect on bank deposits and a negative impact on interest rates. However, the recent history in emerging markets shows that bonds can sometimes become illiquid, while their prices suffer large fluctuations. Thus, a priori, it is difficult to predict the effect of this variable.

3. Results

We report the results under three headings. First, to assess the impact of deposit insurance and banking crises on market discipline, we examine whether deposits and interest rates are indeed affected by bank risk characteristics. Second, we study the link between market discipline and deposit insurance. To do so, we compare the extent of market discipline among insured and uninsured deposits, and among deposits in periods with and without deposit insurance. Finally, we evaluate the relation between market discipline and banking crises. In particular, we contrast the response of deposits and interest rates before, during, and after episodes of stress in the banking sector. To minimize the number of tables and to avoid referring to different specifications throughout the paper, we work with a particular partition of the data that enables us to jointly shed light on the three questions of interest. Thus, the next three sections refer to the same tables, although particular specifications may sometimes provide more detail than needed.

3.1 Responsiveness of Deposits and Interest Rates to Bank Risk Taking

This section evaluates whether there is evidence of market discipline, that is, whether depositors respond to bank risk taking by with drawing their deposits and/or by requiring higher interest rates on deposits. Here we do not focus our analysis on particular specifications, but we do so in the following sections. The estimations of equations (1) and (2) are displayed in tables 1 to 5. Fixed effects and time effects are not reported to save space.

Tables 1 to 3 present the results for Argentina. These tables show estimations for peso and dollar deposits and for interest rates over the following periods: June 1993 to September 1994, June 1993 to March 1995, and June 1995 to March 1997. Our data set begins in June 1993, when bank-level data were made available systematically to the public on a quarterly basis. The Mexican crisis, which triggered a banking crisis in Argentina, started in December 1994. Therefore, our first estimation covers the precrisis period, June 1993 to September 1994. Our second estimation, for the period June 1993 to March 1995, includes the so-called tequila crisis. For the period starting in June 1995, our data set enables us to analyze the behavior of time deposits by size. We conduct separate estimations for

insured (those below 10,000 pesos or dollars) and uninsured deposits (those above 20,000 pesos or dollars). To analyze the degree of market discipline exercised by medium-size and large depositors, we distinguish between deposits in the 20,000-100,000 peso or dollar range and those larger than 100,000 pesos or dollars.

The results in tables 1 and 2 support the finding that deposits respond to bank risk taking. In particular, the ratio of nonperforming loans has a significant negative effect on both peso and dollar deposits. Also, in several specifications, we find that a rise in the capital-to-assets ratio fosters deposit growth. An increase in the expenditures-to-assets ratio is associated with a fall in deposits. Meanwhile, profitable banks attract more deposits. Medium-size dollar deposits increase as banks' cash-to-assets ratio rises. The ratio of real estate loans to total loans has a positive effect during the crisis period.

Table 3 presents between and within estimates of the interest rate paid by Argentine banks on deposits. We find that across sample periods there is evidence of market discipline. As expected, the significant coefficients take the opposite sign to the ones in the regressions using deposits. We find that banks with higher capital-to-assets and cash-to-assets ratios pay lower interest rates. Also, banks with a larger share of nonperforming loans pay higher interest rates. Finally, tables 1 to 3 show that bank risk characteristics are jointly significant, even after controlling for fixed effects and time effects.

The results for Chile, including those for deposits during the 1980s, for peso (or UF) time deposits during the 1990s, and for interest rates, are displayed in table 4.[8] There is no information on deposits by size in the 1980s and for interest rates. Since Chile suffered a banking crisis in the 1980s, we divide the sample into three periods, to capture the different phases of the crisis.

For the period 1991 to 1996, we estimate a number of specifications. Given that we have information on the size of deposits, we present estimates for small, medium-size, and large time deposits. Small or insured deposits are those smaller than 120 UFs. Medium-size deposits are defined as those between 120 and 1,500 UFs. Large deposits are those above 1,500 UFs. We also estimate an equation for uninsured deposits, namely, all deposits above 120 UFs.[9]

8. UFs are *unidades de fomento* or units of account, equal to around 4,000 dollars in 1997.

9. Dollar deposits in Chile account for only a small fraction of total deposits in Chile (around 2 to 3 percent), so those results are only reported in the working paper version of this paper.

Table 1. Argentina: Response of Growth of Peso Deposits to Bank Risk Characteristics[a]

	June 1993-September 1994 Precrisis period		*June 1993-March 1995 Crisis period*		*June 1995-March 1997 Postcrisis period*							
					<$10,000 Insured deposits		*>$20,000 Uninsured deposits*		*>$20,000 and <$100,000 Medium-size deposits*		*>$100,000 Large deposits*	
Explanatory variable	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*
Lag(capital/assets)	–0.067	–0.018	0.218*	0.243	–0.284	2.749**	–0.410	6.376***	–0.261	3.216***	–0.411	5.348**
	(–0.470)	(–0.098)	(1.679)	(1.493)	(–1.060)	(2.384)	(–1.325)	(4.061)	(–0.943)	(2.714)	(–0.892)	(2.378)
Lag(nonperforming loans/total loans)	–0.101	–0.131	0.104	0.115	0.070	–0.642**	–0.039	–0.502	0.208	–0.721	–0.084	–3.521**
	(–1.188)	(–1.212)	(1.295)	(1.263)	(0.429)	(–2.003)	(–0.217)	(–0.807)	(1.353)	(–1.413)	(–0.251)	(–2.212)
Lag(real estate loans/total loans)	–0.005	0.006	0.272***	0.236*	0.062	–0.614	–0.280	–0.101	0.023	–0.287	–0.262	–0.455
	(–0.043)	(0.034)	(2.685)	(1.885)	(0.362)	(–1.370)	(–1.555)	(–0.150)	(0.148)	(–0.580)	(–0.941)	(–0.699)
Lag(personal loans/total loans)	0.044	0.013	0.043	0.039	0.098	–0.328	–0.036	–0.781*	–0.024	–0.265	0.092	–0.800
	(0.734)	(0.174)	(0.796)	(0.717)	(0.782)	(–0.948)	(–0.277)	(–1.826)	(–0.211)	(–0.595)	(0.484)	(–0.921)
Lag(return/assets)	1.839**	0.404	1.154	0.584	6.100**	6.160	17.799***	7.944	9.228***	4.623	15.005**	–7.268
	(2.179)	(0.838)	(1.419)	(1.419)	(2.082)	(1.374)	(5.104)	(1.457)	(3.149)	(1.127)	(2.35)	(–1.585)
Lag(cash/assets)	–0.259	–0.251	0.165	0.078	0.612	0.473	–0.440	0.201	0.357	0.711	0.196	–1.230
	(–1.413)	(–1.114)	(0.910)	(0.451)	(0.989)	(0.700)	(–0.587)	(0.228)	(0.523)	(1.032)	(0.212)	(–1.055)
Lag(bonds/assets)	0.581*	–0.161	0.419	0.479*	–0.020	0.189	0.109	0.538	–0.128	–0.425	–0.070	2.338**
	(1.959)	(–0.493)	(1.467)	(1.610)	(–0.042)	(0.38)	(0.228)	(0.786)	(–0.301)	(–0.842)	(–0.100)	(2.410)
Lag(expenditure/assets)	0.032	–0.715	–0.852	–0.249	–4.628	–7.287*	–1.266	–6.720*	–1.575	–6.934*	–2.528	–3.560
	(0.031)	(–0.576)	(–0.857)	(–0.253)	(–1.511)	(–1.952)	(–0.378)	(–1.788)	(–0.551)	(–1.702)	(–0.477)	(–0.305)

Table 1. (continued)

	June 1993-September 1994 Precrisis period		*June 1993-March 1995 Crisis period*		*June 1995-March 1997 Postcrisis period*							
					<$10,000 Insured deposits		*>$20,000 Uninsured deposits*		*>$20,000 and <$100,000 Medium-size deposits*		*>$100,000 Large deposits*	
	Between estimates	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*
Summary statistic												
Adjusted R^2	0.047	0.009	0.053	0.320	0.054	0.264	0.272	0.262	0.073	0.244	0.166	0.166
F test fixed effects	...	0.467	...	0.618	...	1.771***	...	1.522***	...	1.455**	...	1.441*
F test time effects	...	2.975**	...	66.424***	...	8.248***	...	5.887***	...	12.060***	...	4.562***
F test bank fundamentals	...	0.679	...	1.681*	...	12.000***	...	11.458***	...	8.692***	...	5.777***
No. of banks	...	152	...	155	...	83	...	75	...	82	...	57
No. of observations	152	747	155	1,045	83	462	75	377	82	453	57	293

Source: Authors' calculations.

a. The table reports regression results of the growth of peso deposits on bank risk characteristics. Between and within (fixed effects) or pooled results are reported. When the fixed effects are not jointly significant at 10 percent, pooled ordinary least-squares results are reported. Estimators for time dummies, fixed effects, and the constant term are not reported in the table, even though they are included in the regressions. *T* statistics are in parentheses. Robust standard errors with the White correction for heteroskedasticity are obtained. The sign $ denotes both Argentine pesos and U.S. dollars. *F* tests for fixed effects, time effects, and bank fundamentals (risk characteristics) test the null hypothesis that the corresponding group of variables is equal to zero. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level.

Table 2. Argentina: Response of Growth of Dollar Deposits to Bank Risk Characteristics[a]

	June 1993-September 1994 Precrisis period		*June 1993-March 1995 Crisis period*		*June 1995-March 1997 Postcrisis period*							
					<$10,000 Insured deposits		*>$20,000 Uninsured deposits*		*>$20,000 and <$100,000 Medium-size deposits*		*>$100,000 Large deposits*	
Explanatory variable	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*
Lag(capital/assets)	0.021	0.102	0.046	0.155	–0.287	1.866*	–0.177	1.709	–0.141	2.622***	–0.023	–0.101
	(0.201)	(0.760)	(0.563)	(1.523)	(1.223)	(1.857)	(–0.657)	(1.094)	(0.494)	(2.955)	(–0.072)	(–0.247)
Lag(nonperforming loans/total loans)	–0.197***	–0.232	–0.114**	–0.139*	–0.087	–0.736**	–0.101	–0.465*	–0.020	–0.328	–0.180	–0.319
	(–3.161)	(–1.029)	(–2.238)	(–1.710)	(–0.612)	(–2.191)	(–0.641)	(–1.659)	(–0.127)	(–0.926)	(–0.795)	(–0.870)
Lag(real estate loans/total loans)	0.026	0.034	0.055	0.031	0.034	–0.075	0.059	0.673	0.040	0.124	0.102	0.187
	(0.306)	(0.421)	(0.863)	(0.485)	(0.229)	(–0.224)	(0.374)	(1.155)	(0.248)	(0.378)	(0.537)	(0.931)
Lag(personal loans/ total loans)	0.054	0.033	0.060*	0.052	0.039	0.458	–0.092	–0.801	–0.073	0.099	–0.075	–0.124
	(1.245)	(0.866)	(1.739)	(1.509)	(0.358)	(1.097)	(–0.812)	(–1.101)	(–0.619)	(0.22)	(–0.584)	(–1.021)
Lag(return/assets)	0.105	–0.042	–0.145	–0.528	5.254**	4.894	7.249**	8.333*	6.602**	4.247	2.537	4.094**
	(0.171)	(–0.075)	(–0.283)	(–1.399)	(2.052)	(1.257)	(2.383)	(1.817)	(2.195)	(1.115)	(0.583)	(1.978)
Lag(cash/assets)	–0.036	0.116	0.025	0.164	0.096	0.436	–0.144	–0.749	–0.107	0.987**	–0.320	0.031
	(–0.272)	(0.796)	(0.215)	(1.410)	(0.178)	(0.900)	(–0.220)	(–0.566)	(–0.153)	(2.044)	(–0.506)	(0.054)
Lag(bonds/assets)	–0.349	–0.367	–0.078	0.070	0.269	0.238	0.411	–1.683**	0.444	–0.279	0.127	–0.982*
	(–1.614)	(–0.660)	(–0.435)	(0.411)	(0.645)	(0.682)	(0.981)	(–2.191)	(1.014)	(–0.774)	(0.267)	(–1.890)
Lag(expenditure/ assets)	0.466	0.692	0.216	0.693	–0.231	–7.422*	2.994	–9.270***	2.697	–13.761***	4.219	4.614
	(0.623)	(0.859)	(0.344)	(1.247)	(–0.086)	(–1.785)	(1.025)	(–3.263)	(0.919)	(–3.926)	(1.167)	(1.283)

Table 2. (continued)

	June 1993-September 1994 Precrisis period		*June 1993-March 1995 Crisis period*		*June 1995-March 1997 Postcrisis period*							
					<$10,000 Insured deposits		*>$20,000 Uninsured deposits*		*>$20,000 and <$100,000 Medium-size deposits*		*>$100,000 Large deposits*	
	Between estimates	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*
Summary statistic												
Adjusted R^2	0.079	0.028	0.024	0.289	0.114	0.285	0.040	0.155	0.108	0.317	0.001	0.006
F test time effects	...	0.721	...	0.914	...	2.185***	...	1.358**	...	2.577***	...	0.855
F test time effects	...	2.669**	...	53.561***	...	4.380***	...	1.900*	...	6.045***	...	1.084
F test bank fundamentals	...	2.539***	...	2.899***	...	14.502***	...	9.006***	...	12.623***	...	1.416
No. of banks	...	152	...	155	...	83	...	75	...	82	...	57
No. of observations	152	747	155	1,045	83	462	75	377	82	453	57	293

Source: Authors' calculations.

a. The table reports regression results of the growth of U.S. dollar deposits on bank risk characteristics. Between and within (fixed effects) or pooled results are reported. When the fixed effects are not jointly significant at 10 percent, pooled ordinary least-squares results are reported. Estimators for time dummies, fixed effects, and the constant term are not reported in the table, even though they are included in the regressions. *T* statistics are in parentheses. Robust standard errors with the White correction for heteroskedasticity are obtained. The sign $ denotes both Argentine pesos and U.S. dollars. *F* tests for fixed effects, time effects, and bank fundamentals (risk characteristics) test the null hypothesis that the corresponding group of variables is equal to zero. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level.

Table 3. Argentina: Response of Interest Rates Paid on Deposits to Bank Risk Characteristics [a]

	June 1993-September 1994 Precrisis period		*June 1993-March 1995 Crisis period*		*June 1995-March 1997 Postcrisis period*	
Explanatory variable	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*	*Between estimates*	*Within estimates*
Lag(capital/assets)	–0.008	–0.090***	0.003	–0.048***	0.017	0.019
	(–0.607)	(–3.214)	(0.281)	(–2.575)	(1.093)	(1.344)
Lag(nonperforming loans/total loans)	0.052***	–0.004	0.019***	–0.012*	–0.009	–0.008
	(5.343)	(–0.362)	(2.638)	(–1.659)	(–0.970)	(–1.028)
Lag(real estate loans/ total loans)	–0.001	–0.009	–0.012	–0.007	0.000	–0.017
	(–0.112)	(–0.899)	(–1.572)	(–0.793)	(–0.045)	(–1.268)
Lag(personal loans/ total loans)	0.019**	0.014	0.007	0.005	0.005	–0.043**
	(2.458)	(1.456)	(1.235)	(0.610)	(0.545)	(–2.479)
Lag(return/assets)	–0.020	–0.001	–0.024	0.000	–0.178	–0.002
	(–0.803)	(–0.242)	(–0.897)	(0.114)	(–1.207)	(–0.091)
Lag(cash/assets)	–0.085***	–0.003	–0.110***	–0.009	–0.134***	–0.064***
	(–4.873)	(–0.224)	(–7.673)	(–1.297)	(–3.208)	(–3.735)
Lag(bonds/assets)	–0.002	0.011	–0.033	–0.011	–0.116***	–0.005
	(–0.073)	(1.161)	(–1.550)	(–1.130)	(–3.654)	(–0.560)
Lag(expenditure/assets)	0.007	0.026	0.086	–0.131	–0.117	0.013
	(0.068)	(0.288)	(1.042)	(–1.572)	(–0.745)	(0.153)
Summary statistic						
Adjusted R^2	0.334	0.822	0.368	0.745	0.332	0.728
F test fixed effects	...	16.073***	...	11.857***	...	10.727***
F test time effects	...	9.554***	...	32.310***	...	28.413***
F test bank fundamentals	...	8.190***	...	6.621***	...	6.603***
No. of banks	...	102	...	114	...	79
No. of observations	102	501	114	750	79	570

Source: Authors' calculations.

a. The table reports regression results of the interest rates paid on deposits on bank risk characteristics. Between and within (fixed effects) or pooled results are reported. When the fixed effects are not jointly significant at 10 percent, pooled ordinary least-squares results are reported. Estimators for time dummies, fixed effects, and the constant term are not reported in the table, even though they are included in the regressions. *T* statistics are in parentheses. Robust standard errors with the White correction for heteroskedasticity are obtained. *F* tests for fixed effects, time effects, and bank fundamentals (risk characteristics) test the null hypothesis that the corresponding group of variables is equal to zero. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level.

Overall, we find that deposits respond to bank risk taking in the period following the 1980s banking crisis. We find that a rise in bank capitalization and a rise in the cash-to-assets ratio lead to an increase in the growth rate of deposits. On the other hand, a surge in the ratio of nonperforming loans to assets has a negative impact on deposits. Return over assets has a positive effect on the growth rate of deposits during the 1990s. In the case of interest rates, the results indicate that Chilean depositors require higher interest rates as bank risk taking increases. In particular, as the bank capitalization ratio and the return over assets increase, interest rates drop. These signs, as expected, are opposite to the ones obtained in the regressions in which deposit growth is the dependent variable. The *F* tests show that risk characteristics are jointly significant in most equations for peso deposits and interest rates.

Table 5 displays estimates of the percent change of peso time deposits and interest rates in Mexico. We estimate four sets of regressions. For the period March 1991 through September 1995, we only have information for the twelve most important Mexican banks, which held 80 to 90 percent of total deposits. Approximately eighteen banks were in business at the beginning of the sample period. We study the behavior of deposits during the precrisis period, March 1991 through September 1994. To test for the effect of the Mexican crisis, we expand the sample to include data through September 1995. For the postcrisis period, December 1995 to December 1996, we estimate two sets of regressions. First, we use the twelve banks for which we have data for the whole sample, to compare precrisis, crisis, and postcrisis results. The other set of regressions includes all banks in the sample. The greater number of banks in the postcrisis period is largely the outcome of the deregulation of the Mexican banking sector and the lifting of restrictions on foreign entry after 1995.

The regressions for Mexico provide some evidence that deposits respond to bank risk, particularly in the postcrisis period. During this period, banks with higher returns on assets, higher capital over assets, and a higher proportion of personal loans attract more deposits. Bank risk characteristics are not significant in the precrisis and crisis periods. On the other hand, the evidence suggests that interest rates do respond to bank risk taking throughout the three periods. A higher proportion of nonperforming loans raises the interest rates paid by banks.

A rise in the cash-to-assets ratio and a rise in the capital-to-assets ratio reduce the interest rates charged to banks. Banks that increase

Table 4. Chile: Response of Growth of Peso Deposits and Interest Rates Paid on Deposits to Bank Risk Characteristics[a]

	June 1981-November 1986 Growth of deposits			*February 1991-November 1996 Growth of deposits*				
Explanatory variable	1981-1982 *Crisis period (first phase)*	1983-1984 *Crisis period (second phase)*	1985-1986 *Postcrisis period*	<120UF *Insured deposits*	>120UF *Uninsured deposits*	>120 UF and <1,500UF *Medium-size deposits*	>1,500UF *Large deposits*	*Interest rates*
Lag(capital/assets)	0.199	0.117	0.272*	–0.011	–0.070	–0.178	–0.123	–0.047*
	(1.004)	(0.868)	(1.796)	(–0.059)	(–0.450)	(–1.350)	(–0.590)	(–1.953)
Lag(nonperforming loans/total loans)	–0.004	–0.039	–0.647***	–1.375***	–0.572	–0.206	–0.802	0.037
	(–0.060)	(–0.378)	(–2.583)	(–2.619)	(–0.695)	(–0.513)	(–0.839)	(0.476)
Lag(return/assets)	2.467	0.539	0.149	–0.056	4.920**	3.365*	5.182**	–0.558**
	(1.194)	(0.457)	(0.045)	(–0.034)	(2.175)	(1.797)	(1.947)	(–2.320)
Lag(cash/assets)	–0.439	–0.383	–0.058	–0.091	0.323*	0.190**	0.370*	0.014
	(–1.433)	(–1.556)	(–0.338)	(–0.660)	(1.927)	(2.340)	(1.850)	(1.251)
Lag(investments/assets)	0.093	0.017	0.067	–0.159	–0.121	–0.001	–0.186	0.012
	(0.609)	(0.235)	(0.424)	(–1.566)	(–1.195)	(–0.011)	(–1.381)	(1.296)
Lag(expenditure/assets)	–1.987*	1.400	1.347	0.557	–0.399	–0.345	–0.229	–0.046
	(–1.833)	(1.305)	(1.021)	(1.441)	(–1.061)	(–1.182)	(–0.513)	(–0.725)

Table 4. (continued)

	June 1981-November 1986 Growth of deposits			*February 1991-November 1996 Growth of deposits*				
	1981-1982 *Crisis period (first phase)*	1983-1984 *Crisis period (second phase)*	1985-1986 *Postcrisis period*	<120UF *Insured deposits*	>120UF *Uninsured deposits*	>120 UF and <1,500UF *Medium-size deposits*	>1,500UF *Large deposits*	*Interest rates*
Summary statistic								
Adjusted R^2	0.054	0.049	0.064	0.357	0.023	0.226	0.018	0.625
F test fixed effects	1.310	0.692	1.637**	1.987***	0.659	0.976	0.498	12.643***
F test time effects	1.763**	2.690***	1.419	14.571***	1.513*	7.764***	1.401	21.2344***
F test bank fundamentals	1.667	1.122	4.017***	2.977***	2.883***	2.842***	2.598**	4.264***
No. of banks	21	37	37	34	37	32	37	30
No. of observations	304	808	721	547	619	527	619	506

Source: Authors' calculations.

a. The table reports regression results of the growth of peso deposits and of interest rates on bank risk characteristics. Between and within (fixed effects) or pooled results are reported. When the fixed effects are not jointly significant at 10 percent, pooled ordinary least-squares results are reported. Estimators for time dummies, fixed effects, and the constant term are not reported in the table, even though they are included in the regressions. *T* statistics are in parentheses. Robust standard errors with the White correction for heteroskedasticity are obtained. UF stands for *unidades de fomento*, a Chilean unit of account. *F* tests for fixed effects, time effects, and bank fundamentals (risk characteristics) test the null hypothesis that the corresponding group of variables is equal to zero. The crisis period is divided into two subperiods, which include separately the first and second round of bank interventions. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level.

Table 5. Mexico: Response of Growth of Peso Deposits and Interest Rates Paid on Deposits to Bank Risk Characteristics[a]

	March 1991-September 1994 Precrisis period		*March 1991-September 1995 Crisis period*		*December 1995-December 1996 Postcrisis period*			
	12 banks		*12 banks*		*12 banks*		*All banks*	
Explanatory variable	*Growth of deposits*	*Interest rates*	*Growth of deposits*	*Interest rates*	*Growth of deposits*	*Interest rates*	*Growth of deposits*	*Interest rates*
Lag(capital/assets)	–0.843	0.166	–0.756	0.068	0.015	–0.597***	3.171***	–0.384**
	(–1.351)	(0.762)	(–1.500)	(0.428)	(0.019)	(–3.028)	(3.358)	(–2.270)
Lag(nonperforming loans/total loans)	0.117	0.319*	–0.190	0.257**	–0.229	0.082	0.507	–0.104
	(0.182)	(1.864)	(–0.495)	(1.973)	(–0.367)	(0.508)	(0.351)	(–0.470)
Lag(real estate loans/ total loans)	0.368	–0.156**	0.166	–0.195***	–0.108	–0.242***	0.985	–0.126*
	(1.250)	(–2.404)	(0.941)	(–3.004)	(–0.427)	(–3.870)	(1.465)	(–1.807)
Lag(personal loans/ total loans)	–0.813*	0.083	–0.257	0.014	2.476*	–0.064	0.357	–0.823***
	(–1.687)	(0.542)	(–0.812)	(0.114)	(1.865)	(–0.216)	(0.113)	(–3.739)
Lag(return/assets)	6.892	–0.046	4.088	–1.776**	4.277*	0.265	3.435	0.959
	(1.540)	(–0.032)	(1.274)	(–2.106)	(1.805)	(0.431)	(0.855)	(1.332)
Lag(cash/assets)	0.510	–0.371***	–0.137	–0.187	0.595	–0.193*	–1.799	0.123
	(0.673)	(–3.023)	(–0.249)	(–1.304)	(0.884)	(–1.785)	(–1.331)	(0.628)
Lag(expenditure/assets)	6.145	1.874	6.714*	1.364	–4.917	–0.556	–2.841	3.049**
	(1.393)	(1.313)	(1.891)	(1.442)	(–1.108)	(–0.648)	(–0.314)	(2.065)

Table 5. (continued)

	March 1991-September 1994 Precrisis period		*March 1991-September 1995 Crisis period*		*December 1995-December 1996 Postcrisis period*			
	12 banks		*12 banks*		*12 banks*		*All banks*	
	Growth of deposits	*Interest rates*	*Growth of deposits*	*Interest rates*	*Growth of deposits*	*Interest rates*	*Growth of deposits*	*Interest rates*
Summary statistic								
Adjusted R^2	0.072	0.644	0.073	0.808	0.1994	0.816	0.398	0.176
F test fixed effects	0.705	10.664***	1.319	6.801***	1.301	2.258*	2.096***	8.150***
F test time effects	1.773*	6.619***	1.727**	38.088***	1.872	21.454***	2.867**	1.853
F test bank fundamentals	1.539	4.782***	1.213	3.464***	2.227**	13.302***	4.388***	1.959*
No. of banks	12	10	12	10	12	10	34	31
No. of observations	158	99	195	139	55	44	111	103

Source: Authors' calculations.

a. The table reports regression results of the growth of peso deposits and of interest rates paid on bank risk characteristics. Between and within (fixed effects) or pooled results are reported. When the fixed effects are not jointly significant at 10 percent, pooled ordinary least-squares results are reported. Estimators for time dummies, fixed effects, and the constant term are not reported in the table, even though they are included in the regressions. *T* statistics are in parentheses. Robust standard errors with the White correction for heteroskedasticity are obtained. *F* tests for fixed effects, time effects, and bank fundamentals (risk characteristics) test the null hypothesis that the corresponding group of variables is equal to zero. The last two columns display pooled estimates due to the small number of observations per bank, since many institutions enter the sample during this period. Data for up to twelve banks are available before 1996. For comparison, the same banks are used in one of the estimations for the period December 1995 to December 1996. * = significant at the 10 percent level; ** = significant at the 5 percent level; *** = significant at the 1 percent level.

the return on assets and the proportion of personal loans and real estate loans pay lower interest rates. The *F* tests indicate that bank fundamentals are generally jointly significant.

In the three countries, the *F* tests for bank fundamentals show that bank risk characteristics jointly affect the behavior of deposits and interest rates in most specifications; this is a sign of market discipline. However, the coefficients on various bank risk characteristics are individually not different from zero. This can be due to two factors. Since bank risk characteristics are highly collinear, the individual significance of certain indicators is not captured in the estimations. Alternatively, the results could suggest that depositors only monitor banks by following a few variables. Future research might help to disentangle the relative importance of individual bank risk indicators.

Summarizing, the results discussed in this section indicate that there is evidence of market discipline across the three countries. We find support for the notion that deposit growth falls as bank risk taking increases. Moreover, the evidence suggests that depositors require higher interest rates when banks undertake more risk. The finding that depositors charge higher interest rates to riskier banks suggests that the behavior of deposits is not just the consequence of regulatory pressures on risky banks. We proceed, in the next two sections, to investigate whether the differences across specifications are related to the existence of deposit insurance and to the occurrence of banking crises.

3.2 Market Discipline and Deposit Insurance

Having found evidence of market discipline, we now concentrate on the effects of deposit insurance on market discipline by comparing the behavior of insured and uninsured deposits. To study the relationship between market discipline and deposit insurance, we refer again to tables 1 to 5, but we complement those results by calculating the proportion of the variance explained by bank fundamentals across different periods and types of deposits.

As mentioned before, all three countries in our sample have different insurance schemes, which varied over time. Argentina had no deposit insurance whatsoever before the Mexican crisis of 1994 to 1995. Then, for the estimations using data up to March 1995, we concentrate on total time deposits, which is equivalent to studying the behavior of uninsured deposits. After that, we separate insured

from uninsured deposits. In April 1995, following the tequila crisis, Argentina introduced a partial deposit insurance scheme that covers deposits up to 20,000 dollars or pesos, depending on their maturity.[10] Deposits with a maturity of more than ninety days are protected up to 20,000 dollars or pesos. For deposits with a shorter maturity, the guarantee covers them up to 10,000 pesos or dollars. Since we do not have data on the maturity of deposits, there is no clear way to separate insured from uninsured deposits with full certainty. To reduce the probability of including uninsured deposits in the insured group, we work with a conservative cutoff point of 10,000 pesos or dollars.

In the case of Chile, in the 1980s, a limited insurance scheme was in place; however, most deposits were de facto protected. Thus, the distinction between insured and uninsured deposits in the 1980s is not very clear. Prior to November 1986, Chile had, in principle, a limited deposit insurance scheme. This deposit insurance, first introduced in January 1977 and expanded in December 1981, protected deposits up to 3,500 dollars. However, throughout this period, several banks were taken over and most deposits were de facto fully insured. In 1986, a new banking law redefined the deposit insurance scheme. According to the current legislation, only deposits of up to 120 UFs are covered in the Chilean system.In the 1990s, the clear rule about the insurance coverage permits us to study the behavior of insured and uninsured deposits separately.

During the period under study, Mexico had no formal system of deposit insurance. The Credit Institutions Law of 1990 established FOBAPROA, a trust administered by the central bank, created for preventive support to commercial banks and to protect savings. The law did not obligate FOBAPROA to explicitly guarantee or insure any obligations of commercial banks. Nevertheless, each December, FOBAPROA used to announce the maximum amount of the obligations it intended to protect. In general, FOBAPROA expressed an intention to protect all deposits, even though FOBAPROA was not an explicit deposit insurance scheme and was not liable in the event of an uncovered default. For the period we analyze, FOBAPROA implicitly protected 100 percent of deposits. The data set for Mexico does not provide information regarding the size or the currency denomination of deposits, but the legislation on deposit insurance does not

10. In September 1998, the insurance coverage was extended to deposits up to 30,000 pesos or dollars.

distinguish between small and large deposits. Due to legal restrictions, almost 100 percent of deposits are held in local currency.

The results from table 1 to 5 yield some lessons regarding the effects of deposit insurance on market discipline. Insured and uninsured depositors discipline banks in Argentina and Chile. There are no significant differences in the response of deposits to bank risk characteristics across type of deposits. In the case of Mexico, we find evidence of market discipline, despite the government's promise to protect all deposits. Therefore, the results suggest that the deposit insurance is not fully credible in any of the three countries, since even insured depositors exercise market discipline.

Another way of studying the effect of deposit insurance on market discipline is to consider the results displayed in table 6. The table shows the proportion of the R^2 explained by bank risk characteristics and an adjusted R^2 (in brackets) of the regression, which reflects the proportion of the total variance only explained by the time-varying variables. The variance explained by bank fundamentals, relative to the variance explained by all time-varying dummies, is the product of these two numbers. The results for Argentina indicate that the proportion of the variance of deposits explained by bank fundamentals increases substantially after the deposit insurance system is established. This increase occurs even for insured deposits. The proportion of the variance explained by bank fundamentals in the estimations for insured deposits is at least as large as the one obtained using the equations for uninsured deposits. The evidence for Chile is more mixed. We find that the proportion of the variance explained by bank fundamentals among uninsured deposits is larger than the one explained by these variables in the regression for insured deposits. However, the adjusted R^2 values tend to be lower for uninsured deposits than for insured deposits.

The finding that even insured depositors discipline banks may be due to a number of reasons. Previous confiscation of deposits (as in Argentina during the 1980s) or instances when the government did not keep its promise could be fresh in depositors' minds. Deposit protection can be uncertain when the insurance schemes are underfunded and the fiscal costs of repaying deposits are large. Finally, it is possible that we observe discipline by insured depositors because, even if the insurance is credible, depositors may want to avoid any costs they might face (typically in the form of delays) when banks fail. Repayments through the insurance fund usually take time, imposing

liquidity costs on depositors. Moreover, when a bank fails, there are efforts to sell the failing bank to other institutions, to minimize the cost for the insurance fund. One of the major incentives for a healthy bank to buy a failing bank is to acquire the failed bank's deposits. Therefore, if deposits are returned through the deposit insurance, the value of the failing bank decreases. As a consequence, both insured and uninsured deposits are typically paid once the acquisition process is completed.

3.3 Market Discipline and Banking Crises

As mentioned in the introduction, banking crises are unique episodes to examine market discipline. First, during crises, there are large aggregate shocks to the economy and to the banking sector. Also, bank interventions, typical of crises, temporarily immobilize deposits and interest rates. Second, the risks of bank failures and of losing deposits, temporarily or permanently, become more evident and are magnified during these events. Moreover, the ability of the deposit insurance system to continue guaranteeing deposits can be questioned and jeopardized. We refer once more to tables 1 to 6 to analyze whether the responsiveness of depositors to bank risk taking is affected by banking crises.

The results for Argentina suggest that the extent of market discipline diminishes during the crisis and increases sharply afterward. The within estimates show that bank fundamentals are mostly nonsignificant up to March 1995, but become significant after June 1995, that is, after the tequila crisis. Moreover, table 6 illustrates that the proportion of the variance explained by bank fundamentals increases substantially in the postcrisis period. This occurs for the models estimated with equations (1) and (2), for peso and dollar deposits. During the crisis, the proportion explained by bank fundamentals decreases notably, probably due to large systemic shocks. Time effects become particularly relevant during this period. The estimations regarding the behavior of interest rates do not signal such large differences between the period covering the crisis and the following period.

Table 6 shows that time effects explain a higher proportion of the variance for peso deposits than for dollar deposits.

This result is interesting since peso and dollar deposits are affected by different risks. Both peso and dollar deposits are subject to banks' default risk. However, peso deposits are also affected by currency risk.

Table 6. Percentage of Variance Explained by Bank Risk Characteristics [a]

Argentina

Specification	June 1993-September 1994 Precrisis period	June 1993-March 1995 Crisis period	June 1995-March 1997 Postcrisis period: <$10,000 Insured deposits	>$20,000 Uninsured deposits	>$20,000 and <$100,000 Medium-size deposits	>$100,000 Large deposits
Growth of peso deposits (%)	35 [0.02]	2 [0.33]	63 [0.23]	72 [0.24]	41 [0.25]	58 [0.19]
Growth of dollar deposits (%)	68 [0.05]	9 [0.33]	84 [0.22]	93 [0.16]	74 [0.22]	100 [0.06]
			All deposits			
Interest rates (%)	80 [0.12]	10 [0.38]	10 [0.44]	... ...	... ...	... ...

Chile

Specification	Total deposits: 1981-1982 Crisis period (first phase)	1983-1984 Crisis period (second phase)	1985-1986 Postcrisis period	February 1991-November 1996 Peso deposits (UF): <120 Insured deposits	>120 Uninsured deposits	>120 and <1,500 Medium-size deposits	>1,500 Large deposits
Growth of deposits (%)	24 [0.05]	2 [0.05]	70 [0.04]	3 [0.32]	82 [0.02]	8 [0.23]	100 [0.02]

Mexico

Specification	March 1991-September 1994 Precrisis period	March 1991-September 1995 Crisis period	December 1995-December 1996 Postcrisis period	December 1995-December 1996 Postcrisis period
	12 banks			All banks
Growth of deposits (%)	34 [0.07]	11 [0.07]	69 [0.20]	77 [0.18]
Interest rates (%)	36 [0.27]	5 [0.72]	50 [0.82]	83 [0.08]

Source: Authors' calculations.

a. The figures indicate the percentage of the adjusted R^2 explained by bank risk characteristics, as a proportion of all the time-varying variables. Adjusted R^2s are in brackets. To make the results comparable, we report the figures from the same type of estimates for each country. We choose the most frequently used estimator. For Argentina, the results correspond to the within estimates, whereas for Chile and Mexico the results correspond to the pooled estimates. The breakdown corresponds to the estimations displayed in the previous tables. The sign $ denotes both Argentine pesos and U.S. dollars. UF stands for *unidades de fomento*, a Chilean unit of account. In the case of Chile during the 1980s, the crisis period is divided into two subperiods, which include separately the first and second round of bank interventions. In Mexico, data for up to twelve banks are available before 1996. For comparison, the same banks are used in one of the estimations for the period December 1995 to December 1996.

For a given level of bank fundamentals, aggregate shocks that only increase currency risk should prompt depositors to withdraw their peso deposits, but not their dollar deposits. Thus, changes in currency risk, partially captured by aggregate effects, might explain why time effects are relatively more important among peso deposits than among dollar deposits for all specifications.

For Chile, it is more difficult to compare the crisis and noncrisis periods. The 1980s crisis was less defined in time. However, there were two rounds of bank interventions. In 1981 and 1982, the central bank took over and liquidated a series of financial institutions. By 1983, the crisis had expanded, which prompted the government to take further action. The central bank liquidated a new set of institutions and took over weak banks, including the two largest private banks. These interventions revealed the government's concern with the health of the banking system. The crisis was over in 1985.

The results for Chile suggest that deposits become more responsive to bank fundamentals after bank interventions. No variable is statistically significant in the first two subperiods of the 1980s, while capital over assets and the proportion of nonperforming loans become significant afterward. Other variables are significant in the 1990s. As in the case of Argentina, table 6 shows that the variance explained by bank fundamentals decreases in the midst of the crisis and increases afterward.

The case of Mexico also offers very similar evidence. Bank fundamentals only become significant in the regressions using deposits in the aftermath of the crisis. As in the previous cases, the proportion of the variance explained by bank risk characteristics decreases substantially during the crisis and increases afterward to levels above the precrisis ones. In the case of Mexico, this effect can be observed both in the models using deposits and in the model using interest rates.

In sum, the results suggest two conclusions. First, bank fundamentals explain relatively less before and during crises. In crisis times, systemic effects tend to become more relevant, implying that deposits and interest rates are correlated across banks, regardless of their fundamentals. Second, the extent to which depositors shift their funds in and out of banks becomes more evident following banking crises, when the intensity of aggregate shocks diminishes and bank interventions cease. The evidence for Argentina and Mexico, where the

crisis was clearly defined in time, is very suggestive. The degree of market discipline via deposit withdrawals rises substantially. Following crises, high interest might not fully compensate depositors for the risks they undertake. Depositors realize that their funds can be lost, so the degree to which they discipline banks via deposit withdrawals increases relative to precrisis periods.

4. Conclusions

This paper concentrates on two issues largely unexplored by the existing literature on market discipline. In the first place, we empirically analyze the relationship between market discipline and deposit insurance. Second, we investigate the impact of banking crises on market discipline. The developments in Argentina, Chile, and Mexico, together with the detailed bank-level data set we gathered, provide a unique opportunity to study these issues.

The results presented in this paper show that depositors in Argentina, Chile, and Mexico punish banks for risky behavior, both by withdrawing their deposits and by requiring higher interest rates. The use of deposits and interest rate data enable us to distinguish market discipline from alternative hypotheses, like regulatory discipline. Also, we compare the behavior of large and small deposits. Ex ante, one could argue that large depositors, with significant value at risk, would be the primary monitors of banks. However, deposits tend to represent a larger proportion of a small depositor's wealth, so even this type of depositor might discipline banks. The evidence shows no significant difference across depositors: both large and small depositors discipline banks.

Regarding the relationship between market discipline and deposit insurance, we find that deposit insurance does not necessarily decrease market discipline. We could reject the null hypothesis that insured and uninsured depositors do not respond to bank risk taking. This result suggests that none of the deposit insurance schemes is fully credible. Insured depositors would not need to respond to bank risk taking if they perceived that their deposits were safe and liquid. Nevertheless, depositors are prompted to exercise market discipline when there is uncertainty about the future availability of their deposits, insured or uninsured.

With respect to market discipline and banking crises, the results show that large systemic effects take place during crises, affecting

deposits and interest rates across banks, regardless of bank fundamentals. Also, the relative importance of market discipline rises after banking crises for all types of deposits. Before and during crises, the extent of market discipline tends to be more limited, particularly when compared with aggregate effects. These results suggest that, following bank interventions and failures, depositors become more aware of the risk of losing deposits; thus, they start exercising a stricter market discipline. In sum, crises seem to be wake-up calls for depositors.

There exists another potential rationale for the increase in market discipline after crises. If the deposit insurance funds were depleted during a crisis, insured depositors would have an incentive to start monitoring banks more closely. Although this might be the case in some crises, the insurance funds were not depleted in the episodes we analyze. Whenever a bank was in difficulties, governments tried to find buyers or took over the failing bank. Even though the deposit insurance funds were not exhausted, it became obvious during these events that the existing schemes were underfunded, indicating the limits of the deposit insurance coverage.

The cases analyzed suggest that traumatic events teach depositors that they should be concerned about the safety of their deposits at all times. The case of Argentina shows that the responsiveness of depositors to bank risk characteristics increased after the crisis, although at that time the authorities introduced an insurance scheme to guarantee deposits. This implies that the crisis had a greater impact on depositors than the introduction of the deposit insurance system. In the case of Chile and Mexico, depositors were de facto covered during crises, yet their responsiveness increased following central bank interventions.

To conclude, the literature has argued that the existence of deposit insurance might diminish the extent of market discipline. However, the fact that we find market discipline among insured depositors suggests that deposit insurance schemes are not always fully credible. There are important reasons for this lack of credibility. Many governments have reneged on their promises in the past, the deposit insurance schemes tend to be undercapitalized, and depositors are concerned about the cost of repayment (typically in the form of delays) through the deposit insurance fund. As an example, following the tequila crisis, while the Argentine central bank and the deposit insurance administrators tried to find a buyer for every failing bank, deposits were indefinitely frozen to conserve the bank's franchise value.

This type of experience seems to remind depositors that, despite the presence of deposit insurance, it might still be justified to monitor banks for bad behavior.

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Some Measures of Financial Fragility in the Chilean Banking System: An Early Warning Indicators Application

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The regulatory framework of the Chilean financial system includes a number of regulations that seek to maintain the financial stability of banks. On one hand, the Central Bank of Chile in its role as regulator and, on the other hand, the Superintendency of Banks in its role as supervisor have set a variety of prudential regulations such as margin lending requirements, property-related concentration margins, limits on market risk exposure, and capital adequacy requirements. (The capital adequacy requirements are based on Basle principles and were established after the enactment of a new banking law sought to replace leverage ratios.) This set of regulations is reinforced through periodic on-site supervision of financial institutions, a task for which the Superintendency of Banks is responsible.

The goal of banking regulation is to narrow or constrain the risk that banks encounter in their business. However, it is difficult or extremely costly to eliminate these sources of risk, unless the regulatory authorities are willing to severely limit banking activity. Therefore it is always a possibility that a large bank or group of banks will become

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fragile, to such an extent that they or the regulatory authorities are forced to undertake a process of intervention or liquidation, which can affect the public trust. In order to avoid reaching this stage in the deterioration of the financial condition of institutions, methods of on-site supervision have been improved in recent years. Although on-site supervision is by far the most reliable mechanism for drawing a definitive picture of a bank, it is nonetheless an expensive and sometimes gradual process. In fact, depending on the size and complexities of the activities of the institution, it can take months before supervisors have an accurate idea of the financial condition of a bank.

During the 1980s as well as in recent years, several countries at different stages of economic development have suffered from episodes of banking crises of considerable magnitude. Many of these crises arose from macroeconomic imbalances that led to the collapse of the financial system. Generally, the causes of systemic banking crises are rooted in processes of rapid financial liberalization, which creates lending booms and asset price bubbles fueled by excessive capital inflows, large fiscal and current account deficits, excessive currency appreciation in terms of the real exchange rate, or sudden and large increases in real interest rates. It is well established in the literature that, although the two types of crisis are different in nature, banking crises are usually accompanied by balance of payments crises. On several occasions, however, the eruption of banking crises has been due to microeconomic factors, which commonly put the blame on poor management by banks of the risks they face (moral hazard).

Welfare costs associated with banking crises are often of considerable magnitude in relation to GDP.[1] This fact has caused great concern and motivated authorities in many countries to establish a permanent process for assessing the stability and soundness of financial systems against possible threats, and to design early warning systems capable of alerting the authorities of potential bank failures. Also, the literature on early warning indicators of fragile banks has attracted interest in countries like the United States, because of the large number of banks in the market. This abundance of banks makes it impossible to practice

1. Caprio and Klingebiel (1996) report over a hundred systemic banking crises and smaller banking crises in many countries since 1970, as part of a large group which they define as bank insolvency episodes. The costs of these episodes range from as little as 1 percent of GDP in the case of Thailand in 1983-87 to a 55 percent loss of GDP in the case of Argentina in 1980-82. Eyzaguirre and Larrañaga (1991) estimate the loss for the Chilean banking crisis at 23 percent of GDP, spread across various aid programs.

periodic on-site supervision of all institutions at least once a year, and therefore it becomes crucial to rely on early warning models. In addition, poor management practices and the risk of contagion to nearby institutions have forced regulators to design some mechanism of detecting weaknesses among banks. An early warning model based on financial ratios provides such a mechanism at a relatively low cost.

The purpose of this paper is to explore different measures of financial fragility within the Chilean financial system and the extent to which reduced-form models of these measures fit the sample data. The evolution of the Chilean financial system during the 1990s was far from being as turbulent and crisis-prone as that in other developing economies. On the contrary, Chile is among the group of countries that have had a stable financial system dating back to the mid-1980s and has managed to avoid banking crises as defined, for example, in Kaminsky and Reinhart (1996). This fact forces us to be cautious both in defining the variables considered as measures of financial fragility and in our general approach to estimation. Despite the stability of Chile's financial system, it should be possible to identify a group of less favored banks, and the inferences drawn from such an exercise should provide valuable information. In this sense, we adopt mainly a microeconomic approach. That is, we work on a bank-by-bank basis, defining fragility as depending on two variables: the interest rate spread on interbank lending and the ratio of nonperforming loans to total loans.

The rest of the paper is organized as follows. Section 1 briefly reviews the literature about early warning systems and its application under various types of banking crises. Section 2 introduces the reduced-form models adopted for the estimation of our measures of financial fragility and discusses the relevant empirical findings for the financial system and banking groups. Section 3 presents final comments and conclusions.

1. Early Warning Systems: Review and Motivation

During the 1980s and more recently, many countries in various circumstances have suffered banking crises of various kinds. Many of these episodes started from a situation of macroeconomic disequilibrium in some fundamental factors that ended with the collapse of the financial system. These crises forced central banks to intervene, adopting a variety of measures to rescue the bankrupt institutions. Demirgüç-Kunt and Detragiache (1997) conclude that the macroeconomic environment

plays a fundamental role in the generation of banking crises.[2] For instance, a low rate of GDP growth is associated with an increase in credit risk due to an increase in the probability of default on loans. These authors point out that increasing credit risk could well be reduced through international diversification of the portfolio of loans. If credit risk is effectively diversified by extending loans to other countries whose growth rates show a negative correlation with that of the home country, it could benefit banks from small, open economies that have a significant concentration of loans related to domestic income sources.

Demirgüç-Kunt and Detragiache conclude that interest rates are also an important factor in explaining banking crises. Increases in interest rates raise the probability of a financial crisis when they are driven by policies aimed at inflation stabilization and financial liberalization. Examples include the case of Brazil and its program to end hyperinflation, and the case of Chile in the late 1970s. On the other hand, high nominal interest rates are seen as a factor in explaining banking crises when they reflect high and volatile inflation rates, which make it difficult for banks to perform the maturity transformation of assets and liabilities. In environments like these, banks face increasing financial and credit risk and a reduction in revenue due to the inflation tax.

In a related article, González-Hermosillo, Pazarbasioglu, and Billings (1996) take into consideration the interaction of microeconomic variables, namely, financial ratios taken from the financial statements of banks, with a set of macroeconomic factors to estimate an early warning model of the Mexican financial crisis of 1994. These authors found that a reduction of economic activity, an increase in real interest rates, and a depreciation in terms of the real exchange rate are important factors anticipating an increasing vulnerability of the financial system. Macroeconomic factors play an important role in determining the timing of failure. In particular, the authors found that the negative macroeconomic shocks suffered by the Mexican economy increased the vulnerability of the country's financial system. On the other hand, variables relating to specific banks and the banking sector helped

2. Demirgüç-Kunt and Detragiache (1997) define a systemic banking crisis as the occurrence of at least as one of the following: the ratio of nonperforming loans to total assets in the banking system exceeds 10 percent; the cost of a rescue operation is at least 2 percent of GDP; an extensive nationalization of banks occurs; or there are extensive bank runs, deposit freezes, or prolonged bank holidays at the time of the crisis.

explain the likelihood of bank failure more than the timing of the crisis. Among the bank-specific variables considered by the authors are the risk-adjusted capital ratio, the ratio of nonperforming loans to total loans, loan concentration in certain sectors (such as the agricultural and household sectors) as a proportion of total loans, relative bank size, and operating expenses. Among the banking sector variables considered are the ratio of banking sector loans to GDP, the ratio of nonperforming loans to total loans, and the banking sector's contributions to the deposit guarantee fund in relation to total nonperforming loans. These variables capture the vulnerability of the banking sector.

A large literature considers only bank-specific variables in estimating early warning models. Its development coincides with the large number of bankruptcies that occurred at the beginning of the 1980s in developed countries; examples include Martin (1977), Whalen and Thompson (1989), Jones and Kuester-King (1995), Atle Berg and Hexeberg (1994), and Cole (1995). A very good survey can be found in Demirgüç-Kunt (1989). In general, the variables considered as predictors of insolvency in this literature are variations of those mentioned in the previous paragraph, as well as proxy variables of profitability and liquidity. The standard approach is to construct a set of explanatory variables that closely resembles the on-site supervision process that gives rise to the CAMEL evaluation of banks in the United States.[3] Recent articles have emphasized the need to add variables that may be more sensitive to the assessment by the market (that is, by other financial intermediaries) of a bank's soundness and stability. Among the variables suggested are the interest rate paid on deposits, measures of the cost of funds, the spread between lending and deposit rates, and loan growth rates. These variables presumably can more rapidly reflect the deterioration of problem institutions and, in the case of variables related to the interest rate paid on deposits, are less affected by discretionary accounting standards.[4]

In the early warning literature, a common estimation technique has been used at each of the different stages of its development. Earlier articles employed multivariate discriminant analysis (MDA), which, rather than identifying a single dependent variable a priori, instead

3. CAMEL is an acronym for capital, asset, management, equity, and liquidity, which are the factors evaluated in on-site supervision of financial institutions in the United States. The system was established in 1979 by the U.S. regulatory agencies to help identify those institutions that require closer supervision.

4. For a more detailed discussion see Rojas-Suárez (1998) and Honohan (1997).

tried to distinguish between troubled and healthy banks by looking at the joint distribution of a number of financial ratios. MDA requires that the financial ratios considered to distinguish among a group of banks be distributed normally—an assumption that in many instances could limit the analysis.

More recent articles have completely discarded the MDA approach and instead estimate models of the probability of failure or nonfailure of banks, using models with discrete dependent variables. These models are distinguished according to the cumulative distribution function that describes the behavior of the dependent variable: *probit* models are used for a cumulative normal density function, and *logit* models for a cumulative logistic density function; these two are the most popular specifications. These models seek to establish a causal relationship between a discrete event (specified such that 1 = failure and 0 = no failure) and a set of explanatory macroeconomic and financial variables considered for an arbitrary number of periods before a given event took place. Since it is thought that failing banks deteriorate slowly rather than suddenly, this regression approach is a natural one to embrace. From the results of the probit or logit estimation one obtains an expected probability of failure, so that institutions can be distinguished according to their inherent degree of risk.

The usual goodness-of-fit statistics such as the adjusted R^2 can no longer be directly calculated in the context of logit or probit estimation, since the dependent variable is discrete.[5] However, in order to assess the accuracy of the model in predicting failures, it is customary to compute the percentage of sample predictions that prove correct ex post. Two types of error are usually computed. A type I error is said to take place when the model fails to predict problems in a bank that later actually encounters problems. Conversely, a type II error occurs when the model predicts that a bank will show signs or symptoms of problems, but instead it does not. An early warning model is considered good if the probability of committing type I error is low. However, given the inherent trade-off between the two types of error, a search for a lower type I error implies a higher type II error. That is, the more banks the model identifies as problematic, the more will be identified as problematic when in fact they are not. However, the cost

5. An analog measure to the conventional R^2 in these models is the likelihood ratio index (LRI), which is constructed by comparing the log-likelihood of the model and the same statistic that results from estimating the model with a constant term only: LRI = 1 – ln L/ln L_0, where L_0 is the log-likelihood computed only with a constant term.

of a larger number of type II errors is relatively low, because it only implies additional revisions or a stricter supervision of those institutions identified as problematic. In contrast, failure to correctly anticipate the insolvency of institutions that are in fact weak might result in the expenditure of a large amount of resources. For instance, it might require an explicit deposit insurance scheme or liquidity support to maintain the normal functioning of the payments system, to avoid the propagation of a crisis to the whole financial system.

The identification of the dependent variable (failed institutions) becomes trivial when we confront severe crises, characterized, for example, by massive interventions of the government or the monetary authorities. Fortunately, Chile did not suffer massive disruptions of its financial system during the 1990s. However, this fact makes it more difficult to isolate events in Chile that could clearly jeopardize the solvency of financial institutions. Following the definition of a crisis by Kaminsky and Reinhart (1996) as "i) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions, or ii) the closure, merging, or takeover, or large-scale government assistance of an important financial institution (or group of institutions)," Chile has not even come close. During the 1990s, Chile developed a process of market consolidation, starting with the solution of problems inherited from the 1983 crisis that led to a conservative regulatory scheme. This process of market consolidation was characterized by banking company mergers that led to the disappearance of nine institutions, a process that increased market concentration as reflected in such measures as the Herfindahl index. At the same time, substantial investment in new technologies and steady economic growth contributed to a system with a greater capital base and a low percentage of nonperforming loans. However, none of the nine cases of bank disappearance could be clearly identified as a solution to a latent insolvency problem or failure of these institutions. In fact, none of these exits from the market caused a disruption in the functioning of the financial system. Therefore, for Chile in the 1990s it is very difficult to adopt a dichotomous approach—crisis versus noncrisis, or failure versus nonfailure—because such events have not occurred.

Alternative definitions of banking crises are postulated by Rojas-Suárez (1998). These are summarized as follows: intervention by the authorities; periods when the ratio of nonperforming loans to total loans is greater than the average for the system as a whole, during a tranquil period plus two standard deviations; periods when a bank loses at least 5 percent of its deposits; and periods when a properly computed crisis

index that combines the two previous criteria exceeds the system average during a tranquil period plus two standard deviations. This paper uses the ratio of nonperforming loans, since it is consistent with the concept of fragility found in other articles. This definition assumes that credit risk is the main source of instability of financial institutions; hence, troubled institutions are those with a greater proportion of nonperforming loans in their portfolios. This approach is congruent with the characterization of a banking crisis as a period with a greater proportion of nonperforming loans.

Given the increasing importance of new banking activities beyond traditional commercial lending, we believe that other sources of risk, such as liquidity risk, are gaining relevance. Therefore we adopt an alternative measure of financial fragility (not an overall index) that better captures liquidity risk through the interest rate spread on interbank lending. This indicator is constructed as the difference between the real interest rate charged among banks for short-term daily liquidity loans and the liquidity interest rate for overnight deposits in domestic currency at the central bank (the lowest interest rate paid by this institution). We believe that the interbank spread, thus defined, provides an indirect market assessment of the financial condition of banks, since interbank credit operations are not directly covered by some deposit guarantee scheme, forcing lender institutions to assess the borrower's financial situation on an ongoing basis.

2. Early Warning System: Estimation during a Noncrisis Period

2.1 Measuring and Estimating Fragility

This section presents the results from the estimation of a simple, reduced-form equation for the determination of two variables: nonperforming loans as a percentage of total loans, and interbank spreads. Since the number of institutions that comprise the Chilean financial system is relatively small, and given the large number of financial ratios that could explain the behavior of the dependent variables, we estimate the models using a longitudinal data regression to increase the degrees of freedom of the model and the efficiency of the parameter estimates. As explained above, we adopt a nondichotomous approach for the dependent variables.

The sample size varies according to the dependent variable. In the case of the ratio of nonperforming loans to total loans, the sample

ranges from January 1990 to October 1998 on a monthly basis, an ample period over which to model this variable. Unfortunately, in the case of interbank spreads, the liquidity overnight banking deposit rate is a recently created instrument, and data are available only since May 1995. Although this interest rate is determined daily, we collected data monthly for purposes of estimation. One additional drawback of the interbank spread data is that individual banks do not transact on the interbank lending market in every period; therefore in several periods data for some banks are nonexistent. For simplicity, we ignore the problem of missing observations for interbank spread data, since it is not clear that filling in the blanks with some average or regression-based interpolation would improve the efficiency of the estimates. The missing-variable problem could, however, become severe during critical periods if it is assumed that nonexistent information regarding interbank lending operations for some banks signals an unwillingness to lend to those banks considered more risky.[6]

The list of regressors can be separated into bank-specific, or microeconomic, variables and a set of macroeconomic variables that may have an impact on the solvency of banking institutions. The first group of variables is believed to have an impact on overall fragility, for instance on the quality of loans, through an indirect mechanism that basically is related to the quality of bank management. The macroeconomic variables eventually have a direct impact on the quality of loans since they are more related to the nature and development of the business activities of the bank's borrowers. That is, it could be argued that some loans get into trouble because certain sectors of the real economy deteriorate, but certainly this explanation is not sufficient to explain why some firms fail whereas others do not, except in the case of a widespread shock to the economy. This group of variables includes a measure of economic activity such as the twelve-month variation on a seasonally adjusted monthly index of economic activity (this index is called ECA in the model). A market interest rate that captures intertemporal substitution and wealth effects is also included, namely, the real lending rate for 90 to 365 days (called IRR in the model). There is also a measure of the international competitiveness of the economy: the real exchange rate as reported by the Central Bank of Chile (RER). Table 1 lists the bank-specific variables.

6. There is an identification problem with banks that do not operate in the interbank market at all. They might have chosen voluntarily to abstain, or they may have been excluded from the market because of their riskiness.

Table 1. Bank-Specific Variables Used in the Regressions

Criterion	*Variable name*	*Description*
Capital	CAP	Capital plus reserves, divided by total assets
Efficiency	MEX	Managerial expenditure divided by total assets
	AOL	Productive assets divided by costly liabilities
Liquidity	LIQ	Portfolio liquid assets plus central bank paper, divided by total deposits
Earnings	MOP	Operating margin divided by total assets
Growth	LOG	Twelve-month logarithmic difference in total loans
Market based	INL	Interbank lending divided by total deposits

The estimation of measures of bank fragility is carried out by grouping the banks over time to form a panel data set (a longitudinal database), because of the statistically small number of banks in the Chilean financial system. Panel data estimation provides more degrees of freedom and greater efficiency in the parameter estimates, given the large number of explanatory variables and observations. Hence, in addition to the natural but possibly less clear-cut cross-banking differences due to the limited number of banks in the market, we incorporate variation over time between them. The estimation is simple in the sense that we assume that the slope coefficients as well as the intercepts are constant for all banks. This model represents the most restricted version of a longitudinal data estimation, and so its results in terms of goodness-of-fit measures can only be improved by adopting a more general model specification. In the case of nonperforming loans we proceed even further and estimate the model on the assumption that there are three different groups of banks in the market: larger domestic banks (which include the larger foreign banks Banco Santander and Citibank), foreign banks, and the small domestic banks called *sociedades financieras* (financial companies). This separation into different groups allows us to check for differences in parameter values across groups and to take into account the widespread belief that some strategic groups are always present in a financial system, each of which has a different business orientation and therefore should be treated separately. The division into these three groups is taken from the traditional categories published by the

Superintendency of Banks, modified to include those larger foreign banks with active involvement in the domestic market in the group of domestic banking institutions that have a similar product profile.

The estimated equation can be summarized as

$$y_{it} = \alpha_i + \rho y_{it-1} + \beta' x_{it} + \varepsilon_{it} \quad ; \qquad i = 1,...,N \; ; \qquad t = 1,...,T \, . \tag{1}$$

where x_{it} is a vector of explanatory variables, y_{it} is the dependent variable (the ratio of nonperforming loans to total loans, or, alternatively, the interbank spread), N is the number of banks, and T is the number of months covered by the estimation. The estimation imposes the restriction of parameter constancy for all banks; therefore the ordinary least-squares method provides consistent and efficient estimates of α and β. The model with lagged dependent variables is applied only for the case of nonperforming loans, given that this series, unlike the interbank spread, shows a clear persistence that can be well approximated by including the lagged dependent variable among the regressors.[7] The results can be interpreted as an average systemic response of measures of both credit and liquidity risk to expected changes in the explanatory variables. The model is estimated with various lags, starting from twelve lags of each explanatory variable, and includes a correction for autocorrelation for the nonperforming loans variable, which means including an arbitrary number of lagged dependent variables to reduce the autocorrelation of the residual process. In the case of nonperforming loans, this variable is measured as a twelve-month percentage difference to eliminate possible deterministic trending and seasonal behavior. Also, variables that are measured as flows, for instance operational margins and managerial expenditures, are measured as monthly differences of the accumulated flow of a given year divided by total assets from the previous period. For example, operating income for June 1998 was generated using assets available at the end of May of the same year. Table 2 summarizes the results using both measures of fragility as the dependent variable.

7. There are some problems with the estimation of the model using panel data in terms of the parameter's inconsistency in the presence of lagged dependent variables. However, in this case the number of time observations exceeds the number of banks, which resembles the case when T goes to infinity. Therefore the inconsistency problem is less important during the estimation. The samples that we use can be better classified within the category of longitudinal data instead of panel data.

2.2 Analyzing the Evidence

The results for the pooled banking system (table 2a) suggest that a number of bank-specific variables are important in explaining the future behavior of nonperforming loans. For instance, an increase in the level of capital tends to decrease banking fragility in terms of credit risk. This can be interpreted as indicating that when a greater proportion of owners' capital is at stake, the bank will implement a more risk-averse (that is, conservative) lending process. This finding supports the current trend in regulation, which requires more capital for banking operations to improve the solvency of these intermediaries. Higher liquidity tends, in the short run, to reduce the percentage of nonperforming loans; this, too, makes sense if we consider that more liquid institutions tend to be more risk averse. Higher interest rates that result from a tightening of monetary policy increase banking fragility no later than a year after the rise in interest rates. The results in table 2a indicate that the effect of interest rates is persistent, given the significance of the parameter at various lags. This result suggests that during periods of high interest rates we should expect an increase in nonperforming loans on a bank-by-bank basis. A different interpretation is to assume a close relationship between interest rates in the market and the cost of funds to banks to support active operations. In that case higher interest rates would reveal those institutions with reckless procedures in their credit policy, which should therefore have, on average, a higher proportion of nonperforming loans. Table 2a also shows loan growth to be an important factor in explaining a subsequent deterioration in loan quality. Banks that enjoy a rapid expansion of credit, possibly because a less stringent credit policy allows them to reach more risky customers, will have a greater proportion of loans past due. The results also indicate that the impact of a loose credit policy surface only after some time; hence a rapid increase in market share and profits, although it may look positive in the short run, may reveal itself later on to be a source of banking fragility.

An interpretation of the regression results suggests the possibility that nonperforming loans can be taken as the percentage of loans that are actually not paid. Implicitly, this interpretation allows us to take the ratio of nonperforming loans itself as an ex post average probability measure of default on loans for the bank as a whole. Therefore, following the model, an increase in, for example, managerial expenses can be understood as increasing the average probability that

Table 2a. Longitudinal Data Estimation of the Behavior of Nonperforming Loans, Sample Including All Banks[a]

Independent variable	*Number of lags*											
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Constant	−0.0003	−0.0017	−0.0031	−0.0025	−0.0030	−0.0014	−0.0006	−0.0008	−0.0007	−0.0009	−0.0008	−0.0010
	(−0.42)	(−1.99)	(−3.64)	(−2.86)	(−3.41)	(−1.67)	(−0.67)	(−0.87)	(−0.74)	(−0.98)	(−0.89)	(−1.08)
NPL (-1)	0.7599	0.7622	0.7557	0.7594	0.7616	0.7624	0.7612	0.7575	0.7566	0.7583	0.7576	0.7523
	(41.30)	(41.68)	(41.17)	(41.13)	(41.09)	(41.05)	(40.66)	(40.32)	(39.90)	(39.81)	(39.87)	(39.35)
NPL (-2)	0.1835	0.1781	0.1939	0.1862	0.1819	0.1829	0.1850	0.1879	0.1887	0.1879	0.1871	0.1914
	(8.05)	(7.82)	(8.49)	(8.13)	(7.89)	(7.92)	(7.96)	(8.05)	(8.04)	(7.96)	(7.95)	(8.12)
NPL (-3)	−0.0758	−0.0646	−0.0723	−0.0694	−0.0672	−0.0698	−0.070	−0.0692	−0.0687	−0.0700	−0.0662	−0.0654
	(−4.11)	(−3.51)	(−3.93)	(−3.72)	(−3.59)	(−3.74)	(−3.73)	(−3.67)	(−3.61)	(−3.66)	(3.47)	(−3.43)
AOL	−0.0005	0.0015	0.0011	0.0006	0.0010	0.0005	0.0007	0.0010	0.0005	0.0002	0.0006	0.0005
	(−1.76)	(5.35)	(3.79)	(1.95)	(3.43)	(1.68)	(2.31)	(3.33)	(1.61)	(0.50)	(2.01)	(1.56)
MEX	0.0161	0.0092	−0.0223	−0.1362	0.0295	−0.1564	−0.0307	−0.0852	−0.0220	−0.0201	−0.1568	−0.1906
	(0.23)	(0.14)	(−0.34)	(−2.05)	(0.44)	(−2.33)	(−0.45)	(−1.26)	(−0.32)	(−0.29)	(−2.27)	(−2.75)
CAP	0.0026	−0.0033	−0.0019	−0.0008	−0.0017	−0.0010	−0.0016	−0.0027	−0.0019	−0.0110	−0.0033	−0.0032
	(2.40)	(−2.67)	(−1.59)	(−0.60)	(−1.37)	(−0.81)	(−1.28)	(−2.05)	(−1.42)	(−0.81)	(−2.47)	(−2.40)
INL	0.0028	0.0013	0.0014	0.0025	0.0013	0.0021	0.0019	0.0014	0.0018	0.0017	0.0017	0.0021
	(2.12)	(0.98)	(1.09)	(1.89)	(0.95)	(1.52)	(1.41)	(1.04)	(1.28)	(1.20)	(1.19)	(1.39)
LIQ	−0.0017	−0.0012	−0.0009	−0.0011	−0.0003	−0.0004	−0.0002	0.0004	0.0012	0.0013	0.0016	0.0023
	(−2.07)	(−1.39)	(−1.07)	(−1.31)	(−0.39)	(−0.45)	(−0.31)	(0.48)	(1.30)	(1.38)	(1.75)	(2.48)
LOG	−0.0002	−0.0004	0.0002	0.0004	0.0004	0.0002	0.0007	0.0008	0.0009	0.0095	0.0011	0.0014
	(−0.58)	(−1.13)	(0.58)	(0.99)	(1.08)	(0.61)	(1.88)	(2.08)	(2.25)	(2.42)	(2.71)	(3.55)
MOP	−0.0202	−0.0182	−0.0059	0.0657	−0.0298	0.0827	−0.0005	0.0272	0.0181	0.0171	0.0826	0.1204
	(−0.60)	(−0.53)	(−0.17)	(1.89)	(−0.85)	(2.36)	(−0.01)	(0.76)	(0.50)	(0.47)	(2.29)	(3.33)
IRR	0.0129	0.0127	0.0225	0.0197	0.0212	0.0091	0.0024	−0.0011	−0.0017	0.0028	−0.0030	−0.0034
	(2.13)	(1.78)	(3.13)	(2.66)	(2.84)	(1.21)	(0.32)	(−0.14)	(−0.22)	(0.37)	(−0.39)	(−0.45)
RER	0.0107	0.0127	−0.0132	−0.0217	−0.0215	−0.0105	0.0005	0.0029	0.0081	−0.0097	0.0054	−0.0049
	(0.93)	(1.08)	(−1.11)	(−1.80)	(−1.79)	(−0.87)	(0.03)	(0.24)	(0.66)	(−0.79)	(0.44)	(−0.39)
ECA	−0.0055	−0.0029	−0.0030	−0.0029	−0.0023	−0.0010	−0.0028	−0.0015	−0.0006	−0.0019	0.0015	0.0006
	−1.72)	(−0.92)	(−0.93)	(−0.90)	(−0.69)	(−0.31)	(−0.86)	(−0.47)	(−0.19)	(−0.57)	(0.44)	(0.19)
Summary statistic												
Adjusted R^2	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.74	0.74	0.75	0.75
DW	2.00	2.01	2.01	2.01	2.00	2.01	2.02	2.01	2.01	1.99	2.01	1.98

Source: Authors' calculations.

a. NPL, nonperforming loans; IRR, real lending rate on loans of 90-365 days; RER, real exchange rate; ECA, index of economic activity; other variables are defined as in table 1. The number below each regression coefficient is its t statistic.

some loans will not be recovered. Therefore these models, although simpler, yield some early warning signs about the future behavior of individual banks.

A similar conceptual framework can be devised for the interbank spread. If we call d the liquidity overnight banking deposit rate and s the spread, which is determined entirely among the banks themselves, then a proportion of the institutions will pay $d + s$ at the expiration of the contract, and the rest will not have paid at the expiration date. To illustrate this point, we present a restricted model that assumes, for simplicity, risk-neutral behavior on the part of lenders. For instance, on average the payment received by a bank that is in a lender position will be $p(d + s)$, which will be equal to d.[8] Hence p will represent the probability of repayment and 1 - p the probability of default on interbank lending operations:[9]

$$p = \frac{d}{s+d}, \qquad 1-p = \frac{s}{s+d} = \frac{1}{1+d/s}. \tag{2}$$

We see that, as the spread charged to a bank for interbank operations goes to infinity, the probability of default tends toward one, excluding that institution from this market.

We can use this interpretation to analyze the output estimation of the model for interbank lending. For instance, table 2b shows that an increase in the market rate of interest produces an increase in the spread charged for interbank lending in the short run (with lags of one and two periods). The t statistics for the estimated parameters show that the variables have a significant impact on the interbank spread, as we observe during the episodes of liquidity shortages in 1998. The sign on the regression coefficient suggests that an increase in the level of interest rates increases the interbank spread. One should expect a strong association between market interest rate and the cost of funding liabilities among banks: institutions with a higher cost of funding should be charged a higher spread. This makes sense if one considers this latter

8. Risk neutrality implies that the bank is indifferent between lending to a private bank or to the central bank and will accept rate d in either case. Risk-averse behavior on the part of the lender will imply an additional risk premium; therefore the expected value of the lending operation will not be the same as d.

9. The interpretation of the interbank spread in terms of liquidity risk assumes that it measures the probability that banks will not pay on time, because of liquidity constraints. Liquidity risk is related to but slightly different from credit risk, and so the two should be treated separately. Under Chilean legislation the Central Bank of Chile fully insured liabilities on demand, to prevent systemic instability.

Table 2b. Longitudinal Data Estimation of Interbank Spread Behavior, Sample Including All Banks[a]

Independent variable	*Number of lags*											
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Constant	–0.0792	–0.0752	0.0084	0.0371	–0.0417	0.0318	0.0369	0.0300	0.0354	–0.0110	0.0262	0.0205
	(–3.59)	(–3.94)	(0.40)	(1.55)	(–1.63)	(1.37)	(1.64)	(1.34)	(1.61)	(–0.49)	(1.21)	(0.95)
NPL	–0.1613	–0.2318	–0.1814	–0.1167	–0.0521	–0.0491	–0.0836	–0.0607	–0.0366	–0.1445	–0.2354	–0.2476
	(–1.18)	(–1.68)	(–1.30)	(–0.83)	(–0.38)	(–0.36)	(–0.62)	(–0.46)	(–0.29)	(–1.19)	(–1.87)	(–1.88)
AOL	–0.0003	–0.0007	–0.0017	–0.0010	–0.0003	–0.0014	0.0013	0.0017	–0.0007	–0.0019	–0.0008	–0.0003
	(–0.11)	(–0.29)	(–0.70)	(–0.40)	(–0.14)	(–0.47)	(0.41)	(0.60)	(–0.24)	(–0.71)	(–0.26)	(–0.10)
MEX	–0.4300	–2.1224	–2.2985	–2.1591	–0.4704	1.3814	0.0575	1.6696	0.6996	0.7875	–0.0678	–1.91
	(–0.41)	(–2.14)	(–2.09)	(–1.81)	(–0.46)	(1.35)	(0.05)	(1.69)	(0.75)	(0.85)	(–0.07)	(–2.00)
CAP	–0.0027	–0.0077	–0.0018	–0.0036	0.0002	0.0185	0.0068	0.0090	0.0074	0.0111	0.0068	0.0044
	(–0.20)	(–0.56)	(–0.13)	(–0.25)	(0.01)	(1.17)	(0.43)	(0.60)	(0.49)	(0.77)	(0.46)	(0.30)
INL	–0.0121	–0.0125	–0.0070	–0.0014	–0.0060	–0.0066	–0.0069	–0.0117	–0.0103	–0.0184	–0.0127	–0.0132
	(–1.31)	(–1.38)	(–0.75)	(–0.14)	(–0.58)	(–0.60)	(–0.61)	(–1.02)	(–0.92)	(–1.67)	(–1.10)	(–1.10)
LIQ	0.0003	0.0012	–0.0054	–0.0093	–0.0093	–0.0161	–0.0150	–0.0101	–0.0051	–0.0019	–0.0083	–0.0128
	(0.04)	(0.15)	(–0.70)	(–1.15)	(–1.11)	(–1.78)	(–1.65)	(–1.12)	(–0.59)	(–0.24)	(–0.99)	(–1.55)
LOG	–0.0028	–0.0051	–0.0045	–0.0005	–0.0004	0.0058	0.0068	0.0083	0.0053	–0.0002	–0.0011	–0.0012
	(–0.52)	(–0.97)	(–0.82)	(–0.09)	(–0.08)	(1.01)	(1.16)	(1.40)	(0.95)	(–0.03)	(–0.18)	(–0.21)
MOP	0.1069	1.0646	1.0057	0.8994	0.0805	–1.0720	–0.4660	–1.2101	–0.6093	–0.5307	–0.2182	0.5576
	(0.19)	(1.94)	(1.71)	(1.44)	(0.16)	(–2.04)	(–0.82)	(–2.44)	(–1.26)	(–1.18)	(–0.46)	(1.19)
IRR	0.9757	0.8006	–0.0147	–0.2431	0.5689	–0.0949	–0.1900	–0.0859	–0.0728	0.4061	0.0318	0.0741
	(4.60)	(4.30)	(–0.07)	(–0.98)	(2.16)	(–0.39)	(–0.81)	(–0.36)	(–0.31)	(1.75)	(0.14)	(0.33)
RER	–0.4324	–0.7307	–0.7063	–0.6597	–1.3337	–0.2003	0.2537	–0.0879	–0.8930	–1.4294	–0.8190	–0.4828
	(–2.21)	(–4.36)	(–4.27)	(–3.68)	(–5.64)	(–1.12)	(1.52)	(–0.52)	(–5.29)	(–8.26)	(–4.72)	(–3.04)
ECA	0.0662	0.1985	0.0897	–0.0279	–0.0489	–0.0708	0.0437	–0.0975	–0.3104	–0.3303	–0.2577	–0.1350
	(1.03)	(3.21)	(1.43)	(–0.46)	(–0.83)	(–1.18)	(0.73)	(–1.64)	(–5.87)	(–6.16)	(–4.63)	(–2.58)
Summary statistic												
Adjusted R^2	0.03	0.07	0.07	0.06	0.06	0.01	0.003	0.01	0.08	0.14	0.06	0.04
DW	1.50	1.53	1.56	1.56	1.48	1.45	1.44	1.46	1.56	1.63	1.61	1.47
P value (F statistic)	0.007	0.000	0.000	0.000	0.000	0.262	0.302	0.116	0.000	0.000	0.000	0.002

Source: Authors' calculations.

a. NPL, nonperforming loans; IRR, real lending rate on loans of 90-365 days; RER, real exchange rate; ECA, index of economic activity; other variables are defined as in table 1. The number below each regression coefficient is its t statistic.

variable as a signal of liquidity problems in those institutions; hence banks that have liquidity problems are seen by other banks as more risky and hence are charged a higher spread.

An overall assessment of the results for the interbank spread suggests that macroeconomic or market variables play a much more important role in the determination of this variable than do financial ratios from institutions. Apart from some isolated effects from managerial expenditure, nonperforming loans, and the operating margin, the rest of the variables are irrelevant. In fact, when the macroeconomic variables are not significant, neither is the regression as a whole (see the results for specifications with six, seven, and eight lags). Moreover, the sign of the coefficient on the financial ratios variables is hard to interpret. For example, an increase in managerial expenditure decreases the spread charged by other banks, as if institutions that are less efficient had a lower probability of default.

The interpretation of the parameter estimates for the macroeconomic factors is less troublesome. It is clear that an improvement in economic activity decreases the overall spread charged among banks. Nonetheless, the response of the interbank spread to changes in economic activity becomes important only after several periods. This finding is clearly the opposite of the interpretation of the market interest rate, indicating that, in the very short run, the interbank spread is clearly determined by market rates.

The fact that most of the bank-specific variables are not significant in explaining the behavior of the spread over time and across banks suggests that the interbank spreads charged to different banks may be similar, reacting mainly to market rates. If so, it is not a good indicator of inherent bank risk. This observation is also consistent with the role of the central bank in safeguarding systemic risk in the Chilean financial system. These comments should be interpreted with care, however, because of the missing-observation problem already mentioned. Missing data on spreads could be the result of inability to access the interbank market for inconvenience either to the borrower or to the lender.

2.3 Results from Separating Banks into Groups

Table 3 summarizes the results of regressions in which banks are separated into groups, in recognition that some banks have different business strategies and responses to aggregate shocks and therefore should be treated differently. To account for such differences, we used

system estimation regression with cross-equation restrictions separating banks into those groups described in section 2.1, as a restricted model. That is, we assume that the group consisting of the larger domestic banks and the two large foreign banks behaves differently from the smaller foreign banks and from the financial companies. (These institutions operate for the most part in the consumer loan market.) The system estimation technique provides a more general specification than running three separate regressions, since it allows us to formally test for differences among banking groups using all the information provided by the variance-covariance matrix of the residuals from each regression.[10]

The estimated parameter values in table 3 suggest that the banking industry can effectively be described as three separate groups during the sample period. The dependent variables for the financial companies display practically no relationship with the group of explanatory variables (the financial ratios or the macroeconomic variables), except for the ratio of assets to liabilities. This result shows that the business of the financial companies is not the same as that of the other institutions, which are characterized by a wide variety of products. Table 3 clearly shows that capital ratios are important factors in banking fragility among banks as opposed to financial companies. Unlike in table 2a, where the capital ratio has an unbalanced effect (it is significant at very short lags and at very long lags, but generally not in between), the capital ratios for both domestic and foreign banks are important irrespective of the lag the model considers. In a sense, the estimation of a single large regression incorporating the financial companies was obscuring the strong and stable relationship between capital ratios and credit risk in the other institutions. The behavior of nonperforming loans in the domestic and foreign banks also is strongly dependent on the market interest rate used in the estimation. In contrast, the financial companies show no reaction to the evolution of the short-term interest rate used in the estimation. One explanation for this lack of response is that the main product of financial companies is

10. Conventional goodness-of-fit statistics are no longer useful in the context of systems of regression equations. Therefore an alternative measure involves computing the following statistic:

$$R^2 = 1 - \left[M / tr\left(\Sigma^{-1} S_{yy}\right)\right],$$

where M is the number of banks in the system, Σ is an estimate of the variance-covariance matrix of the residual, and S_{yy} is the sum of squared differences with respect to the mean of the dependent variable (nonperforming loans) of each bank.

Table 3. System Equation Regressions of the Behavior of Nonperforming Loans, Sample Divided into Banking Groups[a]

Independent variable	*Number of lags*											
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Constant	–0.0004	–0.0005	–0.0013	–0.0015	–0.0016	–0.0010	–0.0004	–0.0006	–0.0002	–0.0005	–0.0005	–0.0004
	(–1.42)	(–1.58)	(–4.17)	(–4.82)	(–5.41)	(–3.91)	(–1.80)	(–2.54)	(–0.70)	(–2.34)	(–2.59)	(–1.54)
NPL (-1)	0.8928	0.8970	0.8992	0.8978	0.8951	0.8950	0.8965	0.8901	0.8916	0.8948	0.8955	0.8945
	(106.6)	(106.8)	106.3	(105.4)	(105.0)	(105.4)	(105.0)	(106.0)	(103.4)	(104.1)	(104.2)	(101.9)
Sample = domestic banks												
AOL	–0.0001	0.0001	0.0002	0.0001	0.0003	0.0001	0.0000	0.0002	0.0002	0.0005	0.0005	0.0003
	(–0.61)	(0.41)	(1.05)	(0.79)	(1.48)	(0.44)	(0.20)	(1.44)	(1.33)	(3.10)	(2.66)	(1.59)
MEX	–0.0268	0.0009	–0.0216	–0.0064	–0.0469	–0.0396	–0.0307	–0.0123	–0.0538	–0.0501	–0.0685	–0.0685
	(–0.74)	(0.03)	(–0.60)	(–0.18)	(–1.31)	(–1.10)	(–0.85)	(–0.36)	(–1.47)	(–1.46)	(–2.00)	(–2.00)
CAP	–0.0046	–0.0049	–0.0047	–0.0049	–0.0046	–0.0043	–0.0056	–0.0045	–0.0054	–0.0033	–0.0046	–0.0046
	(–3.79)	(–3.79)	(–3.75)	(–3.75)	(–3.56)	(–3.47)	(–4.60)	(–3.85)	(–4.44)	(–2.78)	(–3.70)	(–3.70)
INL	–0.0004	–0.0001	0.0002	0.0003	0.0004	0.0006	0.0004	0.0003	0.0017	0.0017	0.0018	0.0018
	(–0.43)	(–0.10)	(0.19)	(0.34)	(0.42)	(0.67)	(0.43)	(0.40)	(1.85)	(1.96)	(2.10)	(2.10)
LIQ	0.0008	0.0010	0.0011	0.0011	0.0012	0.0009	0.0009	0.0013	0.0004	0.0006	0.0007	0.0007
	(1.92)	(2.24)	(2.56)	(2.48)	(2.99)	(2.04)	(2.05)	(3.08)	(0.95)	(1.48)	(1.73)	(1.73)
LOG	–0.0002	–0.0002	0.0000	0.0001	0.0001	0.0003	0.0002	0.0003	–0.0002	–0.0001	0.0002	0.0002
	(–0.93)	(–0.79)	(–0.08)	(0.30)	(0.53)	(1.22)	(0.97)	(1.63)	(–0.75)	(–0.59)	(0.91)	(0.91)
MOP	0.0105	–0.0119	–0.0014	–0.0134	0.0136	–0.0088	–0.0092	–0.0124	–0.0261	–0.0283	–0.0050	–0.0050
	(0.53)	(–0.60)	(–0.07)	(–0.69)	(0.71)	(–0.46)	(–0.50)	(–0.71)	(–1.40)	(–1.61)	(–0.27)	(–0.27)
IRR	0.0092	0.0078	0.0129	0.0144	0.0127	0.0097	0.0052	0.0026	0.0027	0.0004	0.0004	0.0004
	(4.78)	(3.44)	(5.33)	(6.78)	(5.84)	(5.30)	(3.00)	(1.58)	(1.53)	(0.25)	(0.21)	(0.21)
RER	0.0046	0.0115	–0.0015	–0.0068	–0.0097	–0.0115	–0.0069	–0.0057	0.0012	0.0051	0.0058	0.0058
	(1.24)	(3.05)	(–0.39)	(–2.02)	(–2.87)	(–4.02)	(–2.55)	(–2.22)	(0.45)	(1.93)	(1.99)	(1.99)
ECA	–0.0016	0.0000	0.0000	0.0001	0.0006	0.0003	0.0005	–0.0002	0.0021	0.0027	0.0028	0.0028
	(–1.37)	(–0.02)	(0.00)	(0.10)	(0.59)	(0.37)	(0.52)	(–0.23)	(2.29)	(3.02)	(2.89)	(2.89)
Sample = foreign banks												
AOL	–0.0003	0.0008	0.0007	0.0008	0.0011	0.0004	0.0005	0.0006	0.0001	0.0003	0.0004	0.0004
	(–1.06)	(3.04)	(2.90)	(2.32)	(3.90)	(1.21)	(1.86)	(2.42)	(0.23)	(1.11)	(1.84)	(1.84)
MEX	0.0298	0.0198	–0.0259	–0.0268	–0.0329	–0.0226	–0.0144	–0.0014	0.0087	–0.0015	–0.0129	–0.0129
	(2.00)	(1.32)	(–1.78)	(–1.86)	(–2.36)	(–1.60)	(–1.04)	(–0.12)	(0.79)	(–0.13)	(–1.11)	(–1.11)
CAP	0.0015	–0.0030	–0.0023	–0.0025	–0.0026	–0.0009	–0.0011	–0.0016	–0.0010	–0.0006	–0.0019	–0.0019
	(1.61)	(–3.17)	(–2.77)	(–2.12)	(–2.87)	(–0.90)	(–1.29)	(–2.01)	(–1.21)	(–0.85)	(–3.03)	(–3.03)
INL	0.0009	–0.0007	–0.0001	0.0009	0.0009	0.0013	0.0013	0.0005	0.0005	0.0005	0.0003	0.0003
	(0.86)	(–0.70)	(–0.06)	(0.78)	(0.83)	(1.22)	(1.27)	(0.51)	(0.52)	(0.46)	(0.27)	(0.27)

Table 3. (continued)

Independent variable	*Number of lags*											
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
LIQ	–0.0012	–0.0012	–0.0011	–0.0009	–0.0001	–0.0001	0.0000	0.0003	0.0005	0.0008	0.0012	0.0012
	(–2.91)	(–3.22)	(–3.07)	(–1.87)	(–0.33)	(–0.21)	(0.07)	(0.70)	(1.14)	(2.22)	(3.25)	(3.25)
LOG	–0.0004	–0.0006	0.0001	0.0002	0.0001	–0.0003	0.0004	0.0005	0.0006	0.0006	0.0007	0.0007
	(–1.32)	(–2.13)	(0.28)	(0.57)	(0.37)	(–1.04)	(1.61)	(1.90)	(2.37)	(2.73)	(3.43)	(3.43)
MOP	–0.0108	–0.0062	–0.0089	0.0365	–0.0106	0.0456	–0.0212	–0.0338	0.0101	–0.0071	0.0087	0.0087
	(–0.73)	(–0.43)	(–0.73)	(1.66)	(–0.78)	(2.47)	(–1.74)	(–2.89)	(0.88)	(–0.82)	(1.11)	(1.11)
IRR	0.0125	0.0082	0.0142	0.0121	0.0090	0.0067	0.0019	0.0025	0.0006	0.0016	–0.0003	–0.0003
	(3.97)	(2.30)	(4.15)	(2.92)	(2.64)	(1.89)	(0.67)	(0.91)	(0.22)	(0.73)	(–0.15)	(–0.15)
RER	0.0048	0.0116	–0.0101	–0.0167	–0.0079	–0.0026	0.0051	0.0063	0.0056	–0.0074	0.0004	0.0004
	(0.72)	(1.76)	(–1.68)	(–1.85)	(–1.34)	(–0.37)	(0.99)	(1.26)	(1.14)	(–1.96)	(0.13)	(0.13)
ECA	–0.0040	–0.0012	–0.0027	–0.0027	–0.0003	0.0005	–0.0022	–0.0016	–0.0018	–0.0041	–0.0012	–0.0012
	(–1.94)	(–0.57)	(–1.50)	(–0.97)	(–0.16)	(0.22)	(–1.40)	(–1.04)	(–1.18)	(–3.48)	(–1.15)	(–1.15)
Sample = financial companies												
AOL	0.0007	0.0004	0.0022	0.0021	0.0021	0.0032	0.0021	0.0034	0.0015	0.0010	0.0012	0.0012
	(0.95)	(0.54)	(2.75)	(2.72)	(2.63)	(4.25)	(2.79)	(4.60)	(2.04)	(1.35)	(1.66)	(1.66)
MEX	0.0167	0.0179	–0.0026	0.0589	0.0461	0.0235	0.0286	–0.0430	0.0722	–0.0427	0.0142	0.0142
	(0.78)	(0.80)	(–0.11)	(2.50)	(1.95)	(1.01)	(1.30)	(–1.90)	(3.19)	(–1.88)	(0.61)	(0.61)
CAP	0.0055	0.0039	0.0002	–0.0024	–0.0020	–0.0012	–0.0028	0.0026	0.0045	–0.0037	–0.0044	–0.0044
	(1.73)	(1.18)	(0.05)	(–0.67)	(–0.58)	(–0.36)	(–0.85)	(0.77)	(1.36)	(–1.11)	(–1.26)	(–1.26)
INL	–0.0008	–0.0018	–0.0010	–0.0019	0.0004	0.0005	0.0010	0.0019	0.0018	0.0016	0.0016	0.0016
	(–0.28)	(–0.61)	(–0.34)	(–0.63)	(0.15)	(0.15)	(0.33)	(0.64)	(0.58)	(0.63)	(0.63)	(0.63)
LIQ	0.0012	0.0029	0.0035	0.0064	0.0016	0.0008	0.0030	–0.0032	–0.0010	0.0013	0.0041	0.0041
	(0.21)	(0.54)	(0.62)	(1.13)	(0.28)	(0.15)	(0.53)	(–0.56)	(–0.18)	(0.29)	(0.88)	(0.88)
LOG	–0.0001	0.0000	0.0001	0.0000	0.0000	–0.0001	0.0000	–0.0001	–0.0003	0.0001	–0.0001	–0.0001
	(–0.60)	(–0.17)	(0.49)	(0.25)	(–0.27)	(–0.75)	(–0.15)	(–0.61)	(–2.01)	(0.53)	(–0.39)	(–0.39)
MOP	–0.0062	–0.0050	–0.0113	–0.0341	–0.0297	–0.0409	–0.0069	–0.0219	–0.0389	0.0236	0.0113	0.0113
	(–0.38)	(–0.29)	(–0.63)	(–1.90)	(–1.63)	(–2.30)	(–0.41)	(–1.28)	(–2.19)	(1.37)	(0.64)	(0.64)
IRR	–0.0092	–0.0053	–0.0107	–0.0086	–0.0052	–0.0175	–0.0187	–0.0227	–0.0161	–0.0036	–0.0078	–0.0078
	(–2.31)	(–1.02)	(–1.94)	(–1.53)	(–0.90)	(–3.21)	(–3.52)	(–4.41)	(–2.95)	(–0.70)	(–1.46)	(–1.46)
RER	0.0144	0.0026	0.0092	–0.0004	–0.0139	–0.0069	–0.0042	0.0041	0.0001	–0.0064	0.0009	0.0009
	(2.18)	(0.37)	(1.24)	(–0.05)	(–1.83)	(–0.99)	(–0.61)	(0.59)	(0.02)	(–0.96)	(0.12)	(0.12)
ECA	0.0039	0.0023	0.0016	0.0003	–0.0017	–0.0039	–0.0032	–0.0031	–0.0046	–0.0016	–0.0032	–0.0032
	(1.97)	(1.07)	(0.75)	(0.13)	(–0.79)	(–1.92)	(–1.58)	(–1.55)	(–2.23)	(–0.82)	(–1.62)	(–1.62)
Summary statistic												
R^2	0.862	0.860	0.863	0.884	0.877	0.863	0.897	0.931	0.932	0.941	0.962	0.957

Source: Authors' calculations.

a. NPL, nonperforming loans; IRR, real lending rate on loans of 90-365 days; RER, real exchange rate; ECA, index of economic activity; other variables are defined as in table 1. The number below each regression coefficient is its t statistic.

consumer credits, which are usually lent for twenty-four or thirty-six months at fixed nominal interest rates. Therefore, nonperforming loans in the case of the financial companies could be related more to the evolution of long-term interest rates or to other macroeconomic factors pertaining to the consumer's ability to repay (such as changes in net income), which in turn may be directly influenced by unemployment rates. We explore this possibility below.

Economic activity in table 3, unlike in the pooled regression in table 2a, is important in explaining the behavior of credit risk for domestic banks. For these banks, increases in economic activity increase bank fragility after many periods. However, the reaction of foreign banks to increases in economic activity shows the opposite sign, although it is less clear or persistent. The liquidity ratio shows the same pattern as the economic activity index; that is, its parameter values are positive for domestic banks, suggesting that greater liquidity leads to a greater proportion of nonperforming loans. Foreign banks instead have negative parameter values, showing perhaps a result more consistent with risk aversion, in the sense that an increase in liquidity decreases the proportion of nonperforming loans.

Finally, loan growth is a significative explanatory variable only for the group of foreign banks. For lags of nine to twelve periods there is a positive response of nonperforming loans to an increase in loan growth among these banks. This result is informative in that it contradicts the pooled estimates in table 2a, which suggest that all banks are responsive to loan growth.

Table 3 also reveals that the financial ratios and macroeconomic variables are essentially unable to explain the evolution of nonperforming loans for financial companies. An alternative model was estimated for this group of institutions using a proxy for household income as a determinant of the repayment ability of consumers. This proxy is computed on a monthly basis as the real wage index times the percentage of working-age people employed in the economy. The goodness of fit of the model did not increase, however, and the household income variable was not significant at various lags. In order to check the results of the longitudinal estimation, we tested the sensitivity of aggregate household income on a company-by-company basis, but still found that it was not significant. We also incorporated the unemployment rate directly in the estimation, but the parameter estimates were not significant at any lags. Therefore we can argue that, in the case of financial companies, the evolution of nonperforming loans is determined exogenously by its own dynamic.

3. Concluding Comments

This paper has attempted a simple estimation of the determination of some measures of banking fragility, to identify which bank-specific and macroeconomic variables could explain their behavior. Despite the model's simplicity, we were able to extract some interesting insights regarding the ratio of nonperforming loans to total loans and how managerial efficiency, liquidity position, and the cost of funding affect its performance.

We concentrated on only two types of risk in this paper: credit risk, which is considered the more relevant, and a proxy of liquidity risk. Certainly banks face other risks in their business, namely, interest rate risk, currency risk, maturity risk, technology risk, and sovereign risk. Nonetheless, in Chile currency risk is severely constrained by central bank regulations, and banks can lend directly in foreign currency only to exporters. Risk arising from interest rate volatility is hedged to some extent for mortgage credit operations. On the other hand, banks normally may have some net open positions with the central bank related to their participation in the payments system. It remains for future study to consider these additional risks, how to measure them and how to identify which variables could explain their evolution and their impact on bank fragility, within the context of reduced-form model specifications.

The results for the interbank spread are also encouraging, but they should be interpreted with care because of the missing-observations problem. An alternative, continuous measure of liquidity risk could be used instead to validate these results. Finally, other sources of banking fragility should be explored, even though credit risk has been traditionally considered the most relevant for the long-term assessment of banks' financial stability.

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Capital Inflows, Credit Booms, and Macroeconomic Vulnerability: The Cross-Country Experience

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The turbulence in financial markets in Southeast Asia in 1997-98 and the crisis in Mexico in 1994-95 have renewed interest among policymakers in the issues of capital account liberalization and financial sector reform. In all the East Asian cases and in Mexico, as well as in many other earlier episodes such as that of Chile in the late 1970s, countries that saw a rapid growth in bank credit typically experienced a financial crisis later on. Bank lending booms in these emerging market economies, often financed by a surge in capital inflows, led to overborrowing and asset price inflation, exacerbating financial fragility and macroeconomic vulnerability. This pattern has led several authors to argue in favor of imposing capital controls to avoid the excesses in financial markets that can lead to distress and crisis.

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This paper presents the results of an exploratory study aimed at better understanding the links between capital account liberalization and developments in domestic financial markets. Subsequent research should address many issues that arise from the study but are not discussed here. The authors are grateful to Eduardo Fernández-Arias for comments on a previous draft and to Ricardo Mayer for his efficient assistance at an early stage of the research. All remaining errors are our own. The interpretations and conclusions expressed in this chapter are entirily those of the authors and do not necessarily represent the views of the International Monetary Fund.

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This paper studies the pattern just described across a relatively large sample of country episodes during the 1970s, 1980s, and 1990s, in both developed and developing economies, highlighting those aspects that appear to be most critical from the point of view of policymakers. The aim of the paper is to determine the importance of private capital inflows in leading to situations of financial distress like those occurring in Southeast Asia in recent years. The main motivation of the paper is the contrasting experience of Chile during the 1970s and the 1990s. Whereas the earlier episode of large (private) capital inflows in Chile ended in a financial crisis and a deep recession in 1981-83, the experience during the 1990s led to sustained high economic growth for almost a decade.

Although financial crises can be due to many reasons and factors, we aim to show that private capital inflows have little to do with situations of financial distress. Consistent with the work of others (Gourinchas, Landerretche, and Valdés, 2001), the analysis in this paper suggests that financial fragility may be related more to developments in domestic financial markets than to those in the external accounts. Thus surges in capital inflows should be of concern for policymakers only to the extent that they finance an unsustainable lending boom, but the latter rather than the former should be the main concern of economic authorities in developing countries. The analysis in this paper shows that, although private inflows contribute to lending booms, it is unlikely that they are the source of instability that leads to financial distress and a credit crunch. Most likely the source of financial instability lies in weaknesses in the regulatory and supervisory framework and in the overall environment in which banks operate.

Therefore, given that the domestic banking sector amplifies economic fluctuations through the so-called credit channel, and that poorly regulated banks may lead to a significant increase in macrofinancial fragility, containing lending booms—while strengthening banking sector supervision and monitoring—emerges as the first policy option for policymakers interested in ameliorating the adverse effects of financial liberalization. Putting "sand in the wheels" of international finance may have a small effect on minimizing the risks associated with financial liberalization, but it should not constitute the main course of action for policymakers in developing countries.

The next section of the paper briefly summarizes the relevant literature and describes the mechanisms through which a surge in

private capital inflows can lead to—or may exacerbate—a lending boom, and how the latter can increase macrofinancial fragility, especially in countries with a weak financial sector. Section 2 presents the cross-country evidence that supports this process while, at the same time, seeking to unveil the role played by surges in capital inflows in situations of financial distress. Section 3 summarizes and concludes.

1. The Role of Banks in the Macroeconomy: The Credit Channel and Vulnerability

1.1 Closed Economy

Financial intermediaries play a crucial role in economic development and growth by channeling savers' money to more efficient and productive uses. This task is most valuable when savers and potential investors are far apart, a likely situation when the household sector—as opposed to the corporate sector—is the main source of saving in an economy. Financial intermediaries perform the task of efficiently channeling funds by screening and selecting investment projects and transforming assets, usually from short-term deposits to long-term investments, but more generally from illiquid to liquid forms. The fact that banks overcome information asymmetry problems between lenders and borrowers, and facilitate the creation of liquidity, gives them a unique role in the economy. In particular, by facilitating the exchange of goods and services, financial intermediaries contribute to higher levels of aggregate output and growth (King and Levine, 1993; Levine, 1997). However, in performing this task these institutions become vulnerable, subject to runs on their deposits (Diamond, 1984; Ramakrishnan and Thakor, 1984; Diamond and Dybvig, 1983).

Extensive research has been devoted to the role of bank credit in the economy and its importance in propagating and amplifying business cycles; this research is directly linked to the operation of monetary policy (Bernanke, 1983; Bernanke and Blinder, 1988; Bernanke and Gertler, 1989, 1995). The role of the banking sector has attracted the attention of researchers because periods of sharp contraction in bank credit have always been accompanied by slow or negative economic growth. Similarly, periods of rapid expansion in bank credit

seem to go hand in hand with rapid economic growth. However, it has also been noted that these large swings in aggregate output do not appear consistent with the relatively small changes observed in interest rates or with the low estimates obtained for the interest rate elasticity of the different components of aggregate demand (Bernanke and Gertler, 1995). The last observation has led proponents of the credit channel of monetary transmission to argue that it is *bank credit,* and not just monetary balances (broad money) and the interest rate, that affects macroeconomic performance.[1]

Two types of credit channel have been proposed, namely, the balance sheet channel and the bank lending channel. In both, bank credit works as an input in the economy's aggregate production function; that is, $Y = g(K; L; CR)$, where Y, K, L, and CR represent output, physical capital, labor, and credit, respectively. The balance sheet channel works because during an economic upturn many potential borrowers become more creditworthy as firms' cash flows rise and asset prices increase. Since bank credit is based on the borrowers achieving certain financial ratios (such as those measuring liquidity, interest coverage, and collateral), during the upturn more credit is made available, which, in turn, allows output to grow faster. In the bank lending channel some kind of market segmentation is assumed, in the sense that good substitutes for bank credit do not exist (bonds, commercial paper, and equities are poor substitutes for bank credit). Thus, additional bank credit allows small firms (those without direct access to capital markets) and households to invest and consume more, inducing faster economic growth. An intuitively simple example in which this type of credit channel operates is the case of a household financing the purchase of a home. Since it would be costly for the household to access the capital markets directly for such a purchase by issuing bonds or stocks, the development of the real estate sector is very often accompanied by the development of the mortgage market by banks. All in all, the credit channel provides a consistent explanation for the observed procyclical behavior of bank credit.

Extensive empirical research has also been undertaken toward understanding and describing the dynamic interactions between the financial and the real sectors and the potential buildup of fragility in the former (Kindleberger, 1978; Hubbard, 1991; Feldstein, 1991).

1. The interest rate mechanism is the one through which monetary policy works in the traditional macroeconomic literature.

The argument goes as follows. A positive development in the real sector that raises expectations about the future will increase firms' willingness to invest, inducing them to borrow more and causing an expansion in bank credit. The lending boom, in turn, enables market participants to increase their level of expenditure and (through the credit channel) accelerates economic growth. The faster economic growth reinforces the entire process by validating economic agents' expectations about the future. The state of euphoria triggered by the initial increase in spending also leads to an increase in asset prices and financial wealth, which further reinforces the process by increasing households' aggregate consumption. The increase in asset prices, in turn, raises collateral values and facilitates the granting of additional bank credit. Meanwhile the economy as a whole becomes more vulnerable to adverse shocks, both because of the increase in the indebtedness of firms and households, and because of the risk of a deflation in asset prices that would reduce borrowers' financial wealth—thereby affecting banks' financial health. Thus, if a negative shock leads economic agents to believe that current conditions are no longer sustainable, and they cut their spending on consumption and investment, economic growth will slow, firms and households will have difficulty servicing their debts, asset prices will plunge, and banks will encounter greater financial problems. All in all, credit booms are associated with the buildup of macrofinancial fragility through the increase in both asset prices and indebtedness.

In sum, not only is bank credit subject to boom-bust cycles during which macrofinancial fragility increases in the economy as a whole, but the banking sector amplifies the magnitude of this macroeconomic cycle (Calomiris, 1995; Calomiris and Gorton, 1991).

1.2 Open Economy

Despite the extensive literature documenting boom-bust cycles in bank lending and the associated fluctuations in economic activity, these issues have only recently been investigated in the context of an open capital account. Although still preliminary, in general the conclusions that emerge from this new literature appear to be straightforward. First, although the presence of foreign credit may result in larger cyclical fluctuations, the domestic banking sector is ultimately responsible for amplifying the magnitude of the macroeconomic cycle. Second, the domestic banking sector exacerbates vulnerabilities in emerging market economies.

For example, the work by Kaminsky and Reinhart (1996) and Hausmann and Gavin (1996) provides evidence that the boom-bust cycles in domestic bank credit, asset prices, and economic activity resemble and precede those in the external accounts (in particular, the current account deficit). This result suggests that, even in a more financially integrated economy, the domestic banking sector is still partly responsible for cyclical swings. Along the same line, Sachs, Tornell, and Velasco (1996) conclude that the impact of the Mexican peso crisis of December 1994 on other emerging market economies —the "tequila effect"—can be partly explained by the level of private sector debt held by the countries' banking systems. In other words, those developing countries in which bank credit was growing more rapidly during the most recent surge in private flows were more vulnerable to the shocks associated with the Mexican crisis.

The results above have also been validated on theoretical grounds. For example, Goldfajn and Valdés (1997) show that, in a financially integrated economy, the existence of a domestic banking system exacerbates capital movements from abroad, therefore amplifying the effects of external shocks. This occurs because the domestic banking system transforms illiquid assets into liquid assets, and this in turn motivates foreign investors to lend more to the recipient country. This provision of liquidity, however, makes banks vulnerable to runs, as in the seminal model of Diamond and Dybvig (1983). Similarly, in analyzing the causes of the East Asia crisis, Krugman (1998) argues that, in the presence of a safety net—in the form of an implicit or explicit deposit insurance—that is perceived to protect foreign lenders, the domestic banking system will overborrow from abroad and overlend domestically. In addition, banks will exacerbate inflation in asset prices and amplify the economic cycle.

Finally, Edwards and Végh (1997) use Granger causality tests to study the relationship among international liquidity, bank credit, and aggregate output. Within a theoretical framework fully consistent with the bank lending channel described above, these authors look at the cases of Chile during 1979-93 and Mexico during 1986-95. Using a two-step procedure, Edwards and Végh provide evidence consistent with the credit channel hypothesis in an open capital account context. In particular, they cannot reject the null hypothesis that the conditions in credit markets—measured by interest rates and spreads—Granger-cause aggregate output, while the reverse causality is rejected in both countries. Movements in bank deposits and credit are also consistent with the credit channel hypothesis in both countries.

1.3 Financial Integration

The surge in private capital inflows that usually accompanies the increase in financial integration is explained, in part, by the implementation in the recipient countries of different economic reforms that improve the country's economic prospects.[2] Thus the increase in private capital inflows usually occurs along with the rise of optimistic expectations about the future. At the same time, the surge in flows provides the additional resources needed to finance an increase in aggregate investment. These two elements together provide the necessary ingredients to trigger a lending boom, especially if the external resources are either directly or indirectly intermediated by the domestic banking industry.

Even if the surge in inflows is due to an exogenous increase in international liquidity, and not to the implementation of economic reforms in the recipient countries, the lower level of interest rates in world capital markets that accompanies such an increase in liquidity makes indebted countries more creditworthy. This effect on its own will trigger a surge in international borrowing and lending (Fernández-Arias, 1994).

Irrespective of the ultimate cause of the increase in international lending, as long as the surge in private inflows is not fully sterilized (which is almost an impossible task), a capital-recipient economy will experience an increase in liquidity, which facilitates a surge in bank credit and a lending boom. In this context, a banking industry operating under suboptimal conditions (in terms of poor incentives and inadequate supervision) may exacerbate the country's macroeconomic vulnerabilities and eventually lead to financial distress or a crisis. In particular, if an increasing flow of funds into a country is intermediated by an undercapitalized and poorly regulated banking sector that is too prone to risk taking—because of, for example, excessive deposit insurance as in Krugman's (1998) model—the economy is likely to consume and import too much, invest too little, and therefore become increasingly vulnerable to shocks. As illustrated by the events in recent years in East Asia, and in Latin America during the 1970s and 1980s (see De Gregorio and Guidotti, 1995), it is not only the amount of total lending that matters, but also the quality of the projects financed by the banking system.

2. These include, for instance, tax, fiscal, and trade reforms and financial liberalization and deregulation.

2. Capital Inflows and Credit Booms: Country Experiences

The experience of different countries, both developed and developing, that have become increasingly integrated with global financial markets shows that a lending boom usually accompanies a surge in private capital inflows (see World Bank, 1997; Asian Development Bank and World Bank, 1998). In this section we analyze the empirical regularities observed in countries experiencing surges in inflows and lending booms, and we try to underline those aspects that are of most concern for policymakers in developing countries seeking greater financial integration.[3]

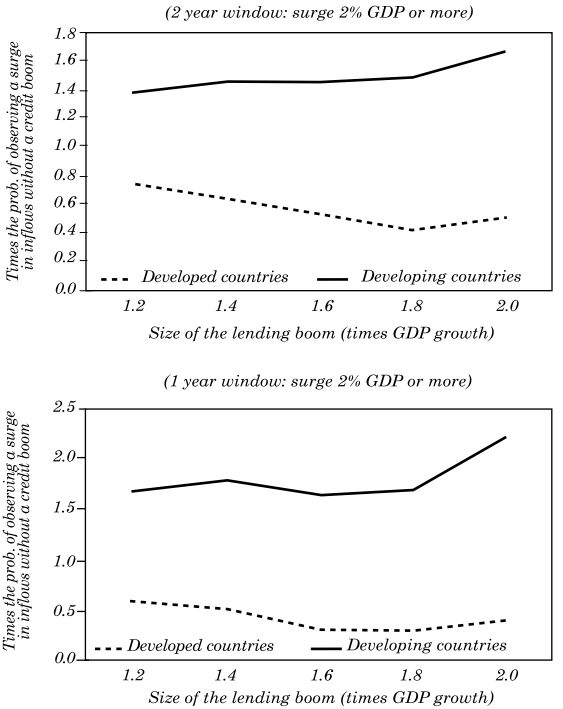
2.1 Credit Booms and Capital Inflows

To corroborate the hypothesis described above, we study whether years of rapid credit growth are preceded or accompanied by years in which private capital inflows rise. The sample comprises a relatively large group of both developed and developing countries for which data were available during 1970-95 (sixty countries in all, although not all countries have a complete data set). The countries are listed in table A5 in the appendix. For each country in every year we measure private capital inflows as a share of GDP (*ki*) and the growth rate of bank credit to the private sector ($\Delta\%bcps$). Private capital inflows are measured as the current account deficit plus the increase in international reserves, minus debt flows from official creditors (mainly multilateral institutions). All data are from the IMF/World Bank databases. A year of rapid credit growth is defined as one that satisfies the following conditions: growth in bank credit to the private sector is at least X times the growth of GDP, where X is a predetermined value greater than 1, and this rapid growth continues for at least another year (that is, year t qualifies if $\Delta\%bcps \geq X\Delta\%gdp$ for years t and $t + 1$). Next we construct the following test. For a specific country we select all the years that satisfy one or both of the following criteria:

- There is a lending boom as defined above (that is, rapid credit growth in two consecutive years), and
- Private capital inflows (as a share of GDP) are positive and increase in that year or the year before (that is, $\Delta ki_t > 0$, or $\Delta ki_{t-1} > 0$,

3. The results presented in this section are preliminary.

Figure 1. Probability of a Credit Boom Accompanying or Following a Surge in Capital Inflows in Developed and Developing Countries



Source: Authors' calculations.

but excluding those years when capital outflows are decreasing). The increase in capital inflows has to be at least *Z*% of GDP.

For each country all the years satisfying both criteria are counted as successes, and all the years satisfying the first but not the second are counted as failures.[4] Tables A1A and A1B in the appendix present the results for different thresholds of both capital inflow increases and lending booms. Figure 1 summarizes the result (for different sizes of lending booms) for the case of a capital inflow

4. In this exercise each year counts as one episode. Thus, periods of rapid credit growth—and surges in capital inflows—that last for several years will (approximately) count for as many episodes as the number of years they last.

increase of at least 2 percent of GDP. The two panels compare the probability of having a surge in capital inflows that leads to a credit boom with that of having a surge in capital inflows that does not lead to a credit boom (the lines in the charts represent the ratio between these two probabilities).

The conclusions that emerge from tables A1A and A1B, and figure 1 are straightforward:

- The probability that a surge in capital inflows will lead to or be accompanied by a lending boom is always higher in developing than in developed countries.[5]
- In the case of developing countries, the probability that a surge in capital inflows will accompany a credit boom is always higher than the probability of observing an increase in inflows without a boom in bank credit. Furthermore, for large capital inflows the probability of having a credit boom is between 1½ and 2 times the probability of not having one.
- For developed countries it is equally likely (and sometimes more likely) to observe a surge in capital inflows *without* a boom in bank credit as to observe a surge in inflows that accompanies a credit boom.

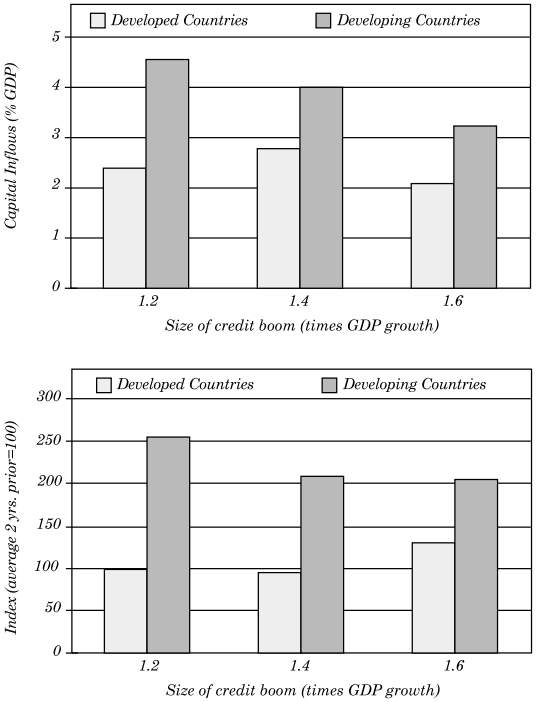
A further conclusion consistent with these emerges when considering each group of consecutive years during which bank credit grows more than X times GDP as a single episode—that is, when different years do *not* count as separate episodes.[6] Table A2 in the appendix shows the size of capital inflows as a share of GDP in both developed and developing countries, during periods of credit booms and in the two years preceding them. Two conclusions emerge.[7] First, private capital inflows tend to be larger during credit boom episodes in developing than in developed countries. Second, private capital inflows tend to increase during credit boom periods in developing countries—sometimes they double compared with the years preceding the credit boom. As shown in figure 2, the same is not true for developed countries.

5. Note from tables A1A and A1B that the probability of a surge in capital inflows occurring one year before or simultaneously with a lending boom is *always higher* than the probability of a surge in inflows occurring simultaneously with a lending boom. This result suggests that capital inflows tend to precede lending booms.

6. See footnote 4.

7. We neglect in the analysis those cases where the number of episodes is small (cases of large lending booms in developed countries), considering that they are most likely not representative of the actual mean of the distribution.

Figure 2. Size of Capital Inflows during Credit Booms



Source: IMF and World Bank databases.

In sum, the evidence suggests that private capital inflows play a more important role in credit booms in developing than in developed countries. Alternatively, developing countries are more likely to enter a credit boom cycle triggered by a surge in private capital inflows than are developed countries.

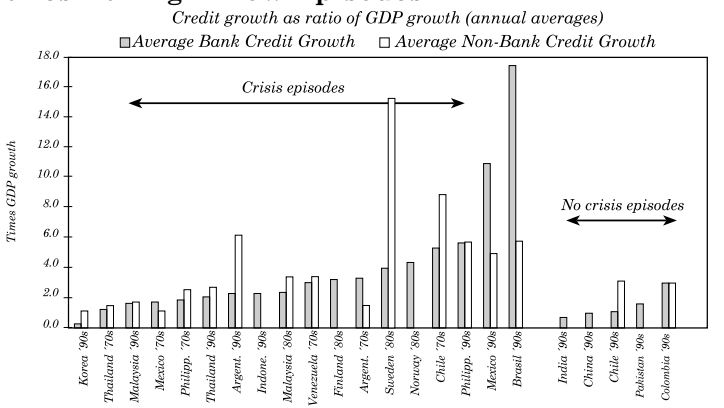
2.2 Capital Inflows, Credit Booms, and Financial Fragility

As for any other industry, periods of rapid (credit) growth may be dangerous for banking. Because of shortages of some important inputs, periods of rapid credit growth tend to create strains in bank staff and management. In particular, because of the limited response in the short run of the supply of adequately trained staff, banks have

limited capacity to screen and select loan applications. Therefore, during a period of rapid credit growth, the quality of banks' portfolios tends to deteriorate. Thus it has been argued that, in order to preserve the quality of banks' portfolios and achieve sustainable growth, as a rough benchmark credit growth should closely follow output growth in economies with mature financial markets. It can be between 1.5 and 2.0 times output growth in developing economies with a low degree of financial deepening. In other words, "... very high loan growth taxes the internal capabilities (to monitor loan portfolios and ensure stable asset quality) and the managerial skills of banks" (Bank for International Settlements, 1997).

Figure 3 shows average annual growth in bank and nonbank credit to the private sector, as a multiple of average output growth, during capital inflow periods for a sample of twenty-three episodes in both developed and developing countries.[8] As argued above, in most episodes where growth in bank and nonbank lending exceeded the benchmark of around 1.5 to 2.0 times GDP growth, the episode ended in a financial crisis (although its severity varied from country to country).

Figure 3. Growth of Bank and Nonbank Credit in Selected Countries During Inflow Episodes



Source: International Monetary Fund, *International Financial Statistic*; World Bank (1997); Asian Development Bank and World Bank (1998). Inflow periods are defined as in the last two sources.

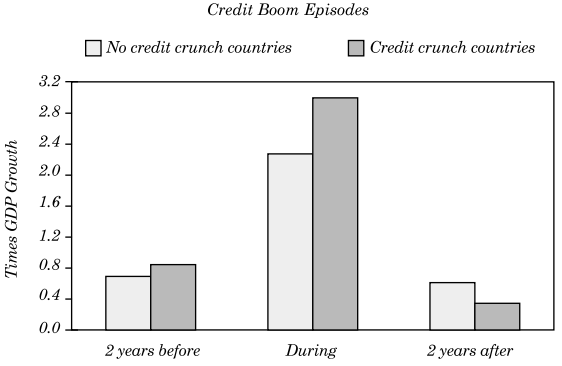
8. The only case among those in the sample in which capital inflows were negligible was Sweden (where they were less than 1 percent of GDP). In all other cases the inflows were 2 percent of GDP or higher (in many cases significantly higher). Inflow periods are defined as in the sources.

A similar conclusion emerges when one compares the size of the lending booms, within the same sample of sixty countries above, in those episodes that ended in a credit crunch and those that did not. For this we use the broadest definition of lending boom possible: we define as lending booms all those periods where bank credit to the private sector grew at least 1.2 times as fast as GDP. In the resulting sample of 133 lending boom episodes, we identified all those that were followed by a credit crunch, defined as a *decrease* in bank lending to the private sector of 4 percent of GDP or more. The results, shown in figure 4, show that growth in bank credit was faster, both during the credit boom and before it, in countries that subsequently suffered a credit crunch than in those that did not.

In sum, figures 3 and 4 and the analysis above suggest that periods of large capital inflows and rapid credit growth very often will lead to periods of financial distress or even crisis. This statement, however, needs to be qualified in at least two respects.

First, capital inflows and rapid growth in bank and/or nonbank credit may increase economic vulnerability but are not always the ultimate reason why a financial crisis occurs. Financial crises are usually caused by exogenous shocks in the real sector, with the financial sector amplifying its effects on the rest of the economy. Also, in some cases, like that of Korea during the 1990s, financial crises occurred even though lending by banks and nonbanks did not show significant growth in the years preceding the crisis. (In the case of Korea the direct external borrowing of the corporate sector is pivotal

Figure 4. Size of Credit Booms in Countries That Suffered and Countries That Avoided a Credit Crunch



Source: IMF and World Bank databases.

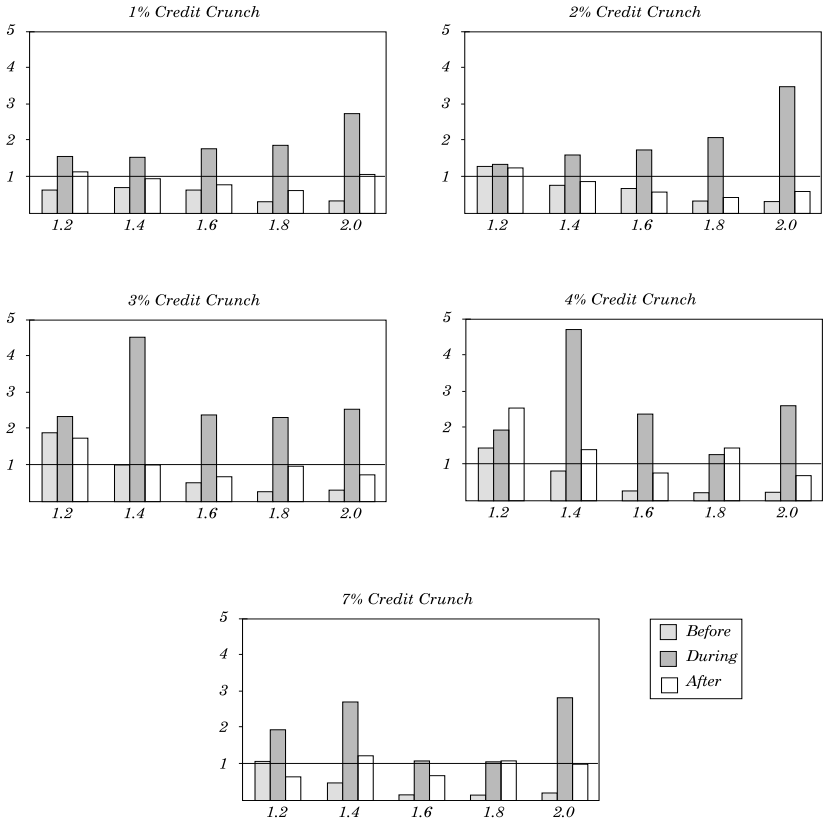
in explaining the extent of the crisis. For a review of the determinants of financial crises see Caprio and Klingebiel, 1997, and Demirgüç-Kunt and Detragiache, 1997.)

Second, and more important, the episodes in which a lending boom is followed by a credit crunch are *not* (on average) those that see the largest capital inflows. On the contrary, countries that do not experience credit crunches are systematically those that receive the largest capital inflows during lending boom periods. This conclusion is drawn from table A3 in the appendix, which shows private capital inflows (as a share of GDP) for two groups of countries: those that suffered a credit crunch after a lending boom, and those that did not. The analysis is done for several sizes of lending booms and credit crunches. Private inflows are shown (averaged) for the two years prior to, for the lending boom period itself, and for the two years after it. A credit crunch is defined as a decrease in financial depth, that is, a fall in bank lending to the private sector as a ratio to GDP. The same conclusion is illustrated in figure 5, which shows the ratio of capital inflows (as a share of GDP) received by the non-credit crunch countries to those received by credit crunch countries. For all sizes of credit crunch, the non-credit crunch countries receive about twice as large an inflow of capital (relative to GDP) during lending boom periods as do credit crunch countries.

Furthermore, credit crunches are *not* (on average) caused by capital *outflows*. Indeed, although private capital inflows are generally smaller during credit boom periods than in the preceding two years for countries suffering a credit crunch, they remain positive during lending boom episodes and afterward (at levels about or above 1.5 percent of GDP). This is true for credit crunches of all sizes (see table A3). Also, it is worth noting that private capital inflows *increase* in the years leading to a lending boom for non-credit crunch countries and the opposite is true for credit crunch countries. This result suggests that foreign private investors start decreasing their exposure to credit crunch countries well before financial difficulties arise.

Overall, private capital flows do not seem to be the reason why countries enter into situations of financial distress. Moreover, based on the evidence above, it could be argued that private capital tends to flow toward countries with stronger financial sectors (among other economic fundamentals—see Hernández and Rudolph, 1997). It would be hard to argue, therefore, that private capital flows cause financial distress because massive inflows occur during lending booms (exacerbating financial fragility) or because large capital outflows *cause* credit crunches.

Figure 5. Capital Inflows in Countries That Suffered and Countries That Avoided a Credit Crunch[a]



Source: Authors´ calculations.
a. The bars show the capital inflows (as a share of GDP) received by non-credit crunch countries, divided by the capital inflows (as a share of GDP) received by credit crunch countries. The horizontal axis measures size of credit boom (times GDP growth).

2.3 Credit Booms and Financial Fragility

The extent to which rapid credit growth exacerbates macrofinancial fragility depends critically on the strength of the financial sector. The latter, in turn, may be partially determined by whether financial markets are "mature" or not, and by the quality of the regulatory and

supervisory framework in which banks operate. Thus countries with strong financial sectors can experience rapid credit growth for some time without increasing macrofinancial vulnerability. This may have been the case in Chile and Colombia during the 1990s (although the growth in financial sector lending to the private sector in these two countries does not compare to that of, say, the Philippines during the same period). In fact, as shown in figure 6, the two countries were rated, at the onset of the financial crisis in Asia, as having the strongest banking sectors in Latin America—in Chile's case as strong as those in Hong Kong and in some developed countries.

However, the strength of the financial system also depends on the maturity of the market. Using the same sample of sixty countries, we calculated financial depth—measured by total bank credit to the private sector as a ratio to GDP—for all countries prior to a lending boom episode, and we grouped the episodes by whether they ended in a credit crunch or not. The results are presented in table A4 in the appendix. Interpreting financial depth as an indicator of market maturity, the conclusion that emerges from this analysis is that less mature (shallower) markets are more prone to suffer a credit crunch after a lending boom, as figure 7 also shows.[9]

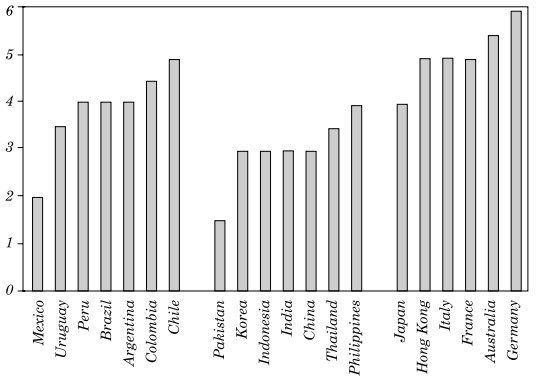
2.4 Credit Booms and Macrofinancial Vulnerability

As the analysis above suggests, it is expected that, ceteris paribus, countries where the banking sector intermediates proportionately larger inflows will become more vulnerable to macroeconomic shocks. Vulnerability in this context means the likelihood that a shock will negatively affect market sentiment toward a country, triggering a portfolio shift toward safer (foreign) assets, a reduction in aggregate credit, asset price deflation, and eventually a balance of payments crisis. Nevertheless, a balance of payments crisis may not occur if prices adjust sufficiently, through a large devaluation or a significant fall in prices of stocks or other assets, but it is the ultimate reason why prices change.

There are three main channels through which the financial sector can exacerbate macrofinancial vulnerability in the presence of large capital inflows: by financing a consumption (as opposed to an investment) boom; by financing an investment boom in the "wrong"

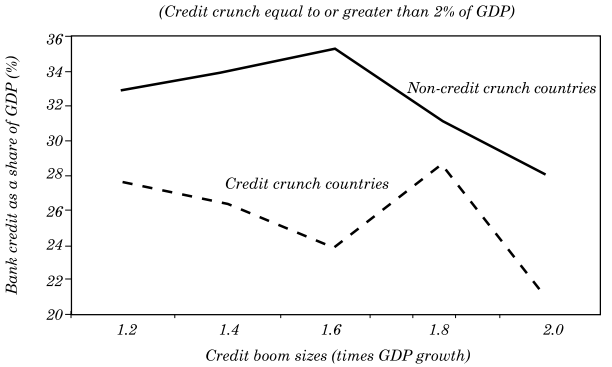
9. In reaching this conclusion we exclude all cases with a small sample, that is, all cases where the credit crunch was equal to or greater than 4 percent (see footnote 7). See table A4 in the appendix.

Figure 6. Ratings of Bank Financial Strength in Selected Countries



Source: Moody's Investor Service, June 1997.

Figure 7. Initial Financial Depth in Countries That Suffered and Countries That Avoided a Credit Crunch



Source: IMF and World Bank databases.

sectors (those that do not increase the repayment capacity of the economy); and by inducing (or enlarging) a bubble in asset prices. However, these channels are all interrelated. For example, when it finances a construction boom, the financial sector indirectly induces an increase in real estate prices. Similarly, when it lends for the purchase of stocks and other securities (margin lending), the financial sector helps to create and sustain a surge in stock prices, indirectly triggering a consumption boom.

Many pieces of empirical evidence support this chain of events, although they fall short of establishing causality in a rigorous manner. For our purposes, nevertheless, it is enough to show that lending booms tend to occur simultaneously with increases in aggregate consumption, investment in "wrong" sectors, or increases in asset prices, since all of these are symptoms of increased macrofinancial fragility. In other words, by containing a lending boom in a country with a poorly regulated banking sector, the authorities can ameliorate macrofinancial fragility, whatever the ultimate cause of the surge in lending—and irrespective of whether bank credit and capital inflows are exogenous or endogenous (whether they are caused, for example, by the implementation of economic reforms). In the rest of this paper we present some evidence that supports, albeit partially, this story. We cannot pursue a more rigorous approach because the necessary data are scant and difficult to obtain.

Consumption Booms

Empirical evidence suggests that, for a given amount of private capital inflows, countries experiencing a larger lending boom also tend to experience larger current account deficits, overconsumption, and underinvestment—all symptoms of greater vulnerability (World Bank, 1997). Similarly, Montiel (1997) concludes from a sample of forty-eight consumption boom episodes that around 75 percent occur simultaneously with a lending boom. Most important, this percentage increases to 86 percent in the case of developing countries, which, as is well established (figure 6), have more fragile and more poorly regulated and supervised banking systems (World Bank, 1997).

Consistent with these results, Butelmann and Landerretche (1998) show that consumption credit behaves pro-cyclically with respect to output, contradicting the permanent income hypothesis,[10] and supporting the view that households are credit constrained when they attempt to consume more. In particular, using a Hodrick-Prescott filter to identify the cyclical components of aggregate output and consumption credit, Butelmann and Landerretche show that these two series are positively correlated in six out of the seven countries included in their sample. Table 1 and figure 8 show their results.

10. According to this hypothesis, consumption credit should behave countercyclically, to help economic agents smooth their consumption over time.

Table 1. Correlations between Cyclical Components of Aggregate Output and Consumption Credit in Selected Countries

Country	*Correlation coefficient*
Germany	+0.54
Canada	+0.73
Chile	+0.49
Italy	–0.17
Japan	+0.63
United Kingdom	+0.53
United States	+0.63

Source: Butelmann and Landerretche (1998).

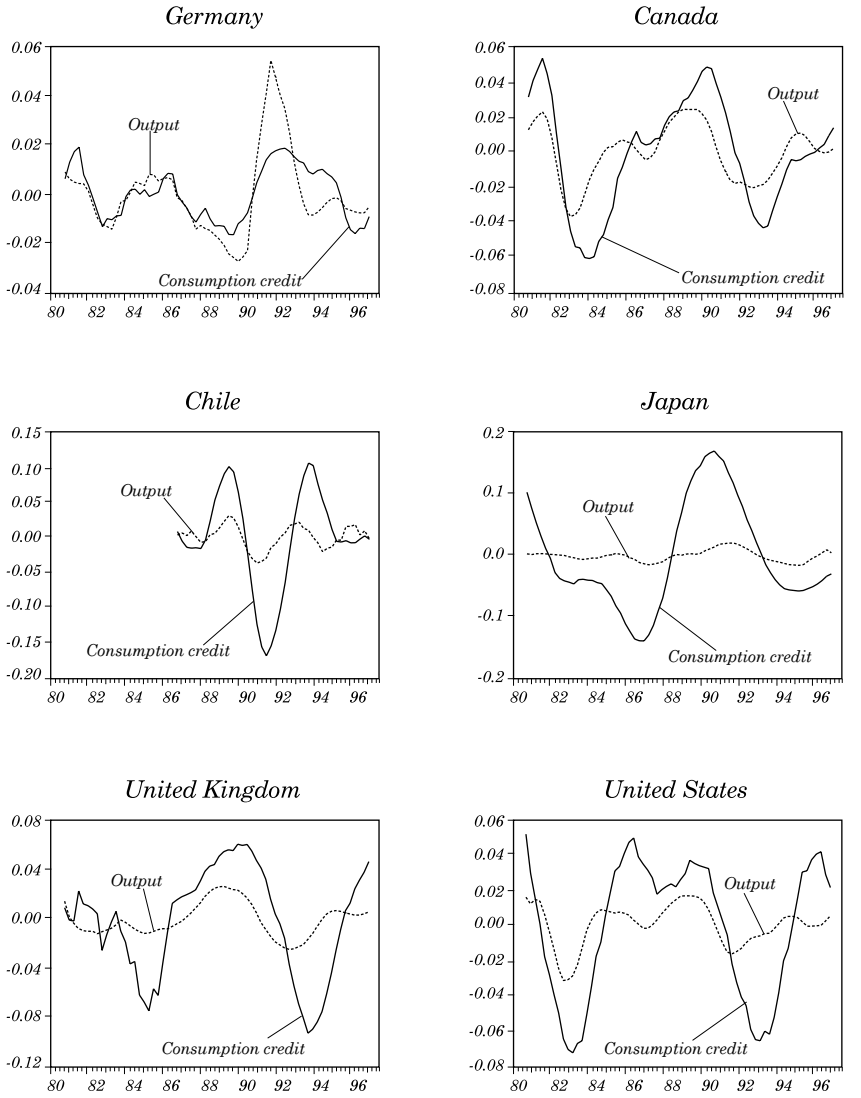
Real Estate Booms

As argued earlier, another way in which poor financial intermediation may exacerbate macroeconomic vulnerability in the context of increased financial integration is by overlending for investment in the "wrong" sectors. This has been vividly illustrated by the real estate booms experienced in most East Asian countries in the 1990s, a development that has two negative implications for the economy. First, it allows the expansion of a sector that is labor intensive, therefore adding extra pressure for a real appreciation of the currency and reducing the competitiveness and debt repayment capacity of the economy. Second, it exposes the banking sector to large losses due to fluctuations in real estate prices,[11] thereby jeopardizing the continuity of normal flows of credit to support other economic activities in the future.

Regarding the first of these implications, systematic evidence is scant. However, because of the high costs involved in issuing bonds or equity, it is possible to argue that homebuyers in most countries have very limited access to sources of funds other than bank loans. Therefore, in a manner similar to the case of consumption credit discussed above, the real estate business is very likely to depend on bank credit for its growth. In an attempt to validate this point—the credit channel hypothesis—we ran a regression, using high-frequency (monthly) data, of new investment in construction in the Philippines

11. Given the nature of the real estate business, assets are typically used as collateral for bank loans.

Figure 8. Aggregate Output and Consumption Credit in Selected Countries (Cyclical Component)



Source: Butelmann and Landerretche (1998).

(measured in constant 1990 Philippine pesos) on two lags of private capital inflows, four lags of new bank credit to the private sector, and four lags of the increase in the money supply (M1). Both credit and money are expressed in changes, whereas capital inflows are measured in absolute value.

The results, shown in table 2, show that the coefficients on money supply (M1) changes alternate sign more often than do those on changes in bank credit. Most important, the test results for the null hypothesis that the sum of all the coefficients associated with one particular variable is zero (the Wald test) indicate that this hypothesis is rejected at standard confidence levels in the case of credit, but cannot be rejected in the case of the monetary aggregates. Moreover, when all the variables are put in the same regression, the sum

Table 2. Relationship of New Construction Investment to Capital Inflows, Bank Credit, and Money Supply Growth in the Philippines[a]

		1985.8 – 1996.1			*1990.12 – 1996.1*		
Independent variable	*No. of lags*	*(1)*	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*
Capital flows	1	0.016	0.007	0.014	0.026	0.010	0.025
	2	0.001	0.006	0.011	–0.004	–0.004	0.006
Change in new bank credit to private sector	1	0.035	...	0.021	0.091*	...	0.032
	2	0.045*	...	0.057**	0.057	...	0.0142**
	3	0.014	...	0.022	0.064	...	0.057
	4	0.017	...	0.009	0.041	...	–0.011
Change in money supply (M1)	1	...	0.023*	0.014	...	0.059**	0.031
	2	...	–0.008	–0.016	...	–0.004	–0.049
	3	...	0.007	0.011	...	0.036	0.032
	4	...	0.012	0.015	...	0.031	0.040
Lagged dependent variable (AR)	1	0.275**	0.350**	0.296**	0.085	0.245	0.144
	2	0.339**	0.382**	0.013**	0.161	0.290	0.147
Summary statistic							
Adjusted R^2		0.343	0.354	0.351	0.111	0.149	0.153
Wald test for sum of coefficients on change in new bank credit		3.96**	...	2.94*	6.82**	...	4.32**
Wald test for sum of coefficients on change in money supply		...	0.99	0.45	...	2.02	0.03

Source: Authors' calculations.

a. The dependent variable is new investment in construction in the Philippines (measured in constant 1990 Philippine pesos). * and ** denote statistical significance at the 5 percent and the 10 percent level, respectively.

of the coefficients for changes in bank credit does not lose its statistical significance.[12]

Also, available information shows that a construction boom occurred in several of the East Asian crisis economies. But this phenomenon has also occurred elsewhere. As is well known, it played a very important role in the crises of Japan during the early 1990s and in that of Chile in the early 1980s. Figure 9 shows the construction booms experienced by a few East Asian economies in recent years, as well as that in Chile in the years surrounding the 1982-83 crisis. All these countries had a surge in capital inflows and a lending boom during those years.

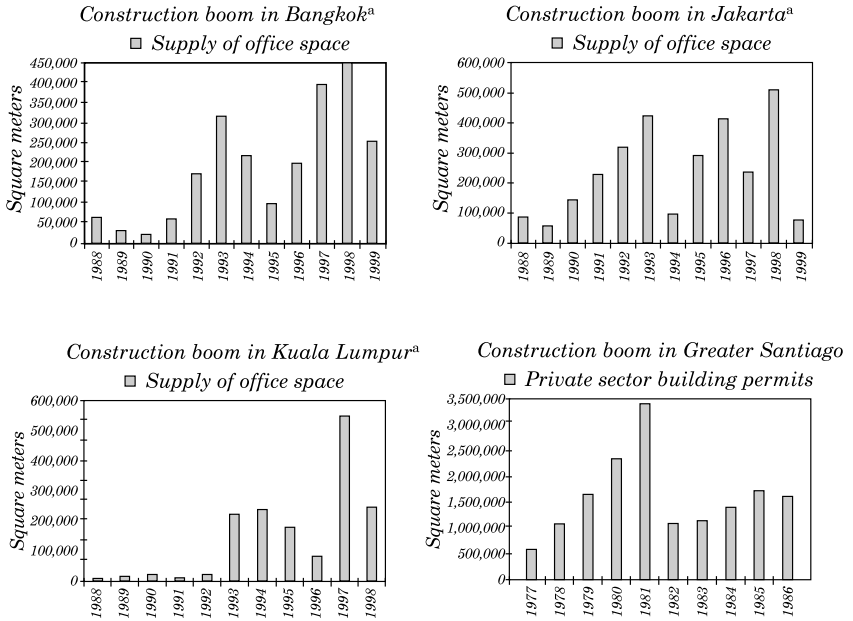
Finally, many case studies provide evidence regarding the second implication above, namely, that during construction booms the banking sector becomes more exposed to the construction business, therefore increasing the risk of suffering large losses should real estate prices fluctuate. Indeed, in addition to the recent experiences in Asia (including, as mentioned above, Japan and several emerging market economies), real estate booms occurred in the United States before the financial crisis of the early 1980s, in the Nordic countries during the late 1980s and early 1990s (after domestic financial deregulation got under way there), and in Chile during the first capital inflows episode in the late 1970s. In all these cases, as well as in Malaysia during the 1980s and Mexico during the 1990s, the banking sector became highly exposed to the construction business. This is shown in figure 10 for several countries for which data were available (data for the non-Asian countries refer to the first year of their banking crisis, for consistency with the Asian country episodes shown in the figure).

Asset Price Bubbles

Capital inflows and lending booms may also exacerbate economic vulnerability by inducing an increase in asset prices. This is a common outcome in most country episodes in which domestic and external

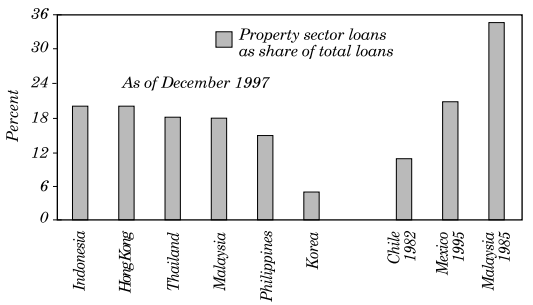
12. In trying to explain the high sensitivity of housing expenditure in the United States to small changes in interest rates, Bernanke and Gertler (1995) use Boldin's (1994) "mortgage burden" measure—the ratio of mortgages payments to income for new homebuyers—and show that it is highly correlated with the federal funds rate. If one believes in Bernanke and Gertler's balance sheet transmission mechanism of monetary shocks, their evidence can be interpreted as indirectly giving full support to the argument above, that is, that banks can cause overinvestment in real estate when interest rates fall.

Figure 9. Construction Booms in East Asia in the 1990s and Chile in the 1980s



Sources: Data for Asian countries are from Jones Lang Wootton (1998). Data for Chile are from Central Bank of Chile (1989).
a. 1997-99 comprise office space under construction.

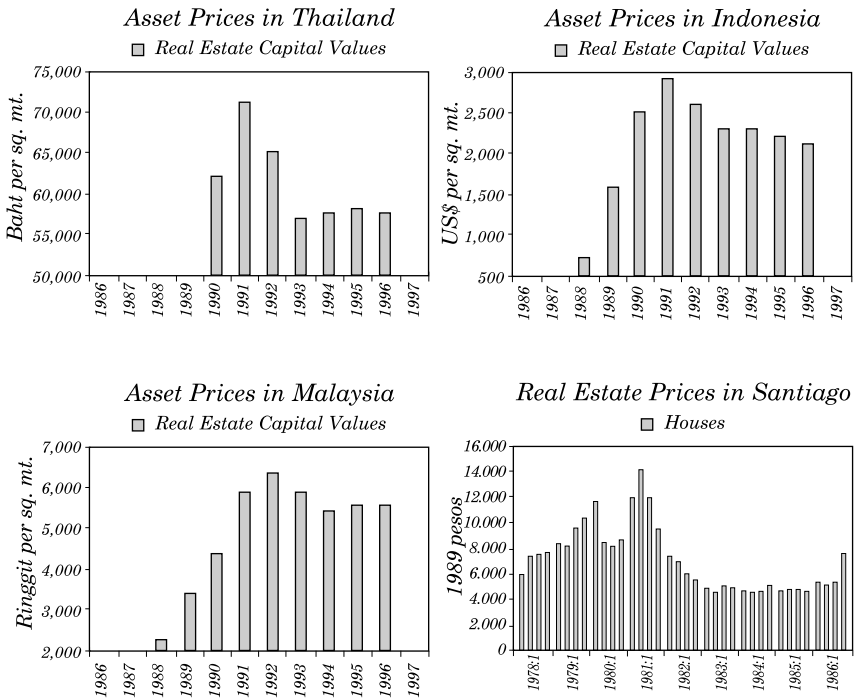
Figure 10. Exposure of the Banking Sector to the Property Sector in Selected Countries[a]



Sources: Goldman Sachs (1997), and country reports.
a. Data for Chile comprise banks and financial companies.

financial sector liberalization has occurred, and its most clear manifestation is through the prices of stocks and real estate. The rise in asset prices exacerbates vulnerability because it increases financial wealth, thereby raising households' indebtedness and consumption. Indeed, households increase their borrowing by using their assets as collateral for new loans (which, in turn, reinforces the lending boom). If the surge in prices proves unsustainable, which is also a common outcome (see figure 11), the economy will need to adjust to a lower level of aggregate spending, and losses—usually very large—will be realized. Most important, banks' nonperforming assets may rise if households start defaulting on their debts, and in many cases the value of assets used as collateral will be insufficient to cover the banks' losses. This applies to loans granted for the purchase of real assets (real estate lending)

Figure 11. Real Estate Prices in Asia in the 1990s and Chile in the 1980s



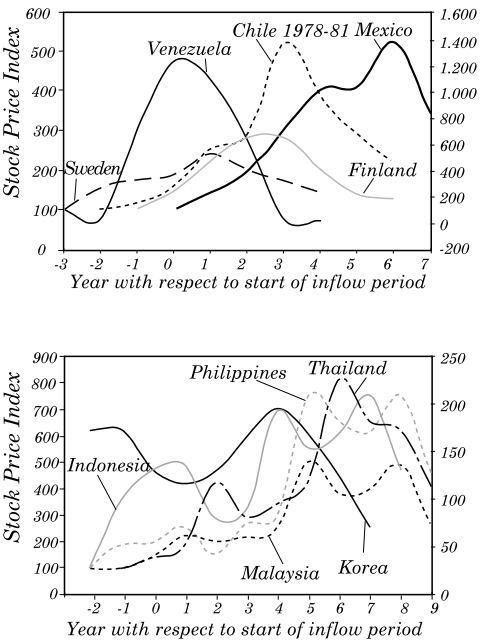
Sources: Data for Asian countries are from Jones Lang Wootton (1998). Data for Chile are from Morandé and Soto (1992).

and financial assets (margin lending). In sum, the plunge in asset prices leaves banks in a weaker financial situation and may even lead to crisis.

A well-documented recent case where this occurred is that of Japan: real estate prices in Tokyo grew by a factor of four between 1985 and 1991, only to plunge and return to their original values five years later. A similar pattern was observed in the case of Chile during the early 1980s, and more recently in some of the crisis countries in Asia. Thus, preliminary evidence shows that real estate prices reached their peaks in 1991-92 in Indonesia, Malaysia, and Thailand and fell thereafter, especially in Thailand (figure 11).

Whereas data on real estate prices are scarce and difficult to obtain, stock prices are more widely available. Figure 12 shows that

Figure 12. Stock Prices During Periods of Capital Inflows in Selected Countries in the 1980s and 1990s[a]



Source: IMF and World Bank databases.
a. Inflow periods are defined as in World Bank (1997) and Asian Development Bank and World Bank (1998). Some indices are shown on the right-hand-side axis.

surges in stock prices have also proved unsustainable and that, in general, significant falls in stock prices (and wealth losses) have occurred a few years after a surge in capital inflows (and lending booms) began.

3. Conclusions

This paper provides evidence supporting the idea that surges in capital inflows, which usually follow the implementation of reforms that improve economic prospects in the recipient countries, tend to finance a lending boom. Although the lending boom by banks (and by nonbank financial institutions) may occur without a surge in foreign inflows, mainly because of financial reforms that liberalize domestic financial markets, the most common case among developing countries may be one in which surges in capital inflows and lending booms occur simultaneously. This is so because the opening of the capital account usually accompanies the implementation of other economic reforms, which in turn make countries more attractive to foreign investors.

Since banks in developing countries tend to be poorly monitored and supervised, and their banking sectors are generally weaker than those in more advanced economies, a lending boom often exacerbates financial vulnerabilities and leads to banks taking excessive risks. This often takes the form of overlending for consumption purposes, a consumption boom, underinvestment in the tradable goods sector, overlending to real estate developers, and asset price bubbles in real estate and financial assets, all of which add to macrofinancial fragility. This has been vividly illustrated recently by the East Asian economies but has also been the case in many other countries in the past, such as Chile and other Latin American countries during the early 1980s. Most important, all these developments make the economy more vulnerable to a significant slowdown (or a recession) if a negative shock occurs in the real sector (for example, an external shock in the form of a decline in the terms of trade or the depreciation of a trading partner's currency). Since the banking sector amplifies real shocks through the credit channel, the loss in aggregate output and potential growth in the case of developing countries may be quite significant.

Overall, it appears that periods of rapid growth in credit (granted either by banks or by nonbank financial institutions) should beavoided,

or at least watched closely by the economic authorities, in emerging market economies, especially when the supervisory and regulatory framework is inefficient and outdated. However, from the analysis of the sample of countries used in this paper, it appears that surges in capital inflows play less of a role in credit boom episodes that prove (ex post) to be unsustainable than in those that do not end up in a credit crunch. Thus, the buildup of financial fragility seems to be related more to domestic factors than to surges in inflows of foreign capital.

This result is consistent with the view that periods of large capital inflows may be less of a problem in countries with more mature financial markets, or where banking supervision is more adequate and market discipline stronger. This may be the case in many developed countries and in some developing countries (such as Chile during the 1990s) where the banking regulatory and supervisory framework has been recently updated and follows international standards closely. However, policymakers in developing countries should focus more on strengthening the domestic financial system than on regulating international capital movements.

APPENDIX

Table A1A. Probability of a Lending Boom Occurring with an Increase in Capital Inflows, Contemporaneously or Starting the Year Before

Percent

	Size of lending boom (ratio to GDP growth)					
Countries	*No boom*[a]	*1.2*	*1.4*	*1.6*	*1.8*	*2.0*
Increase in capital inflows ≥ 0.5 percent of GDP						
Developed	47.0	52.9	52.4	51.8	48.0	51.4
Developing	50.8	59.8	59.5	59.1	58.1	63.2
Increase in capital inflows ≥ 1 percent of GDP						
Developed	41.0	44.4	42.1	38.8	34.0	35.1
Developing	45.8	54.9	55.7	54.8	53.2	60.5
Increase in capital inflows ≥ 2 percent of GDP						
Developed	37.3	27.6	24.1	20.0	16.0	18.9
Developing	34.6	48.2	50.6	50.5	51.6	57.9

Source: Authors' calculations.
a. Ratio of lending boom to GDP growth is 1 or less.

Table A1B. Probability of a Lending Boom Occurring Contemporaneously with an Increase in Capital Inflows

Percent

	Size of lending boom (ratio to GDP growth)					
Countries	*No boom*[a]	*1.2*	*1.4*	*1.6*	*1.8*	*2.0*
Increase in capital inflows ≥ 0.5 percent of GDP						
Developed	32.8	32.9	34.5	32.9	34.0	32.4
Developing	29.6	42.0	43.0	40.9	40.3	44.7
Increase in capital inflows ≥ 1 percent of GDP						
Developed	28.4	25.8	26.2	22.4	26.0	27.0
Developing	25.1	38.0	39.9	36.6	35.5	44.7
Increase in capital inflows ≥ 2 percent of GDP						
Developed	25.4	15.1	13.1	8.2	8.0	10.8
Developing	19.0	32.1	34.2	31.2	32.3	42.1

Source: Authors' calculations.
a. Ratio of lending boom to GDP growth is 1 or less.

Table A2. Size of Capital Inflows during and before Credit Booms

Size of credit boom (times GDP growth)	Developed countries: Percent of GDP (A)	Developed countries: N	Developing countries: Percent of GDP (B)	Developing countries: N	Ratio of B to A
			During credit booms		
1.2	2.4	48	4.6	60	1.9
1.4	2.8	42	4.0	54	1.4
1.6	2.1	28	3.3	43	1.6
1.8	3.2	20	2.5	34	0.8
2.0	3.8	15	2.7	26	0.7
					Average: 1.3
			During 2 years preceding credit booms		
1.2	2.4	48	1.8	60	0.8
1.4	2.9	42	1.9	54	0.7
1.6	1.6	28	1.6	43	1.0
1.8	1.7	20	3.1	34	1.8
2.0	1.1	15	2.8	26	2.5
					Average: 1.4

Source: Authors' calculations.

Table A3. Capital Inflows in Credit Crunch and Non-Credit Crunch Countries before, during, and after Credit Booms

Percent of GDP

Size of credit boom	*Non-credit crunch countries*			*Credit crunch countries*		
(times GDP growth)	*Before*	*During*	*After*	*Before*	*During*	*After*
			Credit crunch ≥ 1 percent of GDP			
1.2	1.6	4.4	1.5	2.6	2.8	1.3
1.4	2.0	4.0	2.3	2.9	2.6	2.4
1.6	1.3	3.2	1.3	2.0	1.8	1.6
1.8	1.7	3.2	1.7	4.8	1.7	2.6
2.0	1.5	3.6	1.1	4.1	1.3	1.0
Average	1.6	3.7	1.6	3.3	2.0	1.8
			Credit crunch ≥ 2 percent of GDP			
1.2	2.2	4.0	1.5	1.7	3.0	1.2
1.4	2.1	3.9	2.2	2.8	2.4	2.5
1.6	1.4	3.2	1.1	2.0	1.8	1.9
1.8	1.7	3.2	1.4	5.3	1.5	3.3
2.0	1.5	3.6	0.9	4.5	1.0	1.5
Average	1.8	3.6	1.4	3.3	1.9	2.1
			Credit crunch ≥ 3 percent of GDP			
1.2	2.3	4.3	1.6	1.2	1.8	0.9
1.4	2.3	4.2	2.3	2.3	0.9	2.3
1.6	1.3	3.2	1.3	2.6	1.3	1.9
1.8	1.8	3.1	2.1	6.4	1.3	2.1
2.0	1.6	3.4	1.0	5.2	1.3	1.3
Average	1.9	3.6	1.7	3.5	1.3	1.7
			Credit crunch ≥ 4 percent of GDP			
1.2	2.1	4.0	1.6	1.4	2.0	0.6
1.4	2.2	3.9	2.5	2.6	0.8	1.7
1.6	1.1	3.0	1.4	4.0	1.2	1.7
1.8	1.8	2.8	2.3	6.4	2.1	1.5
2.0	1.5	3.3	1.0	6.2	1.2	1.3
Average	1.7	3.4	1.8	4.1	1.5	1.4
			Credit crunch ≥ 7 percent of GDP			
1.2	2.0	3.8	1.3	1.8	1.9	1.9
1.4	2.1	3.1	2.4	4.5	1.1	1.9
1.6	1.1	2.8	1.4	8.1	2.5	1.9
1.8	1.7	2.7	2.1	10.8	2.5	1.9
2.0	1.5	3.2	1.1	8.2	1.1	1.1
Average	1.7	3.1	1.7	6.7	1.8	1.7

Source: Authors' calculations.

Table A4. Initial Financial Deepening in Countries That Suffered and Countries That Avoided a Credit Crunch

Size of credit boom (times GDP growth)	*Non-credit crunch countries*		*Credit crunch countries*	
	Mean	*N*	*Mean*	*N*
	Credit crunch ≥ 1 percent of GDP			
1.2	31.5	58	30.6	49
1.4	34.4	62	27.4	37
1.6	35.4	50	26.0	26
1.8	30.8	43	30.5	18
2.0	28.3	33	22.8	12
	Credit crunch ≥ 2 percent of GDP			
1.2	32.9	70	27.6	37
1.4	34.1	69	26.4	30
1.6	35.4	54	24.0	22
1.8	31.3	47	28.7	14
2.0	28.2	36	21.2	9
	Credit crunch ≥ 3 percent of GDP			
1.2	31.6	81	29.4	26
1.4	32.6	78	28.7	21
1.6	34.0	60	24.9	16
1.8	30.8	51	30.4	10
2.0	27.7	38	22.3	7
	Credit crunch ≥ 4 percent of GDP			
1.2	31.0	93	30.9	14
1.4	31.7	87	32.4	12
1.6	32.7	66	27.9	10
1.8	30.2	53	34.1	8
2.0	27.3	39	23.6	6
	Credit crunch ≥ 7 percent of GDP			
1.2	31.0	101	31.0	6
1.4	31.2	93	40.1	6
1.6	32.0	72	34.5	4
1.8	30.1	57	40.1	4
2.0	26.9	41	26.0	4

Source: Authors' calculations.

Table A5. Countries in the Full Sample

Developed countries (25)	Developing countries (35)
Australia	Argentina
Austria	Brazil
Belgium	Chile
Canada	Colombia
Cyprus	Costa Rica
Denmark	Dominican Rep.
Finland	Ecuador
France	Egypt, Arab Rep.
Germany	El Salvador
Greece	Guatemala
Iceland	Honduras
Ireland	India
Israel	Indonesia
Italy	Jamaica
Japan	Jordan
Netherlands	Kenya
New Zealand	Korea, Rep. of
Norway	Madagascar
Portugal	Malaysia
Singapore	Mauritius
Spain	Mexico
Sweden	Morocco
Switzerland	Pakistan
United Kingdom	Paraguay
United States	Philippines
	Poland
	South Africa
	Sri Lanka
	Syrian Arab Rep.
	Thailand
	Tunisia
	Uganda
	Uruguay
	Venezuela
	Zimbawe

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Asset Prices in Chile: Facts and Fads

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Chile enjoyed an unprecedented period of rapid and sustained growth in the 1986-98 period. Although average growth exceeded 7.1 percent a year, significant cyclical fluctuations also marked the period, both across sectors and across time. Growth in the tradable sectors exceeded 6.7 percent annually from 1986 to 1992 but declined to 5.7 percent a year during the following five years. In contrast, the nontradable sectors experienced comparable growth rates in both subperiods (7.5 percent yearly). The evolution of key relative prices, such as the real exchange rate and the real interest rate, has shown distinctively different patterns. Several papers have studied the key role played by these relative prices in inducing the massive resource reallocation between sectors observed in Chile and in providing adequate incentives to exports and growth (Morandé and Vergara, 1997).

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Although these relative prices are an important component of the growth process, other prices contain information that is useful for understanding different aspects of the development of the Chilean economy. In particular, the important role of asset prices in signaling investment opportunities has not been studied. Changes in asset prices should reflect investment decisions made by economic agents in response to the evolution of underlying determinants (the fundamentals), such as productivity gains, the business environment, access to foreign saving, deepening of domestic financial markets, and the strengthening of the growth process itself. One interesting aspect of asset prices is that, by their nature, they reflect the expectations of economic agents about the future. They are also extremely flexible and adjust very rapidly to changing expectations. Consequently, the evolution of asset prices—and the reallocation of financial capital they induce—should reflect changes in wealth and permanent income more accurately and rapidly than prices in other markets, where output and demand often react sluggishly to changes in economic conditions.

The links between macroeconomic development and asset prices, however, are not necessarily clear cut, from either a theoretical or an empirical point of view. In general, abrupt changes in real asset prices are associated with economic crises or, at least, financial turmoil. Nevertheless, real asset prices sometimes exhibit episodes of overvaluation (called fads or bubbles), in which prices deviate from what can be attributed to the economic fundamentals. Historical evidence in many countries shows that whenever a bubble develops, its eventual burst causes extensive damage to both asset markets and the rest of the economy (Kindleberger, 1989). Occasionally, however, bubbles are only apparent, and the change in asset prices that is perceived as abnormal in fact corresponds more to changes in the fundamentals than to speculative market psychology. Consequently, observers find a role for these prices as leading indicators of changes in the fundamentals themselves. If prices of real assets are perceived to be misaligned, it can be an indication, for example, that the real exchange rate or real interest rates are misaligned.

In this paper we study real asset prices in Chile to measure to what extent their changing patterns correspond to varying market fundamentals or policy variables and to determine whether there have been episodes of bubbles. Of particular interest are the role of fiscal and monetary policies, the implications of changes in access to

foreign savings, the impact of domestic credit constraints, and the role of pension funds in inflating or deflating asset prices. We concentrate on the prices of stocks (equity), agricultural land, and real estate, which we deem representative of the evolution of aggregate assets in the economy for the 1978-98 period. The analysis of the links between asset prices and their fundamentals has been largely ignored by economists in Chile, with the exception of Meller and Solimano (1983) and Morandé (1992). Whereas the former paper is limited to a descriptive analysis of asset price indices in the 1979-83 period, the latter models the evolution of asset prices and their underlying determinants using time-series models.

Section 1 of this paper discusses a standard general-equilibrium model in which asset prices arise as the result of agents trying to maximize their utility intertemporally when income is subject to stochastic disturbances. Asset accumulation is used to smooth consumption; hence asset prices reflect not only an intertemporal substitution effect, but also a forecast of future wealth. Consequently, maximizing agents will arbitrage between the short and the long run, and among assets. These arbitrage mechanisms, based on expected future economic activity, provide the basis for a long-run relationship between different asset prices. Nevertheless, short-run dynamics usually reflect deviations from the long-run condition described above. Section 1 also presents the main economic explanations for such deviations.

Addressing this behavior from an empirical point of view requires both a long-run and a short-run model. Section 2 provides an econometric approximation to such model, based on the literature on nonstationary time series. The estimated model successfully parameterizes the available data, allowing us to control for changes in fundamentals, weakly exogenous variables (such as international commodity prices), idiosyncratic variables (that is, those pertaining to a specific asset market), and policy variables.

Finally, we use the estimated model to study the dynamics of asset prices and simulate counterfactual scenarios, which we use to discuss the role that monetary and fiscal policies may have played throughout the 1990s in affecting asset returns. Arguably, the proposed counterfactual scenarios are simplistic. Our aim, however, is not to suggest that these are preferred policies, but to discuss the role that changes in such policies have had in affecting asset prices.

1. Determinants of Asset Prices

The literature on asset price determination is vast and diverse. Financial theories range from efficient-market models (Fama, 1970; Fama and French, 1988) to purely statistical event studies (Campbell, Lo, and McKinlay, 1997). Popular empirical models in the finance literature are the capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965) and the arbitrage price theory (APT) of Ross (1976).

Economic theories, on the other hand, are based on the microeconomic behavior of agents who optimize dynamically within the context of an equilibrium model (Lucas, 1978). This type of model places a number of restrictions on the APT model and the CAPM. In particular, asset prices ought to reflect the valuation by market participants of the discounted stream of earnings derived from holding such assets. These earnings depend on a set of "fundamentals," which describe the functioning of the economy.

As a benchmark for the analysis, we develop a dynamic, stochastic general-equilibrium setting in order to characterize the long-run equilibrium restrictions for the relationship among asset prices. Later we discuss some of the main economic explanations for the existence of short-run deviations from the long-run equilibrium conditions. In this model, assets are used to smooth consumption, so that asset prices should reflect both intertemporal and intratemporal substitution effects. On the basis of their forecasts of future wealth, agents will arbitrage among assets to equalize their short- and long-run returns. This arbitrage mechanism, based on expected future economic activity, provides the basis for a long-run relationship between asset prices.

1.1 The Standard Model of Asset Prices

Consider a world in which a representative agent holds three assets—real estate, land, and equities—as a way to smooth consumption when income is subject to stochastic disturbances.[1] From the consumer's optimization problem we derive the following Euler conditions:

1. Throughout this paper, "real estate" refers to owner-occupied housing and the land it occupies, whereas "land" refers only to agricultural land. "Housing" is used later in the paper to denote the rental price of housing.

$$1 = (1+i)\beta \mathrm{E}_t \left[\frac{u'(c_{t+1})}{u'(c_t)} \right],$$

$$P_t^s = \beta \mathrm{E}_t \left[\frac{u'(c_{t+1})}{u'(c_t)} \left(P_{t+1}^s + d_{t+1} \right) \right], \tag{1}$$

$$P_t^r = \beta \mathrm{E}_t \left[\frac{u'(c_{t+1})}{u'(c_t)} P_{t+1}^r \right],$$

$$P_t^l = \beta \mathrm{E}_t \left[\frac{u'(c_{t+1})}{u'(c_t)} P_{t+1}^l \right],$$

where $\beta = 1/(1+\rho)$ and ρ is the subjective rate of time preference, $u'(c_t)$ is the marginal consumption of the unique good, $\mathrm{E}_t\{\bullet\}$ denotes mathematical expectations conditional on the information available to the decisionmaker up to and including date t, and p_t^j is the real price in terms of the consumption good of an asset j (where the index j represents real estate r, land l, or equities s). The price of a share is quoted after dividends have been paid (the ex-dividend price). Variable d_t is the real output at time t given to holders of the shares, whose number is, for simplicity, normalized to one. Output is a random variable and generates the uncertainty in the model. Finally, assume that there exists a risk-free asset with a constant and exogenous return i. These Euler conditions show that the intertemporal marginal rate of substitution in consumption for the representative consumer is used to price payoffs on all securities traded in this economy.

One implication of these equilibrium conditions is that markets are efficient, in the sense that agents will arbitrage away any deviation of prices from equilibrium. Arbitrage will dissipate any economic rent among assets and over time. This efficient market behavior, however, depends largely on the availability of information. As already stated, the previous setting presumes that uncertainty arises only from shocks to output. In the actual economy, however, information is not a public good. If information is costly, agents will find

it optimal to acquire less than full information. Hence market efficiency is limited to arbitrage conditions derived under restricted information. Moreover, if some information is available to insiders and not traded in any market, the efficiency hypothesis would require arbitrage even among noise traders.

1.2 Departures from the Standard Asset Pricing Model

The efficient-market hypothesis has provided the basis for extensive research on asset prices. The empirical evidence, however, shows that economic and financial theories of asset price formation cannot satisfactorily account for their evolution. In particular, several authors have documented important short-run deviations of asset prices with regards to the fundamentals; these deviations are popularly dubbed "bubbles" (Blanchard and Watson, 1982; Campbell and Shiller, 1987). Econometricians have also found that returns (that is, asset price changes) tend to exceed what rational expectations models would have predicted for any reasonable degree of risk aversion. This is the equity premium puzzle of Mehra and Prescott (1985) and Kocherlakota (1996).

The existence of bubbles can be characterized by studying Euler condition (1), for example, for p_t^s. This stochastic difference equation admits a class of homogeneous solutions of the form

$$P_t^s = \sum_{k=t+1}^{\infty} \mathrm{E}_t \left[\left(\prod_{j=t}^{k} x_{j+1} \right) d_{t+1} \right] + B_t = P_t^* + B_t \,, \tag{2}$$

where P_t^* is the fundamental price of the stock, x_j is a stochastic discount factor and B_t is the bubble. The fundamental price is obtained assuming

$$\lim_{k \to \infty} \mathrm{E}_t \left[\left(\prod_{j=t}^{k} x_{j+1} \right) p_{t+1}^s \right] = 0 \,. \tag{3}$$

In other words, we preclude the existence of bubbles by imposing the condition that the discounted value of the infinitely distant future prices be zero. A bubble exists if the exchange value of an asset exceeds its fundamental price, which is the present value of the

services or dividends it yields over its economic life. This condition, referred to as the transversality condition, follows from the exclusion of Ponzi schemes and allows one to obtain a unique solution to equation (2).

Bubbles occur when the valuation placed on a specific asset becomes self-fulfilling. In this case, price behavior follows a self-reinforcing process not related to any valuation based on the fundamentals, and the market price of the asset includes some extra amount over the equilibrium value. When this extra amount is positive, investors believe they can sell the asset for more than they paid for it. Famous past episodes of such bubbles are the Dutch tulip bulb mania in the seventeenth century, the Mississippi Bubble in Paris in the eighteenth century, and, more recently, the 1987 stock market boom and crash. The bubble ends—and the crisis starts—when some investors decide to exit the market and the premium placed on the assets rapidly disappears.

How does the analytical literature deal with bubbles? One view is that bubbles can be expected to occur in models where there is continuous entry of new, richer agents who buy the existing assets with their savings (Obstfeld and Rogoff, 1996). Alternatively, bubbles may arise from errors in the definition of the fundamentals. Flood and Garber (1980) and Obstfeld and Rogoff (1986), among others, show that, in rational expectations models with incomplete information (for example, omitted variables), prices can deviate substantially from the discounted future earnings stream of the asset and its future terminal value. A different view is represented by the noise trader approach, where investors, being not fully rational, take actions and hold beliefs subject to systematic biases separated from the fundamentals (Shleifer and Summers, 1990). An important question in this context is whether asset prices are a reliable measure of the fundamentals and whether bubbles—inferred from them as the residuals—adequately capture misalignments with respect to the equilibrium value.

The recent turmoil in East Asian stock markets prompted a number of authors to focus on the connection among asset prices, credit constraints, and collateral when there are financial market distortions. Ito (1995) studied the co-movements of land and equity prices in Japan and found that positive credit shocks lead to loan expansions, which, in turn, prompt higher demand for fixed investment and land and a subsequent increase in land and equity prices. With the increase in stock prices, more funds are raised, and as a result,

the price of land increases again, raising the value of collateral and allowing further increases in borrowing and investment. This multiplying process is due to lending constraints that arise either from incomplete financial markets (Kiyotaki and Moore, 1997) or from transactions costs (Stein, 1995). At some point, speculative activities start and prices begin to increase with expectations of further increases.

Finally, recent papers stress the importance of information and incentives within the context of an unregulated financial sector, by relating bubbles to an agency problem (Allen and Gale, 2000), or by considering the importance of moral hazard by looking at implicit government guarantees (Krugman, 1998) or limited collateral (Edison, Pongsack, and Miller, 1998).

Empirical tests for bubbles, which were first employed before the theoretical literature was developed, focused initially on testing the excess volatility of asset prices. Motivated by the observation that fluctuations in the U.S. stock market seem too large to be explained by the fundamentals only, Shiller (1981) and Leroy and Porter (1981) provided statistical evidence that asset prices fluctuate markedly even when the fundamentals fluctuate little. Fama and French (1988), among others, provided evidence that returns are not only more volatile than implied by the fundamentals, but also predictable to a significant extent, contradicting the efficient-market hypothesis.

The predictability of asset returns is one of the most enduring questions in financial econometrics. An extensive literature concentrates on the exclusive use of past returns to forecast future returns, finding weak support for predictability. When other variables such as interest rates and dividends are introduced, however, the evidence becomes stronger. Campbell, Lo, and McKinlay (1997) show that, when changes in dividends are stationary and the convergence condition on the price series is imposed, there may be a stationary linear combination of prices and dividends (that is, they are cointegrated), even when dividends and prices are nonstationary. In this setting, the ability to predict the expected return on assets is not limited to the information from previous returns. This ability, furthermore, is determined by the microstructure of asset markets. In particular, if closing prices do not occur at the same time but are reported as if they did, a false impression of predictability can be created, and nonsynchronous trading effects can arise. Finally, the existence of persons with the monopoly right to post different prices in order to buy or sell shares translates into a cost associated with

the bid-ask spread. Phillips and Smith (1980) showed that a significant fraction of abnormal returns can be eliminated when the previous spread is included. Blume and Stambaugh (1983) showed that the spread generates an upward bias in mean returns calculated with transactions prices. Finally, as Campbell, Lo, and McKinlay (1997) show, the movement of prices from the bid and ask prices can create spurious volatility and serial correlation in returns, even with no change in the economic value of the asset.

1.3 Asset Prices in Chile

Analysis of the evolution of asset prices in Chile from a macroeconomic viewpoint is still incipient, largely because of the lack of appropriate time-series databases. An early paper by Meller and Solimano (1983) was the first attempt to test for bubbles in Chilean equity prices. They provided basic statistical evidence of large fluctuations in equity prices during the 1979-82 period and suggested that these were the result of the absence of adequate financial regulation. However, they did not develop a formal procedure to test such a presumption, nor did they provide any solid evidence of the existence of bubbles.

Morandé (1992) used quarterly data on key macroeconomic variables to investigate the extent to which the real prices of assets—land, real estate, and equities—were affected by structural reform and other macroeconomic policies in Chile during the late 1970s and early 1980s; he also investigated the timing of those effects. That paper stresses the dynamics of asset prices and the effects of exchange rate policies, tariffs, and capital inflows. Morandé found that there are important differences during the period under study with respect to the relevance of each policy for asset price formation. His results suggest that the fundamentals related to structural reform and key macroeconomic policies appear to be more important than portfolio considerations. The econometric analysis, however, was limited by the use of unrestricted vector autoregressive (VAR) procedures, which are able to characterize short-term dynamics but tend to omit long-term restrictions imposed by arbitrage conditions.

Recently, Budnevich and Langoni (1998) analyzed the behavior of real estate prices in Chile in the early 1990s. Using a panel data model, they established a long-run relationship between asset prices and their fundamentals. After analyzing real estate prices for six different counties in Santiago, they report a significant misalignment for some prices, thus casting doubts on the efficiency of the market.

In all of these studies of the Chilean case, government policies seem to play a key role in affecting asset prices. As noted, Meller and Solimano (1983) blamed the absence of financial regulation for the alleged emergence of a stock market bubble in the early 1980s. According to Morandé (1992), exchange rate policies and trade liberalization do affect asset prices in the short run. Likewise, Budnevich and Langoni (1998) assign a prominent role to monetary policies (via interest rates) and exchange rate policies. Certainly, macroeconomic policies played a key role in affecting the level of economic activity in Chile during the 1990s. In fact, the economy has twice experienced a significant contraction in aggregate demand as a result of restrictive monetary policies implemented with the goal of controlling inflationary pressures. To the extent that these policies relied on significant increases in interest rates, it is likely that they affected profitability in asset markets. Additionally, reforms in financial markets (such as pension funds) have been repeatedly blamed for the boom in asset prices observed throughout much of the last decade.

The Chilean experience constitutes an interesting case to study in order to improve our understanding of the evolution and determination of asset prices and their relationship with variables that proxy the evolution of fundamentals, such as profits, dividends, and rental prices for housing. Using a time-series cointegration framework, we attempt to capture not only the relationship between asset prices and their idiosyncratic determinants, but also their mutual influence in long-run equilibrium. This latter feature makes the econometric modeling consistent with the theoretical framework described above. In addition to policy variables (government expenditure and interest rates), the model considers external shocks, such as the terms of trade and capital inflows, which are deemed important in affecting firms' profitability and value.

2. Empirical Analysis

This paper focuses on the evolution of prices of three types of assets in Chile in the 1978-98 period: equities, land, and real estate. The period selected is the longest for which quarterly data are available (a detailed description of the data sources is contained in appendix A). Data on equities correspond to the General Share Index

(IGPA) of the Santiago Stock Exchange, which is the only series spanning the entire period.[2] Data on land prices and real estate were constructed for this study according to a methodology developed by Morandé and Soto (1992). Land prices correspond to the hedonic price of a hectare of agricultural land, derived from the selling prices of farms located in the midsection of the country. To ensure homogeneity and representativeness, the data exclude forest lands and farms advertised as potentially divisible into small properties for residential use. Real estate prices correspond to the hedonic price of residential units offered within a selected set of counties in Santiago. The data exclude apartments and houses offered for commercial use.

2.1 An Overview of Asset Price Evolution in Chile

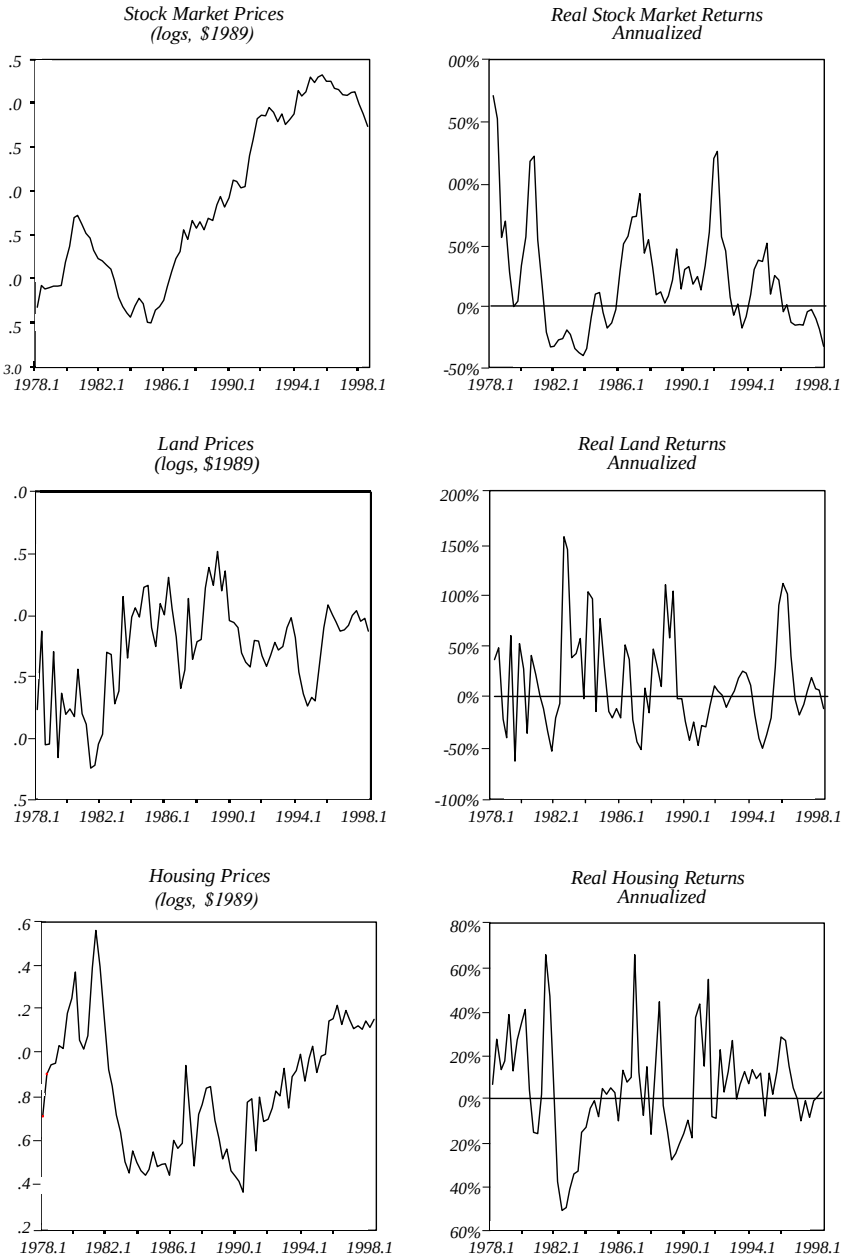
Two elements characterize the behavior of real asset prices in Chile, as depicted in figure 1. First, there has been a long-term upward trend in all prices, but changes in prices for different assets differ in magnitude and are clearly asynchronous. Upward trends in prices should not be surprising in a fast-growing economy, as rising profits are reflected in asset valuations. Second, asset prices are characterized by episodes of sudden and very significant fluctuations, both upward and downward, which could be consistent with the onset and burst of bubbles. Examples of the latter may be the rise and fall in real estate prices in the late 1970s or that in land prices in the late 1980s. The evolution of equity prices reproduces to a significant extent the growth process of the Chilean economy, from the initial expansion in the late 1970s through the severe crisis of the early 1980s and the subsequent boom in the late 1980s and 1990s. Real estate prices display a similar response, but the cycles are exacerbated and exhibit a delay in adjustment when compared with the rest of the economy.

Returns on real assets are characterized by high volatility and, unlike in developed economies, the tendency to display large fluctuations over prolonged periods.[3] Persistence in returns is at odds with economic theory, which, as discussed in section 1, holds that intertemporal arbitrage should eliminate abnormal returns quite

2. There also exists a selective index (IPSA), which is deemed more representative of trading as it considers fewer but more regularly traded shares, but it is available only from 1981 onward. Both stock price indexes are, nevertheless, highly correlated (98 percent).

3. See Campbell, Lo, and McKinlay (1997).

Figure 1. Real Asset Prices and Returns



Source: See appendix A.

rapidly. The evidence in the Chilean case suggests otherwise. Equity prices posted positive returns for twenty-nine quarters between 1985:4 and 1992:3, with only one occasion on which they were below 8 percent on an annualized basis. The annualized real return on real estate, on the other hand, remained negative for almost two years in the early 1980s (1982:1 to 1984:3), accumulating a total decline of more than 35 percent in real terms. The behavior of real returns largely reflects the link between asset prices and economic events and, in particular, macroeconomic policies, which were very active during the debt crisis of the early 1980s and after stabilization (the 1985-89 boom).

Nevertheless, macroeconomic variables cannot account for another characteristic of asset prices in Chile, namely, the fact that real returns do not evolve in similar, synchronized fashion as suggested by theory. The differential evolution of asset prices and returns can be easily assessed by looking at simple descriptive statistics such as those presented in table 1. It can be seen that the long-run average annual real return on equities is markedly higher than that on land or real estate (21.7 percent versus 12.6 percent and 4.7 percent, respectively). When the sample is split into the two decades, the result is unaffected. Naturally, differences in the riskiness of these assets should account for a fraction of the difference in returns, but it would be unjustified to attribute all differences to that factor. An additional explanation for this difference in returns is that, unlike equities, land and housing yield an implicit service in the form of rental prices. For example, real rental prices (on housing units of similar characteristics to those surveyed to derive real estate prices) averaged 14 percent in real terms in the sample, which would increase the return on real estate to 18.7 percent.

The return on equities has been quite high by international standards. The annual nominal return of the New York Stock Exchange index was 13.6 percent in the 1976-92 period (Harvey, 1994). However, the average return on real estate (4.7 percent) is slightly below the U.S. level for the 1975-95 period (5.3 percent), as reported by Taylor (1998).

A second interesting feature is that, although prices of all three types of assets increased in the period, the returns in the first and second decades present contrasting behaviors. Whereas equity and land returns declined markedly in the 1988-98 period, real estate returns increased significantly (from 3.3 percent in the first decade to 6.1 percent in the second). Although part of this phenomenon could

reflect the adjustment induced by arbitrage, other elements also played an important role. For example, a significant fraction of the decline in land returns could be the result of the continuous appreciation of the Chilean peso since 1988 and the fact that land prices considered in this study were obtained from farms that produce tradable goods. Between 1988 and 1997, the real exchange rate appreciated by 30 percent.

A third element that characterizes asset returns is their high degree of volatility, as is apparent from the extreme values, standard deviations, and coefficients of variation presented in table 1. Annual returns as high as 170 percent and price drops of over 50 percent are impressive when one considers that changes in returns—as measured, for example, by the coefficient of variation—are usually a measure of risk or the risk premium (Engle, 1982).

Finally, the volatility of all asset prices fell significantly in the last decade when measured in absolute terms. A similar phenomenon is seen when volatility is normalized with respect to returns (using the coefficient of variation), except for land returns, whose volatility has clearly increased. This is consistent with the stability of the Chilean economy and the increased depth of financial markets.

2.2 Characterizing the Persistence of Shocks in Asset Prices

Assessing the persistence of shocks is important in econometrics because failure to account for the presence of permanent shocks (such

Table 1. Statistical Properties of Annual Returns on Real Asset Prices

	Equities			*Land*			*Real estate*		
Measure[a]	*1978:1-1998:2*	*1978:1-1987:4*	*1988:1-1998:2*	*1978:1-1998:2*	*1978:1-1987:4*	*1988:1-1998:2*	*1978:1-1998:2*	*1978:1-1987:4*	*1988:1-1998:2*
Mean	21.7	25.5	17.7	12.6	16.4	8.8	4.7	3.3	6.1
Maximum	170.7	170.7	125.5	157.0	157.0	111.0	66.0	66.0	54.7
Minimum	–39.5	–39.5	–32.1	–64.1	–64.1	–51.1	–51.2	–51.2	–27.7
Standard deviation	43.5	52.1	32.6	46.9	51.1	42.4	23.0	26.7	18.6
Coefficient of variation	2.0	2.1	1.8	3.7	3.1	4.8	4.9	8.1	3.1

Source: Authors' calculations based on data sources in appendix A.
a. Mean, maximum, and minimum are in percentages per year.

as unit roots and other nonstationary processes) may lead to spurious regression results (Granger and Newbold, 1974). We use standard parametric tests to assess the presence of nonstationarity. Since parametric tests can potentially be flawed by model misspecification, appendix B reports the results of two additional procedures: variance-ratio tests (used to reveal slow processes of reversion to the mean) and endogenous-breaks unit-root tests (used to test for the presence of structural breaks). Those results complement and support the conclusions reached in this section.

Table 2 presents the results of augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit-root tests on real asset prices. As expected for this type of data, the series exhibit strong autocorrelation, which is usually indicative of the presence of unit roots. In fact, ADF and PP tests cannot reject the null hypothesis of a unit root for equity and real estate prices. For land prices, however, both tests reject the null hypothesis, although for the ADF test only marginally. With regards to the first (log) difference of the series (asset returns), stationarity is easily rejected.

The results of the nonparametric tests in appendix B confirm these results but also suggest that persistence in land prices is marked and that considering the series as an integrated process could be a reasonable characterization. Recursive parametric tests conclude that no series should be characterized as trend-stationary with structural level and/or trend breaks.

2.3 Characterizing Long-Term Relationships among Asset Prices

The results of stationarity tests sustain the notion that it is convenient to treat asset prices as integrated processes of order 1 without

Table 2. Unit-Root Tests on Real Asset Prices[a]

	Level			*First difference*		
Price series	*Autocorrelation*	*ADF test*	*PP test*	*Autocorrelation*	*ADF test*	*PP test*
Equities	0.958	–1.57	–1.99	0.267	–5.17	–6.75
Land	0.694	–2.60	–3.91	–0.380	–8.62	–14.66
Real estate	0.880	–2.09	–2.04	–0.060	–9.62	–9.67

Source: Authors' calculations.
a. Results are based on quarterly data, 1978:1-1998:2. Critical values of the tests at the 10 percent and the 5 percent level are –2.58 and –2.90, respectively.

significant structural breaks. Once it is established that the variables behave as integrated processes of the same order, a natural question arises regarding the possibility of observing a long-run relationship among them. If there exists such a relationship (dubbed the cointegrating vector), it would imply that, although the series are subject to both permanent and transitory shocks, they present a stochastic common trend. The natural interpretation of this cointegrating vector would be as the long-run equilibrium that emerges from the arbitrage process between asset prices and returns.

There are several procedures for estimating cointegrating vectors.[4] Johansen's (1988) procedure, used in this paper, sets up a simultaneous-equation, error correction model, which corresponds to a quasi-VAR model and is parameterized by maximum likelihood methods. An advantage of this procedure over other methods is that it allows for direct testing of the number of cointegrating vectors. In addition, one can control for exogenous forcing variables in the estimation. However, two problems of Johansen's technique are its reliance on Gaussian processes for innovations and its tendency to obtain overparameterized results from VAR techniques.

Table 3 presents the results of applying Johansen's procedure to asset prices when controlling for government expenditure, capital inflows, terms-of-trade shocks, and other forcing variables described below. It can be seen that both informational criteria (Schwartz and Akaike) and the likelihood ratio test suggest the existence of one cointegrating vector. This result is important not only for our econometric purposes, but also for understanding the evolution of asset prices in Chile. It indicates that, despite the apparent randomness of their fluctuations, there is a tendency toward fulfilling arbitrage conditions.

Table 4 presents the results of the estimated cointegration model for asset prices, in particular the normalized representation for housing prices. Negative coefficients obtained for the companion asset prices reflect the role of arbitrage in the economy's portfolio. The linear trend component is remarkably high (reaching 6.9 percent), similar to the average annual growth rate of the economy during the period (7.1 percent). This estimated cointegration equation is used

4. Two techniques for estimating cointegrating vectors are the two-stage estimation strategy suggested by Engle and Granger (1987) and the maximum likelihood procedure developed by Johansen (1988). Refinements of such techiques are the three-step algorithm of Park (1992) and the methods suggested by Phillips and Loretan (1991) and Boldrin (1995).

Table 3. Johansen Cointegration Test on Asset Prices[a]

Rank or No. of cointegrating equations	*Data trend*				
	None		*Linear*		*Quadratic*
	No intercept, trend	*Intercept, no trend*	*Intercept, no trend*	*Intercept, trend*	*Intercept, trend*
	Akaike information criteria by model and rank				
0	–14.08431	–14.08431	–14.22726	–14.22726	–14.16908
1	–14.27120	–14.46594	–14.49107	–14.51170	–14.47655
2	–14.23298	–14.41194	–14.42528	–14.59933	–14.58360
3	–14.09388	–14.29109	–14.29109	–14.45054	–14.45054
	Schwartz criteria by model and rank				
0	–13.80192	–13.80192	–13.85074	–13.85074	–13.69844
1	–13.80056	–13.96392	–13.92630	–13.91556	–13.81765
2	–13.57408	–13.69029	–13.67225	–13.78355	–13.73644
3	–13.24673	–13.34980	–13.34980	–13.41513	–13.41513
Likelihood ratio test	Rank = 1	Rank = 1	Rank = 1	Rank = 1	Rank = 2

Source: Authors' calculations.
a. Based on quarterly data, 1978:1-1998:2.

Table 4. Normalized Cointegrating Vector for Real Estate Prices Using Johansen's Procedure[a]

	Constant	*Equity prices*	*Land prices*	*Linear trend*
Coefficient	12.886	–0.676	–0.647	0.069
Standard error	...	0.255	0.220	0.021

Source: Authors' calculations.
a. Data are for 1978:1-1998:2. All variables are in logarithms.

below to estimate the short-term dynamic models. However, before discussing the results of the error correction models, it is important to note that the cointegration estimations are quite stable across the eighty-six-quarter period. Standard stability tests (Cusum and Cusum of squares) as well as the recursive estimation of residuals and parameters show little evidence of instability (see figures B3 and B4 in appendix B).

The estimated models closely track the long-term evolution of all asset prices, in particular those of equities and land. This is a remarkable result, considering the high volatility of asset prices, and suggests that arbitrage, as discussed in section 1, indeed takes place. As expected for long-term equilibrium values, short-term fluctuations show persistence and are not of a negligible magnitude.

This, in turn, implies that error correction models are necessary to account for the short-term dynamics.

2.4 Error Correction Models

The estimation of the short-run models of asset prices follows the suggestions of Phillips and Loretan (1991) to include leads of the right-hand-side variables to capture potential feedback effects from asset prices. Drawing on the results on causality presented in appendix B (table B2), we include leads of those variables for which there was evidence of two-way causality: housing rental prices and capital inflows.

The results of the estimation are presented in table 5, and a simulation of the models is presented in figure 2. It can be seen that the error correction models are able to capture the dynamics of asset prices with accuracy. In fact, the pseudo R^2 of the regressions between the actual and simulated asset prices (derived from simulating the error correction models) is 99.1 percent for equity prices, 79.8 percent for land prices, and 94.9 percent for real estate prices.

These estimated error correction models provide interesting results regarding the dynamics of asset prices and, in particular, the role of selected macroeconomic variables that influence the short-term evolution of returns. As is apparent from table 5, several variables have some impact on returns, and their dynamic relationships are rather complex. To organize the analysis, the variables are grouped into "exogenous" variables (such as the terms of trade), "policy" variables (such as public expenditure), and "idiosyncratic" variables (such as dividends). Although the first two potentially affect all asset returns, the latter are expected to have an impact only in their reference market. Nevertheless, to provide a consistent parameterization, the analysis proceeds from general to specific, including all variables and a reasonable number of lags in an initial model and proceeding to eliminate sequentially those that yield nonsignificant results, individually or in groups.

Policy variables have a characteristic effect on asset prices. Public expenditure has a negative and significant impact on equity prices, but a positive and very significant effect on land prices. The effect on real estate is of negligible magnitude. The negative effect on equities is consistent with Ricardian behavior on the part of investors, who anticipate that increased current public expenditure will require higher tax payments in the future. In contrast, landowners

Table 5. Error Correction Models for Asset Returns[a]

Variable	*Equities*	*Land*	*Real estate*
Error correction term	–0.235	–0.757	–0.140
Change in land prices (1)	0.141		
Change in equity prices (1)	0.343	0.447	–0.055
Change in equity prices (2)			0.115
Change in real estate price (4)	0.070		
Public expenditure	–0.197	0.561	
Public expenditure (1)	–0.222	0.294	
Public expenditure (2)		0.358	
Public expenditure (3)		0.311	
Public expenditure (4)			–0.028
Real interest rate	–0.011		
Real interest rate (1)		0.032	0.004
Real interest rate (2)		–0.021	
Real interest rate (3)			–0.006
Capital inflows		–0.176	–0.077
Capital inflows (1)	0.020		
Capital inflows (3)		–0.642	
Capital inflows (4)		–0.835	
Terms of trade (1)		–0.623	
Terms of trade (3)		0.454	
Terms of trade (4)		0.832	
Credit		0.305	
Credit (1)	–0.098		0.021
Credit (2)	0.017		
Credit (4)	–0.007		–0.016
Dividends (1)	0.026		
Dividends (3)	0.023		
Housing rental price			–0.704
Housing rental price (1)			–0.779
Housing rental price (2)			–0.115
Shares in pension funds	0.457		
Shares in pension funds (1)	0.351		
Shares in pension funds (3)		–0.692	
Shares in pension funds (4)	0.220		
Summary statistic			
Pseudo R^2 [b]	0.991	0.798	0.949
DW	1.92	1.90	1.96

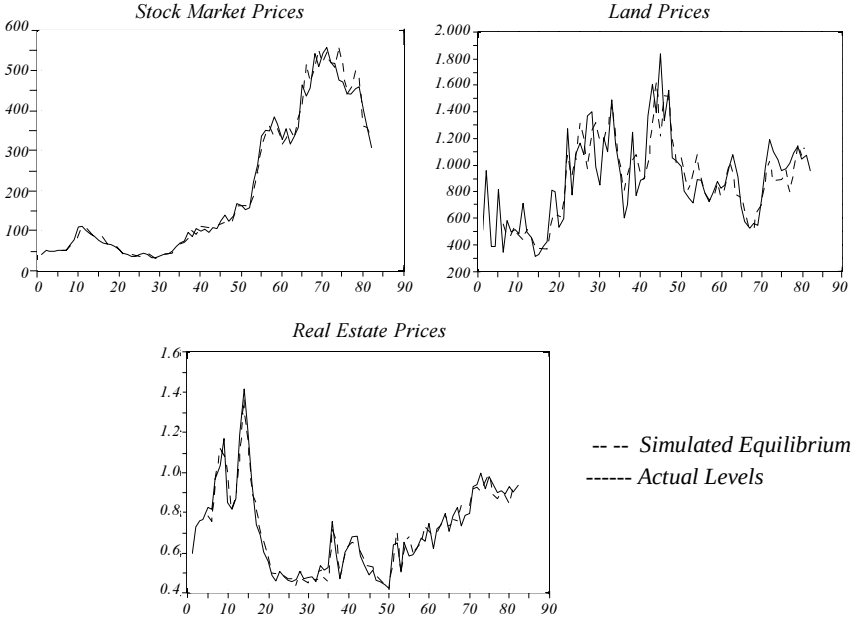
Source: Authors' calculations.
a. Numbers in parentheses indicate order of the lag. Non significant (at 95%) results were omitted from the table.
b. Pseudo R^2 corresponds to the fit of a regression between the actual asset price and a simulated asset price obtained from the error correction models.

pay income taxes that largely depend on presumed rents (as opposed to actual profits), and they are less sensitive to income tax increases since presumed taxes are adjusted with significant lags. The size of the coefficients implies that an increase in public expenditure of 1

percent would induce a transitory decline in stock market returns of 0.4 percent and an increase in land prices of 1.6 percent. A change of this magnitude is not unusual in public expenditure in Chile; in the five years ending in 1998, for example, public spending fluctuated between 11.6 and 15.1 percent of GDP. On the other hand, a 1 percent increase in the real interest rate on risk-free government bonds reduces equity prices in the short run by 1.1 percent. A similar effect is seen for land prices, but there is an overshooting effect (of 3.2 percent), which is compensated the following quarter (a change of -2.1 percent). Finally, an equivalent change in the yield of government bonds also reduces real estate returns by 2 percent, but with a slightly longer lag.

We control these estimations for shocks to exogenous variables affecting the unobservable fundamentals underlying asset prices. Among these variables, a potential candidate is the real exchange rate, which could summarize effectively the competitiveness of traded

Figure 2. Asset Prices Simulated from Error Correction Models



Source: Authors' calculations.

goods for a small, open economy such as Chile. Nevertheless, the real exchange rate is in fact an endogenous variable, which depends on policies (such as the nominal exchange rate) and other fundamentals. Following Soto (1996), we use instead two key determinants of the real exchange rate: terms-of-trade shocks and capital inflows (a third variable, tariffs, proved nonsignificant). The effect of these variables on real estate returns is, as expected for a nontradable service, negligible. On the other hand, their impact on land prices, which reflect agricultural returns, is negative and significant. An improvement in the terms of trade or an increase in capital inflows leads to appreciation in the real exchange rate, thus reducing profits in the agricultural sector and therefore returns on land. Finally, the impact of both variables on stock market returns is, as expected for an index that combines both tradable and nontradable industries, of very small magnitude. The role of idiosyncratic variables is to some extent surprising, considering that these variables are intended to represent the effect of the flow of services derived from a stock of wealth. As is customarily found in the literature, dividends have a positive effect on equity prices both contemporaneously and after six months. One would have expected that rental prices for housing would behave in similar fashion; the results, however, show a zero overall effect, after some oscillatory behavior.

Two other variables have been proposed as capable of fueling changes in asset prices to the point of creating bubbles: private credit and purchases of equities by pension funds. The results tend to support the role of the latter but not the former. The overall impact of changes in the supply of credit on the stock market and on real estate prices is negligible. However, these changes do have some transitory effect on land prices. Purchases of shares by pension funds have had a positive effect on equity prices and, surprisingly, a negative effect on land prices. The latter result is additional evidence of a substitution effect between land and equities.

Finally, the error correction term shows that there are significant differences in the speed with which asset markets converge to equilibrium. To some extent, it is surprising to find that land prices converge to equilibrium twice as fast as the stock market (0.757 versus an implicit estimate of 0.357), whereas real estate prices converge very slowly (0.140). One would have expected stock markets to adjust faster than land markets, since transactions costs and entry fees are smaller.

2.5 Impulse-Response Functions

As is customary in time-series analysis, the error correction-cointegration model can be simulated to obtain the response of the dynamic system when subjected to a shock with impulse functions. A typical drawback of the methodology is that the ordering of shocks can have a significant impact on the decomposition of responses (Hamilton, 1994). Ordering should be based on the instant causality (that is, requiring intraperiod information), but in its absence econometricians usually simulate the models using different orders in alternation. In our case, however, we have the advantage of having monthly data available from which to obtain a reasonable (sample limited) approximation to intraquarter causality. Table 6 presents the results of Granger causality tests, which indicate that a sensible ordering would be to consider equity prices as precedent in time with respect to land and real estate prices, and real estate price shocks as preceding land price shocks.

Figure 3 presents impulse-response functions for the system. It is apparent that shocks have permanent effects, as expected in a cointegration model, and that these permanent effects tend to be rather idiosyncratic. Asset price shocks tend to be very persistent, with long-term responses above 50 percent of the initial impulse when considering "own" shocks (that is, shocks and responses within an asset category), which is consistent with the notion that changes in the order of the decomposition would not induce significant changes in the interpretation of the dynamics of the model. Cross-shocks are also of interest. Consistent with our intuition, stock market responses to shocks suggest that equities and land are substitute assets; positive land price shocks tend to lower equity prices as investors switch their portfolio structures toward more profitable alternatives. A similar effect is observed in land prices, which respond negatively to positive shocks in equity prices.

The response of real estate prices to shocks to other asset prices, on the other hand, suggests a relative insensitivity beyond an initial negative outcome. The negative response can easily be understood as a substitution effect. The long-term zero effect is interesting because, coupled with the response of equity and land prices, it provides an interesting asymmetry to the dynamics of asset markets. As is apparent, land prices show no long-run response to real estate shocks, but stock markets respond positively. This is consistent with the notion that higher real estate prices raise the value of the portfolios of firms (such as banks, which hold a large share of real estate),

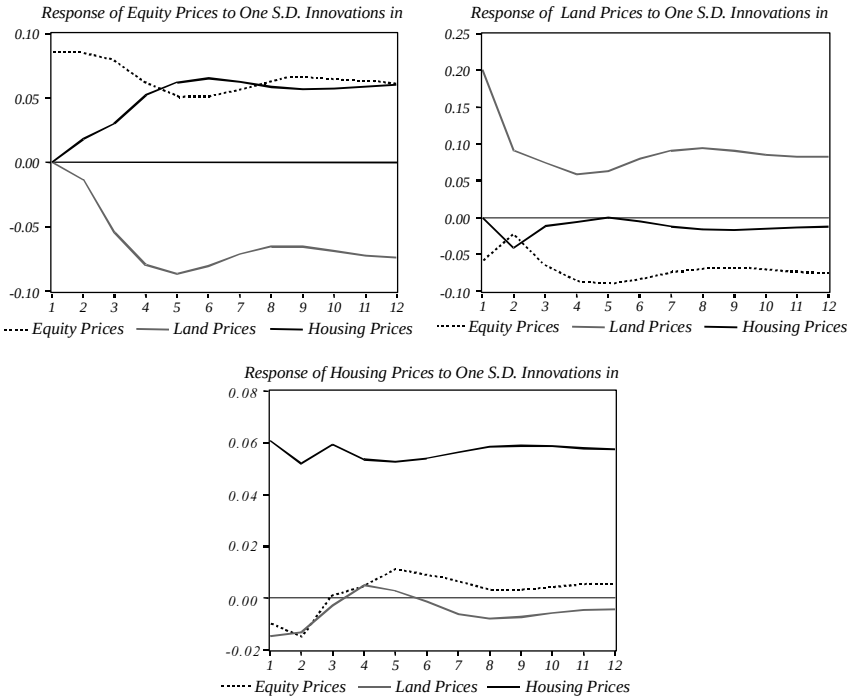
thus raising their valuation in the stock market. However, an increase in equity prices does not necessarily induce changes in real estate prices. Similar effects have recently been found by Ito (1995) for the Japanese case.

Table 6. Intraquarter Granger Causality Tests[a]

Direction of causality tested	*1 lag*	*2 lags*	*3 lags*
Land prices⟶ real estate prices	0.95	0.59	1.29
Real estate prices⟶ land prices	4.15**	2.04	0.84
Land prices ⟶ equity prices	0.67	0.65	0.72
Equity prices⟶land prices	5.40**	2.11	1.62
Real estate prices⟶equity prices	0.01	0.25	0.42
Equity prices⟶real estate prices	20.22**	7.08**	2.97**

Source: Authors' calculations.
a. The null hypothesis is that variable X does not Granger-cause variable Y. Data are monthly, 1975:1-1998:4.
** denotes significance at the 5 percent level.

Figure 3. Impulse-Response Functions



Source: Authors' calculations.

2.6 Non Fundamental Movements and Bubbles in Asset Prices

As discussed in section 1, the definition of a bubble is to some extent arbitrary, since it is generally defined as a movement in asset prices not accounted for by a set of fundamentals, which are more or less arbitrarily defined by the researcher. Two alternative procedures can be derived from the above models.

First, one can use the cointegration models directly to determine the deviations of asset prices from equilibrium. The evidence for the Chilean case suggests the existence of episodes in which asset prices have drifted away from their long-term equilibrium level. As presented in table 7, equity prices have been as much as 25 percent above the level implied by the cointegrating relationship with other asset prices. Likewise, real estate prices have been "overestimated" by as much as 14 percent, in particular in the last five years. Both examples are consistent with frequently quoted opinions of market analysts that, as a result of different and often conflicting causes, bubbles have developed and burst.

As already discussed, however, a better representation of the dynamics of asset prices would be the error correction model presented in table 5. If economic agents are aware of the limitations to rapid adjustments in asset prices, it is natural to presume that they will internalize the existence of adjustment paths and act accordingly. Consequently, deviations from error correction forecasts and not cointegration models should be used as benchmarks for determining the presence of fads. Error correction models are able to properly accommodate both the long-run equilibrium relationship among

Table 7. Estimated Deviations of Asset Prices from "Equilibrium" Levels[a]

Percent

	Long-term equilibrium (full sample model)			*Full dynamic equilibrium (recursive model)*		
Period	*Equities*	*Land*	*Real estate*	*Equities*	*Land*	*Real estate*
1986:1-1989:4	0.7	10.5	–5.6	4.4	5.9	–0.8
1990:1-1993:4	24.7	–5.9	–17.5	2.9	1.0	1.2
1994:1-1998:2	–9.7	–2.0	13.9	–5.0	3.3	3.0

Source: Authors' calculations.
a. Data are quarterly. A positive result implies that the actual value is above the estimated equilibrium level.

variables and their short-term fluctuations. The use of such a model estimated with the complete sample data, however, would yield unwarranted results, as it would amount to using more information than was available to agents at the time they made their portfolio decisions.

Consequently, a second procedure consists of estimating a recursive error correction model to estimate the "equilibrium" level of asset prices and determine the existence of bubbles. A recursive model uses only the information available to economic agents at each instant, and is thus more consistent with the situation faced by investors at the time decisions are made. In addition, recursive models are consistent with models in which agents learn the true nature of economic relationships and adjust to changes in those relationships (Sargent, 1993).

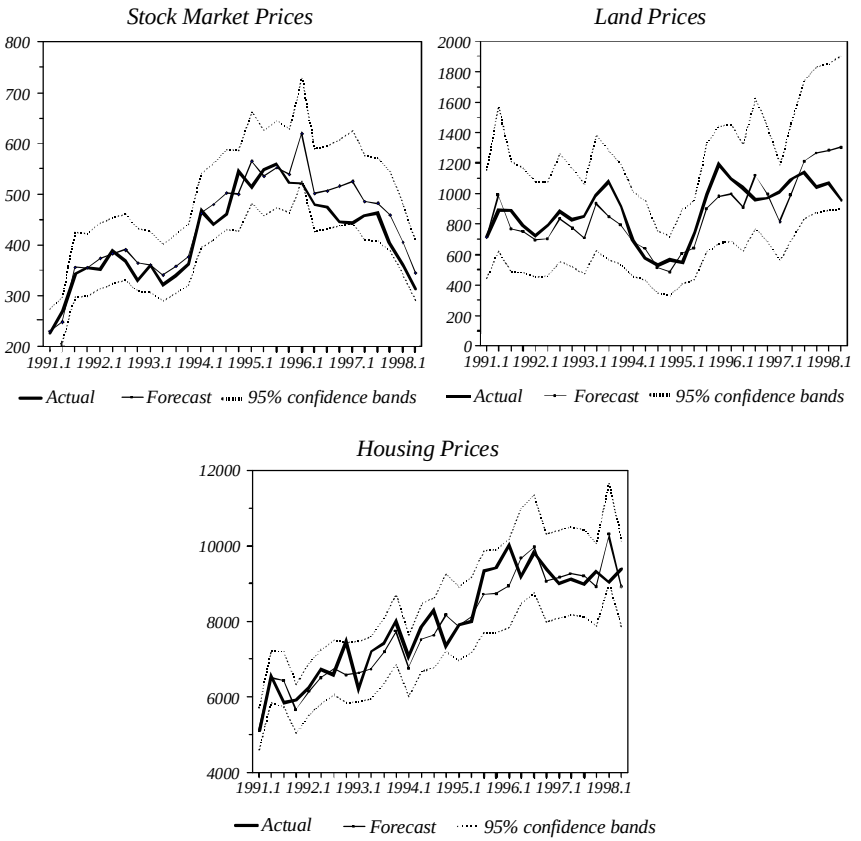
The recursive model is first estimated for the smallest sample size possible (say, T) and then used to compute the one-period-ahead forecast of asset prices and its standard error. Both the cointegration and the error correction models are estimated. In a second iteration, the sample size is increased to $T + 1$ and the model is reestimated, computing the forecast and its standard error. The procedure is repeated until all information is exhausted. Figure 4 presents the results of the recursive estimation of the error correction models and the forecast confidence.[5]

An interesting advantage of this procedure is that it allows us to obtain a 95 percent confidence interval for the forecast; thus it provides a statistical test for deviations of actual prices from "fundamental equilibrium" levels. It can be seen from figure 4 that actual asset prices do not cross the lines marking the 95 percent confidence interval; fluctuations are, consequently, comparable to random noise. The conclusion is that there is no statistical evidence of bubbles in asset prices in Chile during the period under study.

An alternative way of presenting these results is depicted in table 7. The recursive error correction models are used to determine equilibrium levels for each asset price and calculate the deviations of

5. The recursive estimation uses the Engle-Granger procedure, which is less data-demanding than Johansen's technique. This procedure is usually not optimal because of the presence of nuisance parameters (Campbell and Perron, 1991). For the data in this paper, however, two conditions ensure that the cointegration regression is asymptotically optimal: the right-hand-side variables are not Granger-caused by the left-hand-side variables (see appendix B, table B2), and the errors were not correlated.

Figure 4. Forecast Asset Prices Simulated Using Recursive Error-Correction Models



Source: Authors' calculations.

actual prices from such a benchmark. It can be clearly seen that, on average, asset prices have not deviated substantially beyond 5 percent. In this regard, the deviations are again totally consistent with random noise.

2.7 Simulations of Alternative Macroeconomic Policies

The error-correction models discussed above stress the role of macroeconomic policies in influencing asset prices. It is interesting to discuss what would have been the impact of alternative policy scenarios for public expenditure and interest rates. In addition, of

special interest for the Chilean case is the analysis of a counterfactual scenario in which pension funds are forbidden to purchase equities.

Defining the alternative policies is quite difficult, as there is little guidance as to what would have been more appropriate (or even optimal) policies. Hence simple assumptions are made to model these alternative policies, which, nevertheless, help us understand the crucial role that policies played in a dynamic asset price context.

This section presents a series of dynamic simulations of the error correction models for the 1991-98 period. Simulations use the actual data for the 1978-90 period but simulate all asset prices thereafter. Considering that these are cointegrating models, they could accumulate large deviations from short-term equilibria.

Public Expenditure

As already mentioned, public expenditure is characterized by high volatility and a declining trend for most of the 1980s and early 1990s. This trend reversed significantly in the late 1990s, however. We considered that the following estimation would suffice for the purposes of obtaining an approximation to its data generating process:

$$\begin{aligned} \text{Log } Pub.Invest_t = {} & -1.105 - 0.0095t + 0.0007t^2 + 0.378\ LogPub.Invest_{t-1} \\ & (-6.27)\ (-3.57) \qquad (2.39) \qquad (2.65) \\ & R^2 = 0.631, \qquad \text{DW} = 2.00. \end{aligned} \tag{4}$$

This trend-stationary model presents a reasonable fit for a simple structure and is consistent with an adaptive expectations model for public expenditure. Note that the presence of a quadratic trend term allows public expenditure to converge to a long-run level different from zero. The simulation of the model using the counterfactual level of public expenditure shows that, as a consequence of actual policies, stock market and real estate prices were depressed in the 1991-98 period by 5 percent on average. However, when analyzing the subperiods as is done in table 8, one notices important differences among them. In the 1991-94 period, equity prices were above what the counterfactual suggests by 5 percent, whereas real estate prices were depressed by 7 percent. In the 1995-98 period, in contrast, equity prices were markedly below what the counterfactual suggests (14 percent), because of excess public expenditure of 1.5 percent of GDP. On the other hand, public expenditure increased land prices by approximately 5 percent. Note that although public expenditure

Table 8. Estimated Effect of Alternative Macroeconomic Policies on Asset Prices[a]

Percent

	Public expenditure			*Monetary policy*			*Pension funds restricted*		
Period	*Equities*	*Land*	*Real estate*	*Equities*	*Land*	*Real estate*	*Equities*	*Land*	*Real estate*
1991:1–1994:4	–5.1	–0.4	7.1	–19.1	17.8	–11.1	11.7	–6.7	–4.8
1995:1–1998:2	14.3	–5.0	4.9	0.9	5.3	–7.3	–2.7	1.1	1.4
1991:1–1998:2	4.9	–2.8	5.8	–8.8	11.4	–9.2	4.2	–2.7	–3.1

Source: Authors' calculations.
a. Data are quarterly. A positive number implies that asset prices were actually below those that would have prevailed under the counterfactual scenario.

does not have a significant short-term impact (as apparent in error correction models), the arbitrage condition of the cointegrating equations induces the portfolio shift.

Interest Rate Policies

Designing a counterfactual scenario for interest rates involves the use of a larger model, which would consider elements such as monetary policies, financial structures, and integration with international markets. Some of the variables involved may have unknown effects: for example, reserve requirements may lead to increased interest rates in the short run, but may induce more confidence in the economy and hence lower interest rates in the long run. An alternative methodology is to assume that arbitrage between domestic and international financial markets guarantees interest rate parity, once expected devaluations and country risk premiums are properly included. Since a measure for the latter is not available, we use as a proxy the premium paid on the dollar in the parallel exchange market. This parallel market is totally legal in Chile, so that the exchange rate does not include any premium for the risk of undertaking illegal activities. The counterfactual scenario then sets the domestic interest rate at the six-month London interbank offer rate (LIBOR) plus the exchange rate premium.

As expected, the results in table 8 show the key importance of the interest rate in influencing asset prices. When analyzing the impact on equity prices, it is clear that there are different effects in the two subperiods. The 1991-94 period is characterized by a much larger premium (1.1 percent on average) than the 1995-98 period

(0.25 percent), as the country consolidated its transition to democratic rule and progressively integrated with international markets. Although stock market prices were heavily affected by interest rate policies in the former period, the distortion (an overvaluation of 19 percent) has almost disappeared in the second (0.9 percent). A similar asymmetric behavior is observed in the other asset prices. It is interesting to note that high interest rates depressed real estate prices by almost 10 percent in the 1991-98 period.

Pension Fund Policies

In early 1990 the Chilean government allowed pension funds to acquire increasing volumes of equities as a means of diversifying their portfolios. Massive investments were made in the 1991-94 period, raising equity prices. Nevertheless, in the same period the value of firms whose shares are traded in the stock market was also growing at a fast pace, as the economy expanded at an annual rate of over 7 percent and diversified markedly. Consequently, equity prices were also expected to increase for this reason. The proposed counterfactual scenario simulates the model restricting pension funds to hold no equities, and calculates the effect of such a restriction on asset prices.

Table 8 suggests that the "excess" value of equities amounted to almost 12 percent on average in the 1991-94 period. This was the period in which the pension funds actively demanded equities in the market. In the 1995-98 period, in contrast, the pension funds did not have any significant effect on equity prices; in fact there was an undervaluation of around 2.7 percent on average. As a side effect of the purchase of equities by pension funds, asset substitution led to depressed values for land prices of as much as 6.7 percent on average in the early 1990s. Real estate markets, however, proved to be less affected by these effects on the stock market.

3. Final Remarks

For over a decade, Chile enjoyed rapid and sustained economic growth. As expected, asset prices rose, reflecting the increase in wealth brought about by such growth. Nevertheless, real asset prices also displayed high volatility, and there have been periods in which returns were systematically negative or positive. Casual inspection, then, suggests the presence of sustained deviations from the

fundamental value of assets, that is, the presence of fads or bubbles. The fact that some of these fads coincided with periods in which important changes in macroeconomic policies were implemented suggests that policies may be able to affect asset prices, at least in the short to the medium run.

The empirical analysis in this paper tends to refute this notion of asset bubbles in the Chilean case, when a dynamic error correction framework is used to model asset returns. The presence of a cointegration equation provides an anchor for asset price deviations in the long run, whereas the dynamic model is able to capture a substantial portion of short-run fluctuations. Arguably, any deviation from the long-run forecast of asset prices could be considered a bubble; in such a case, there have been episodes in which asset prices were as much as 25 percent higher than what the fundamentals would call for (an example is that of equities in the 1990-93 period). If we allow for market friction or less than perfect information, as is likely in the Chilean economy, deviations of actual asset prices should be evaluated against the short-term model (which includes the long-run restrictions on asset price arbitrage). In such cases, fads have been nonexistent, as the deviations do not amount to more than 5 percent.

When considering the dynamics of asset prices, it is found that shocks tend to be very persistent, with long-term responses to own shocks above 50 percent of the initial impulse. This result is consistent with the notion of significant permanent components in asset price shocks and costly adjustments to long-run equilibrium. In addition, and consistent with intuition, stock market responses to shocks suggest that equities and land are substitute assets; positive land price shocks tend to lower equity prices as investors switch their portfolio structures toward more profitable alternatives. A similar effect is observed in land prices, which respond negatively to shocks to equity prices.

The response of equity and land prices to shocks provides an interesting asymmetry in the dynamics of asset markets. Land prices show no long-run response to real estate shocks, but stock markets respond positively. This is consistent with the notion that a rise in real estate prices induces a higher value of the portfolios of firms (such as banks, which hold a large share of real estate), thus raising their valuation in the stock market. However, an increase in equity prices does not necessarily induce changes in real estate prices.

An interesting feature of the model is that it allows for testing of the role of fiscal and monetary policies, as well as changes to regulations that, according to market observers, had a significant impact in fueling asset price bubbles. By simulating the model in a counterfactual scenario in which pension funds were forbidden to acquire equities, we determined that their impact has been sustained but reduced in magnitude. In the 1991-98 period, purchases of equities would have raised equity prices by an annual average of 4.2 percent.

Likewise, public expenditure has had a significant but asymmetric effect on assets. The estimated model finds a negative relationship between public expenditure and equity prices, but a positive link with regard to real estate prices. Consequently, the observed expansion in public expenditure during the 1990s led to a decline in equity prices on the order of 4.9 percent a year and an appreciation of about 6 percent in real estate prices. Moreover, the sudden increase in such expenditure during the 1995-98 period led to a drop in equity prices of 14.3 percent.

Monetary policies, on the other hand, have a significant effect on asset prices. When interest rates are allowed to fully reflect uncovered parities with international capital markets (that is, when restrictions on capital flows are lifted), we observe a reduction in equity prices of about 9 percent in the 1991-98 period and a higher predicted level of land prices of 11.4 percent.

APPENDIX A

Data Sources and Definitions

The macroconomic data were obtained mostly from the Central Bank of Chile; other series were obtained from specific sources discussed below or collected by the authors specially for this study. In particular, land prices, housing prices, and rental prices were estimated using Morandé and Soto's (1992) methodology. The definitions of the variables and their sources are described below:

– *Equity prices*: Indice General de Precios de Acciones, Santiago Stock Exchange.

– *Land prices*: Hedonic price of one hectare of agricultural land, for farms located within regions V through VIII. Farms smaller than 30 hectares or larger than 500 hectares are excluded, to eliminate land subject to subdivision for housing and land subject to forest exploitation, respectively.

– *Real estate prices*: Hedonic price of a house located in a homogeneous sector in the counties of Ñuñoa and Providencia, excluding houses devoted to commercial use and apartments.

– *Dividends*: Data from the Santiago Stock Exchange.

– *Exchange rates*: Bilateral rate of pesos to the U.S. dollar, from the Central Bank of Chile.

– *Capital flows*: Observed transactions in the form of foreign direct investment and long-term loans (long-run capital inflows), and portfolio investment and short-term lending (short-term inflows), all expressed as percentages of GDP using the official nominal exchange rate. Data from the Central Bank of Chile and Morandé (1992).

– *Public expenditure*: Expressed as a ratio to GDP, excluding investment undertaken by public enterprises and decentralized agencies. Data from the Central Bank of Chile.

– *Real interest rates*: Long-term yield on eight-year bonds, calculated ex post using nominal rates and observed consumer price inflation.

– *Rental price for housing*: Hedonic price of a house located in a homogeneous sector in the counties of Ñuñoa and Providencia, excluding houses devoted to commercial use and apartments. Data are consistent with real estate price data.

– *Pension fund purchases of equities*: Change in the value of equitys held by pension funds. Data from the Superintendency of Pension Funds.

– *Credit*: Total credit by the financial sector (*colocaciones*). Data from the Central Bank of Chile.

– *Terms of trade*: Data from the Central Bank of Chile.

Appendix B

Data Properties and Estimated Model Results

B.1 Characterizing the Persistence of Shocks in Asset Prices and Fundamentals

Table B1 presents the results of augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests performed on all variables in the models. The first autocorrelation (ρ) is also presented. Tests optimized the number of lags to control for possible residual autocorrelation.

B.2 Nonparametric Tests of Nonstationarity in Asset Prices

Misspecification of the alternative hypothesis and persistence beyond the initial autocorrelations can lead to misjudgments regarding the existence of unit roots. This suggests complementing the standard tests with additional procedures as discussed below.[6] In

Table B1. Unit-Root Tests[a]

	Level			*First difference*		
Variable	ρ	*ADF test*	*PP test*	ρ	*ADF test*	*PP test*
Equity prices	0.958	–1.57	–1.99	0.267	–5.17*	–6.75*
Land prices	0.694	–2.60	–3.91*	–0.380	–8.62*	–14.66*
Real estate prices	0.880	–2.09	–2.04	–0.060	–9.62*	–9.67*
Bond yield	0.848	–2.78	–2.86	–0.030	–9.49*	–9.21*
Fiscal expenditure[a]	0.707	–1.81	–3.59*	–0.38	–9.49*	–16.60*
Long–term capital inflows[b]	0.598	–3.09*	–4.43*	…	…	…
Real dividends	0.254	–2.26	–7.07*	…	…	…
Real loans	0.921	–3.55*	–3.32*	…	…	…
Terms of trade	0.913	–2.44	–2.41	0.221	–7.28*	–7.35*
Nominal exchange rate	0.966	–2.03	–2.60	0.560	–4.82*	–4.74*
Housing prices	0.791	–3.07*	–2.91*	…	…	…
Short–term capital inflows[b]	0.083	–7.80*	–7.96	…	…	…

Source: Authors' calculations.
a. Data are for the period 1978:1-1998:2. Critical values of the tests at the 10 percent and 5 percent significance levels were –2.58 and –2.90, respectively. * indicates rejection of the null hypothesis at the 5 percent level.
b. As a percentage of GDP.

6. Standard parametric procedures, such as those used above, are widely used by econometricians despite their lack of power in finite samples, when a root in the MA representation of the series is close to (but different from) one, or when the alternative hypothesis is a complex, nonstationary model other than a random walk, such as an ARIMA(1,1,1).

addition, in order to discuss asset price predictability, it is convenient to explore whether these prices follow a random walk.

A nonparametric alternative, suggested to cope with some of the limitations of parametric tests, is the variance-ratio (VR) test,[7] which has comparable power against stationary AR(1) alternatives in small samples but proves superior when the data are generated by more complex specifications (Chow and Denning, 1993). The test measures the importance of the nonstationary component of a series by comparing the variance of the permanent component to that of the innovations. Its main advantages are that it captures long-run reversions to the mean more accurately than do standard parametric techniques in small samples, and it is less sensitive to structural breaks (León and Soto, 1995).

The VR test exploits the fact that the variance of a random-walk process [$X_t = \mu + X_{t-1} + \varepsilon_t$, with $\varepsilon_t \sim N(0, \sigma_\varepsilon^2)$] increases linearly in the sampling interval, and that the magnitude of the random-walk component of a series can be inferred from the 1 /q ratio of the variance of q-differences to the variance of the first difference of the series. For example, if the series follows a random walk, the variance of quarterly increments must be three times as large as that of the monthly increments; dividing by 1 /q is a convenient normalization.

For empirical purposes, consider a sample of T observations of the process $\{X_t\}$. The VR can be obtained as:

$$V(q) = \frac{1}{q} \frac{\hat{\sigma}^2(q)}{\hat{\sigma}^2(1)},$$

$$\hat{\sigma}^2(1) = (T-1)^{-1} \sum_{t=1}^{T} \left(X_t - X_{t-1} - \overline{X} \right)^2,$$

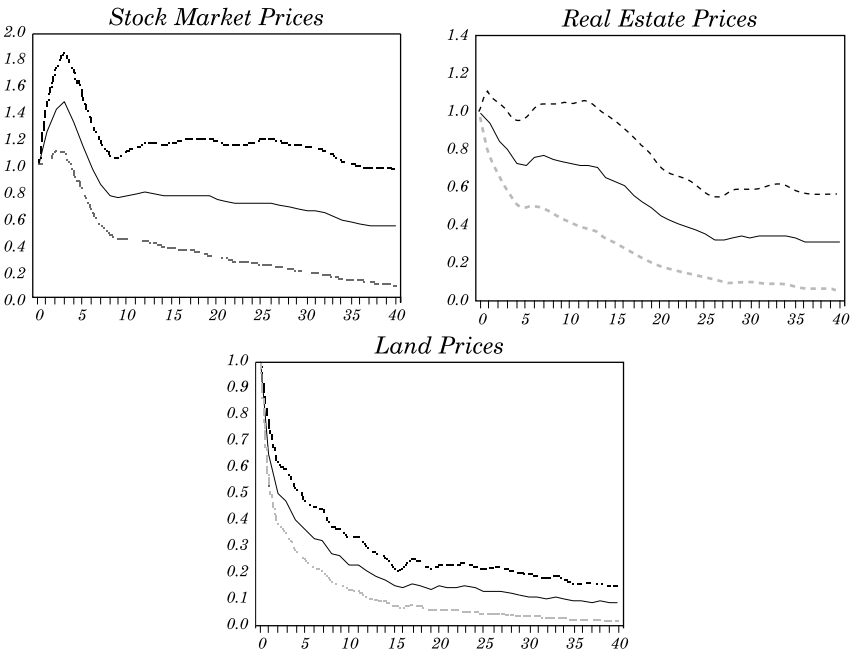
$$\hat{\sigma}^2(q) = \left[(T-q+1)\left(1-\frac{q}{t}\right) \right]^{-1} \sum_{t=q}^{T} \left(X_t - X_{t-q} - q\overline{X} \right),$$

where $\hat{\sigma}^2(1)$ and $\hat{\sigma}^2(q)$ are the sample estimators of the variance of the first and the qth difference and $\overline{X}$ is the mean of the first differences of X_t.

7. This estimator of persistence was proposed by Cochrane (1988) and extended by Lo and McKinley (1989).

Figure B1 presents the variance ratios for each asset price, including a 95 percent interval of the null hypothesis of a random-walk component (represented by the dotted lines). As is apparent, asset prices do not follow random-walk processes, since all series exhibit important long-term mean reversion components and reject the null at 95 percent. Nevertheless, they also exhibit very strong persistence in the short run, which is indicative of nonstationary components. This type of evidence led Cochrane (1988) to suggest that, in the presence of strong autocorrelation and finite samples, it would be advisable to treat series as if they were integrated even if they revert to the mean in the very long run.

Figure B1. Variance Ratio Test for Asset Prices



Source: Authors' calculations.

B.3 Nonstationarity and Structural Breaks

Both parametric and variance ratio tests are sensitive to the presence of structural breaks (Hendry and Neale, 1991; León and Soto, 1995). As noted by Perron (1989), a stationary model with a level shift can easily be taken for a integrated process. In fact, Perron shows that several economic series usually regarded as containing a unit root (such as GDP and interest rates) actually could correspond to stationary models with shifts in the level, the trend, or both.

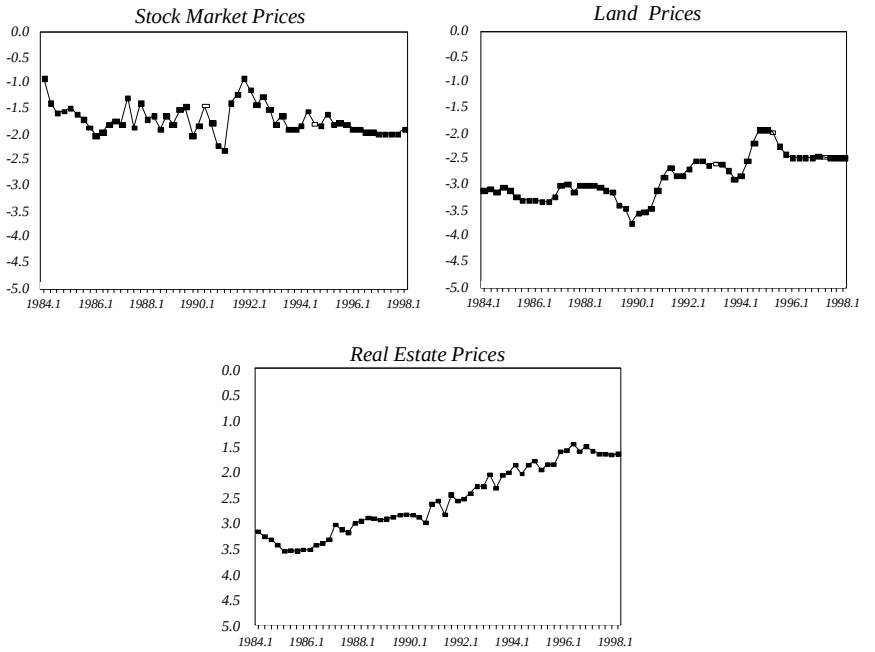
This observation is of some importance in the Chilean case, since a significant number of reforms were implemented during the period covered in this study. Although none of these reforms impinged directly on asset prices, they nevertheless affected fundamentals that guide asset price formation (examples are tax reforms, trade liberalization, and financial market deepening).

To assess the presence of structural breaks in asset prices, we use a test that endogenizes the dating of the breaks. This is done by estimating recursively a normalized version of Perron's (1989) additive-outlier model, starting from the beginning of the period and moving period by period toward the end of the sample (normalization is required to control for the changing size of the sample). The appropriate asymptotic distribution of the statistic, obtained by Zivot and Andrews (1992) using Monte Carlo simulations, provides critical values well below the full-sample DF critical values. When assessing the power of the test against stationary models, the recursive test has comparable power to that of the standard DF test in the absence of breaks.[8]

The results, presented in figure B2, imply that it is not possible to reject the null hypothesis that asset prices are characterized as a difference-stationary process at a 95 percent level of confidence. The alternative hypothesis of trend-stationary processes with level and/or trend shifts is not supported by the data.

8. Its main limitation, however, is that it tests for only one break. It is, nevertheless, preferred over a similar test developed by Banerjee and Lumsdaine, and Stock (1992), because the number of lags is endogenously determined at each recursion, avoiding potential misspecification problems.

Figure B2. Zivot-Andrews Unit-Root Tests (Structural Breaks Allowed)



Source: Authors' calculations.

B.4 Granger Causality Tests

Table B2 presents Granger causality tests for the variables used in the empirical estimation of error correction models.

B.5 The Stability of the Estimated Model

Figure B3 displays estimated recursive coefficients of the longrun cointegration model used to assess the stability of the estimation. It can be seen that the estimated parameters are stable (recursively estimated coefficients for the error correction models are available upon request).

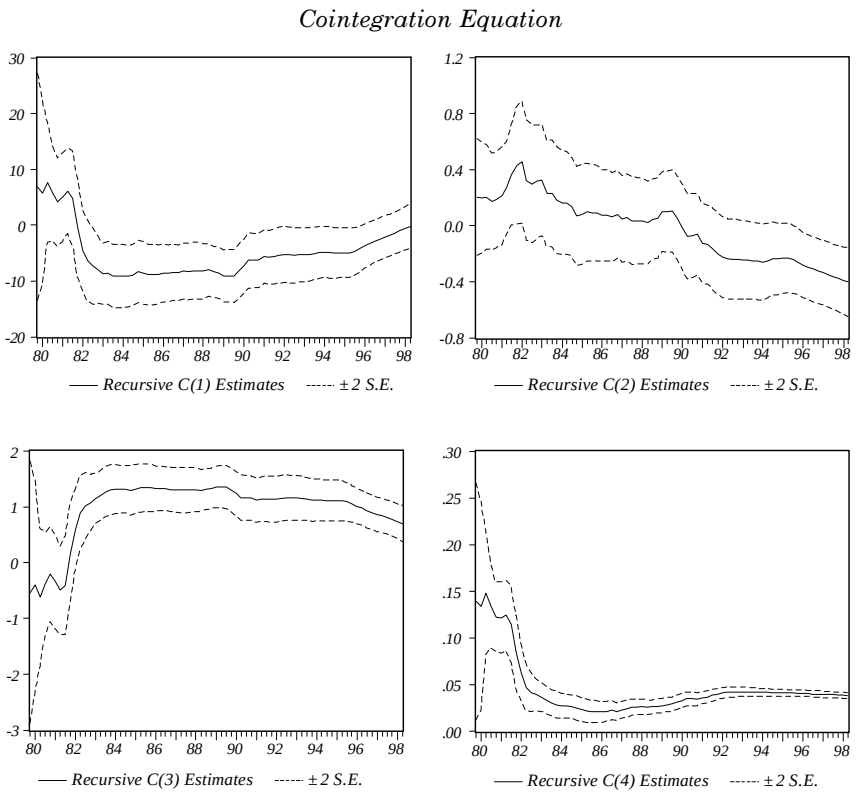
Figure B4 presents recursive estimates of the residuals of the models that show no signs of model mispecification.

Table B2. Granger Causality Tests[a]

Variable	Price of		
	Stocks	*Land*	*Real estate*
Terms of trade	1.32	1.31	0.16
Public expenditure	0.05	0.27	0.18
Real interest rate	1.86	1.49	0.03
Credit	1.83	0.08	1.42
Capital inflows	1.27	0.74	2.42*
Dividends	1.00	0.17	0.78
Housing rental price	0.07	0.17	5.35*

a. The null hypothesis is that innovations in asset prices do not Granger-cause changes in the indicated variable.
* indicates rejection of the null hypothesis at the 10 percent level.

Figure B3. Recursive Estimation of Coefficients



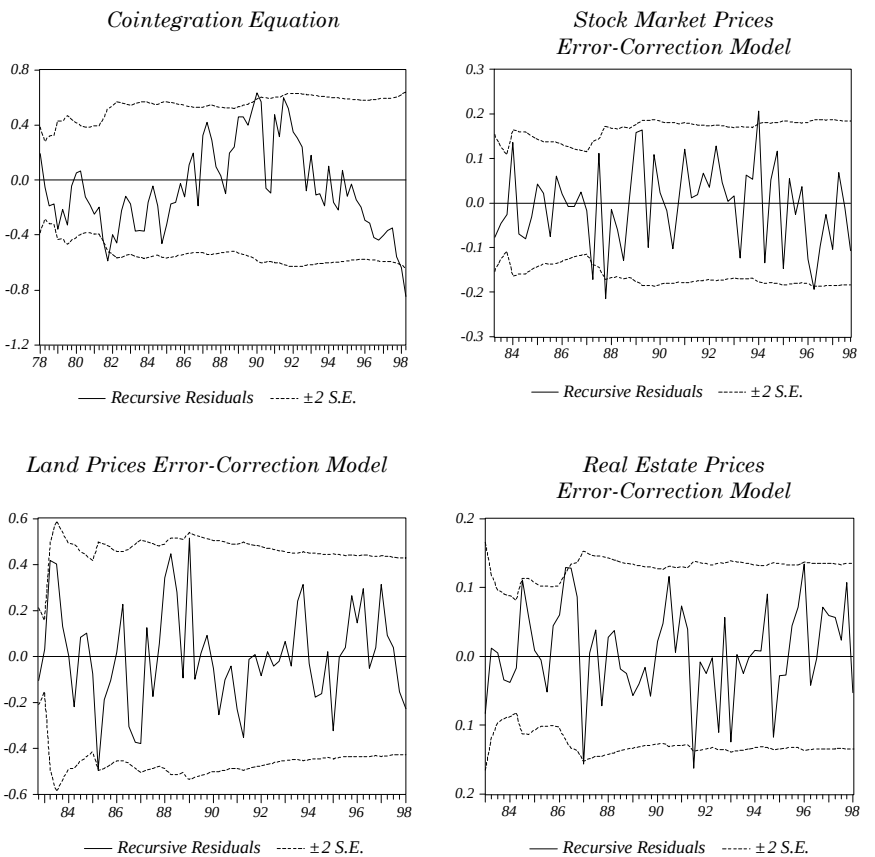
Source: Authors' calculations.

Table B3. Granger Causality Tests for Asset Prices[a]

Null hypothesis	*F statistic*	P *value*
Equity prices do not Granger-cause real estate prices	2.029	0.09878
Real estate prices do not Granger-cause equity prices	2.223	0.07464
Equity prices do not Granger-cause land prices	1.426	0.23372
Land prices do not Granger-cause equity prices	0.646	0.63136
Land prices do not Granger-cause real estate prices	0.243	0.91239
Real estate prices do not Granger-cause land prices	2.010	0.10207

Source: Authors' calculations.
a. Data are quaterly, 1978:1-1998:2.

Figure B4. Recursive Residuals



Source: Authors' calculations.

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Overshootings and Reversals: The Role of Monetary Policy

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Does tight monetary policy stabilize the currency after a collapse? Does the effect of high interest rates on the exchange rate depend on the condition of the banking system? The East Asian crises and other recent currency crises have put these questions at the center of economic policymaking decisions.

There is a lively debate on the effect of tight policies on the exchange rate. The traditional approach stresses that tight monetary policy is necessary to support the exchange rate and curb inflationary pressures. In the short run, higher interest rates make speculation more expensive by increasing the cost of borrowing (shorting) the domestic currency. Also, higher interest rates increase the return from investing in the country. In the long run, higher interest rates may affect the exchange rate by reducing absorption and improving the current account. However, in the current discussion of the role of monetary policy in the Asian crises, several economists have raised the possibility that an increase in interest rates would have a negative effect on the exchange rate. Radelet and Sachs (1998, p. 31), for

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example, have argued that high interest rates would not stabilize currencies in the Asian case: "Despite sharply higher interest rates, currencies have not appreciated so the supposed benefits of this policy are in question. It is entirely possible that in the unique conditions of the midst of a financial panic, raising interest rates could have the perverse effect of weakening the currency." On the opposite side of this debate, Krugman (1998a, b), also referring to the Asian crisis, writes, "I have heard some people propose what amounts to a sort of foreign exchange–interest rate Laffer curve: if you cut interest rates this will strengthen the economy, and the currency will actually rise. This is as silly as it sounds."

When one observes the relationship between the real exchange rate (RER) and real interest rates in the countries affected by the Asian currency crisis, the evidence is mixed. In the crisis period, from July 1997 to May 1998, a fairly positive correlation exists for Hong Kong (0.56), Indonesia (0.62), Malaysia (0.54), and the Philippines (0.58). In contrast, we observe a negative correlation in Korea (–0.45) and Thailand (–0.47).

This paper attempts to shed light on this debate by analyzing a large set of large depreciations in the aftermath of currency crises in the period 1980-98. The analysis of the effect of tight monetary policy on the exchange rate proceeds in three main steps. The first step is to evaluate whether the exchange rate overshot during the crisis, or in other words, whether the currency became undervalued in real terms and needed to be brought back to equilibrium. The second step is to identify the mechanisms through which the RER could be corrected if there is an undervaluation. There are two ways to reverse an undervaluation: through nominal currency appreciation or through higher inflation at home than abroad (or a combination of the two). If avoiding an inflation buildup is an important concern, or if nominal appreciation is desirable for the benefit of domestic corporate and banking balance sheets, the extent to which the reversal occurs through nominal appreciation is fundamental. The third step is to identify through which policies and under which circumstances the reversal occurs through nominal appreciation. In particular, it is important to evaluate whether nominal appreciations occur mainly in cases where interest rates are kept high. In addition, it is important to evaluate whether other economic conditions, for example the state of the banking system, influence the relationship between interest rates and exchange rates.

Operationally, the paper selects a set of currency crises that led to large undervaluations in terms of the RER and investigates how the

subsequent reversal occurred. We define as successful those reversals that occurred primarily through nominal appreciation rather than through higher inflation, and we calculate the probability of successful cases in the overall sample. We also calculate the probability that a tight monetary policy, defined as a case in which real interest rates in the aftermath of the crisis are higher than the average real interest rate during the twenty-four months preceding the crisis, is successful. We then compare that result with the overall probability of success. The traditional approach would suggest that the probability of being successful is higher in cases where tight monetary policy was implemented. Then the whole exercise is replicated using only cases of "twin crises," that is, cases in which currency crises coincided with banking crises. Again the probability of success is compared with the conditional probability of success when tight monetary policy is implemented. In principle, one would expect tight monetary policies to be less successful when a country is also experiencing a banking crisis.

In addition, we report results of a panel regression of RERs and real interest rates in the aftermath of currency crises. We also report results of an equivalent panel regression using only twin crisis cases.

The results indicate that tight monetary policy substantially increases the probability of success. For example, for real undervaluations greater than 15 percent, the probability of success increases from 26 percent to 37 percent when tight monetary policy is implemented. In contrast, tight monetary policies reduce the probability of success when the country is also experiencing problems in the banking sector.

The panel regression results show that the real interest rate is positively correlated with the RER for the entire sample as well as for some regional subsamples, but not for the Asian subsample. The results are mixed when we consider only the twin crises cases. Real interest rates are found to affect the RER positively in the African and European countries, but not in the Asian and Latin American countries.

The exercise in this paper differs from previous studies in a few important aspects. First, it analyzes the relationship between interest rates and exchange rates in crisis episodes, which are crucial periods for policymakers. This leaves out several interesting issues but allows us to concentrate on the role of monetary policy in reestablishing currency stability after a collapse. Previous studies have looked at the general relationship between interest rates and exchange rates, but few have concentrated their analysis on crisis episodes. Second, the paper studies a large set of currency crises and therefore can offer more

general results. Previous studies have concentrated on specific currency crisis cases, offering more limited results.[1] Third, the paper studies the relationship between *real* interest rates and *real* exchange rates using monthly data, as opposed to studying the relationship between the respective nominal variables using daily data. The availability of a sufficient number of monthly observations from the pooling of countries allows us to avoid having to extract the relevant information from more noisy daily data. In addition, the objective of the paper is to evaluate the relationship between tight monetary policy and currency stabilization: both, in our view, are more precisely defined using the real rather than the nominal variables. Finally, the recent research and availability of data on banking crises allow us to evaluate the relationship between real interest rates and real exchange rates in cases where currency and banking crises have occurred simultaneously.

This paper is organized as follows. Section 1 describes the theoretical arguments that would justify different correlations between interest rates and exchange rates in the aftermath of a currency crisis. Section 2 explains the methodology and the data used in the paper. Section 3 characterizes the undervaluation cases, looking at their duration and frequency. Section 4 characterizes the reversals and evaluates the effect of monetary policy, providing the essential results in the paper. Section 5 presents the econometric analysis, and section 6 concludes.

1. Theoretical Considerations

In the midst of an exchange rate crisis, interest rates are raised to make speculation against the currency more costly. If borrowing (shorting) the domestic currency to invest in the foreign currency is allowed, raising the interest rate directly increases the costs of speculation. Even if shorting the domestic currency is not allowed, the increase in interest rates affects the opportunity cost of an investor deciding whether to invest in the domestic economy.

The expected return on investing in the country depends on the promised interest rate and the expected depreciation. The interest

1. For example, the Asian crises and the debate on the role of monetary policy have motivated a few studies on the relationship between exchange rates and interest rates in the five or six countries most affected. See Ghosh and Phillips (1998), Goldfajn and Baig (1998), and Kaminsky and Schmukler (1998).

differential with respect to the rest of the world should allow for both an exchange rate risk premium and a probability of default:[2]

$$\mathrm{E}[i] = i^{*} + \mathrm{E}[\Delta e] + R, \tag{1}$$

where $\mathrm{E}[\Delta e]$ is the expected depreciation, $\mathrm{E}[i]$ is the expected return on an investment in the domestic economy, i^{*} is the safe return on an equivalent international asset, and R is the risk premium demanded by risk-averse foreign investors faced with exchange rate volatility.[3] In principle, increases in interest rates should increase the expected return, making investing in the domestic economy more attractive relative to investing abroad (in other words, making the right-hand side of the above equation larger than the left-hand side) and inducing capital inflows. This would increase the supply of dollars and immediately cause the currency to appreciate to the point where equation (1) again holds (in the Dornbusch, 1976, model, the exchange rate should actually overshoot its target so that agents will expect a future depreciation).

However, increases in interest rates may reduce the expected return by increasing the probability of default. Higher interest rates may affect the probability of default by increasing the borrowing costs of corporations, by depressing the economy and reducing profits, by altering the net worth of corporations adversely exposed to interest rate changes, and, finally, by affecting the health of the banking system, which tends to be naturally exposed to interest rate changes. The last of these factors has a compounding effect on the economy, since problems in the banking system lead to credit crunches, disintermediation, and poor allocation of credit. Formally, the expected return on the domestic asset $\mathrm{E}[i]$ can be written as the product of the domestic interest rate, I, and the probability of repayment, ρ:$\mathrm{E}[i] = \rho(I)I$. The equation can be rewritten in the following way:

$$\rho(i)\, i = i^{*} + \mathrm{E}[\Delta e] + R,$$

where $\rho' < 0$, $\rho'' < 0$.

At some point, additional increases in interest rates do not raise the expected return from investing in the domestic economy.

2. Default here is defined in general terms to include partial payment, delay of payments, or the introduction of exchange controls.

3. The risk premium must also include a component for the uncertainty induced by the probability of default.

Therefore, even though one should expect increases in interest rates to attract capital, there must be cases where additional increases in interest rates reduce the expected return and generate capital outflows. In these cases, raising interest rates paradoxically destabilizes the exchange rate.[4]

Proponents of tighter monetary policy argue that higher interest rates need only be temporary. Once the exchange rate has been defended (or the currency has appreciated), interest rates can be allowed to decline. This argument is important given that the costs of a persistent period of high interest rates could be substantial.

However, the question is then, Why should a temporary increase in interest rates bring about permanent, positive effects on the exchange rate? After all, the objective is to stabilize the exchange rate permanently. One answer is that the temporarily tight policies signal the determination of the monetary authorities to pursue exchange rate stability and low inflation. Temporary policies may then change the beliefs of investors, so that even when the tight policies are withdrawn, the exchange rate will stabilize at a higher level than it would have otherwise.

Tight monetary policies do not always serve as a credible signaling device. Drazen and Masson (1994) have shown that if the costs of implementing the tight policies are too high, the temporary policy will actually reduce credibility, because investors will know that the policy cannot be sustained and will expect a future devaluation. Under this theory, the relationship between interest rates and the exchange rate could be negative. When there are doubts about the determination of the authorities, and signaling is very important, the effect of raising interest rates should be positive, but when there are structural problems that are severely exacerbated by raising interest rates, the effect may be negative.

2. Methodology and Data

This paper analyzes all episodes of currency collapses that resulted in large undervaluations from a sample of eighty countries between

4. Notwithstanding the negative effect of interest rates on exchange rates in these cases, it is not immediately evident that a tight monetary policy will lead to an explosive path. One should still expect a reversal in the long run, since a deep enough recession and a large enough depreciation would eventually generate a surplus in the current account and an appreciation of the currency.

January 1980 and January 1998. It also studies the role of tight monetary policy in reversing the undervaluation through nominal appreciation of the currency rather than through higher inflation. This exercise requires the definition of four different concepts. First, one needs to define the term *undervaluation* and specify the threshold that defines a "large" undervaluation. Second, the exercise requires the definition of what constitutes a successful reversal; that is, it requires a threshold for the proportion of the reversal to equilibrium that is due to nominal appreciation of the currency. For example, is a reversal that is 50 percent driven by nominal appreciation a successful case? Third, there is a need to define "tight" monetary policy. Finally, one needs to specify how to evaluate whether tight monetary policy has helped stabilize the exchange rate.

2.1 Definition of Undervaluation and Identification of Cases

In this paper an undervaluation episode is defined in terms of the departure of the actual RER from an estimated equilibrium RER. We define the undervaluation series in terms of the deviation of the actual exchange rate from a Hodrick-Prescott-filtered series. The filtered series captures stochastic trends in the series and allows us to concentrate on the cyclical behavior of potentially nonstationary RER series. The filtered series represents the predicted equilibrium RER and captures the permanent changes in relative prices between countries, whereas the estimated undervaluation series represents the cyclical component of the RER movements, since, as a misalignment, an undervaluation must eventually correct itself. This approach will also net out from the undervaluation measure any trend in the equilibrium RER, for example that due to a Balassa-Samuelson effect.[5]

The paper defines the equilibrium RER as the predicted value of a cointegrating regression of the actual RER on a set of fundamentals: the terms of trade, openness of the economy, government size, and the international interest rate. We then calculate the undervaluations as deviations from this equilibrium value (see Goldfajn and Valdés, 1998). Since the sample for which measures of

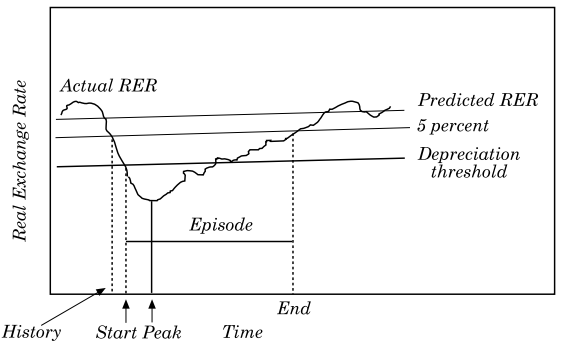
5. The Balassa-Samuelson effect occurs when the productivity of a country's tradables sector grows faster than that in its trading partners, and this differential growth is smaller in the nontradables sector. Then the (cross-country) relative price of nontradables increases, and therefore the currency appreciates in terms of the RER over time. See Rogoff (1992).

the fundamentals are available is more restricted, we will use these RER series to test the robustness of the results.

Figure 1 presents the definition of an undervaluation episode and its phases. We define the start of an undervaluation episode as the time when the difference between the actual RER and our estimate of the steady-state RER is equal to or higher than a certain threshold (for example, 15 percent or 25 percent). The episode ends when this difference hits a second threshold (5 percent) associated with the absence of undervaluation. In order to control for data blips, an episode has to be sustained for more than two consecutive months to be classified as such.

We define four points in the course of an undervaluation episode. The *start* occurs when the undervaluation hits the threshold. The *end* occurs when the undervaluation disappears (that is, when the RER returns to the 5 percent threshold). The *peak* occurs when the undervaluation is at its highest. And the *history* occurs when the undervaluation first reaches 5 percent. An undervaluation episode is then defined as the period between the start and the end. Associated with each episode there are also two phases: from history to peak, representing the buildup of the overshooting, and from peak to end, representing reversion to a "normal" level.

Figure 1. Definition of Cases and Phases



2.2 Definition of Successful Reversals

As noted above, there are two ways to reverse an undervaluation: through nominal currency appreciation or through higher inflation at home than abroad (or a combination of the two). If avoiding an inflation buildup is an important concern, or if nominal appreciation is desirable for the benefit of domestic corporate and banking balance sheets, the extent to which the reversal occurs through nominal appreciation is fundamental.

In order to decompose the real appreciation that occurs during the return to equilibrium, we calculate the total appreciation in terms of the actual RER during the peak-end phase and the total nominal appreciation during that same period. Successful reversals can then be defined as episodes that return to equilibrium with nominal appreciation of the currency above a certain threshold.

Letting Δ denote percentage change, we have the identity

$$\Delta RER = \Delta E + \Delta(P - P^*) ,$$

where E and RER are the nominal and real effective exchange rate indices, respectively, and P and P^* are the price indices at home and abroad, respectively. We can then calculate

$$S = \frac{\Delta E}{\Delta RER}$$

as our success index. As a starting point we define a successful case as occurring when S is greater than 50 percent. In the next section we test the sensitivity of our results to different thresholds for S.

2.3 Definition of Tight Monetary Policy

Ideally, one would like to have exogenous shocks to monetary policy in all the crisis episodes. Clearly, however, there are no such data available. This paper therefore identifies a country as experiencing tight monetary policy when the average real interest rate r during the period of undervaluation exceeds a threshold real interest rate. The latter is calculated as the average real interest rate during the twenty-four months preceding the crisis and is denoted by u_r , plus x times the standard deviation of the series, σ_r . In other words,

$$r > u_r + x\sigma_r .$$

As a starting point, we have set x equal to zero in the benchmark case, but sensitivity analyses are also performed for different values of x.

There are several possible ways of calculating real interest rates, depending on how expected inflation is proxied.[6] In this paper we calculate expected inflation by taking the following month's inflation and use it to find the real interest rate. The real interest rate in period t is then calculated as the moving average of real interest rates for the three months centered at t. We also evaluate the results under alternative definitions of the real interest rate and of monetary tightness.

2.4 Determining the Effectiveness of Tight Monetary Policy

We define monetary policy as effective if we find that the conditional probability of reversing an undervaluation through nominal appreciation using tight policy is higher than the unconditional probability (or higher than the probability conditional on not using tight policy). In other words, we consider that monetary policy has been effective if, in the cases that had tight monetary policies, we observe a larger proportion of successes than in the overall sample.

The main tables of the paper compare the conditional probabilities of success under tight and nontight policies for different thresholds and definitions. In particular, we evaluate the probability of success of tight monetary policy with and without a banking crisis.

2.5 Data

Our sample consists of monthly data for eighty countries (see appendix for a list) during the period January 1980 to January 1998.[7] The monthly data on nominal interest rates were obtained from the International Monetary Fund's *International Financial Statistics*. Depending on data availability, one of the following series is used for the nominal interest rate: the money market rate, the treasury bill rate, or the discount rate. In a few cases where none of these series were available, the deposit rate was used.

Data on the seasonally adjusted consumer price index, the nominal effective exchange rate, and the real effective exchange rate

6. See Goldfajn and Baig (1998).

7. We started with the same set of ninety-three countries as in Goldfajn and Valdés (1998); however, because of data unavailability some countries had to be dropped.

were obtained from the IMF's Information Notice System (INS).[8] The use of the INS real effective exchange rate should, in principle, consider the effect of "competitive devaluations" in third markets.

The existence of banking crises is summarized by a dummy variable. The dates of banking crises were obtained from Lindgren, Garcia, and Saal (1996), Caprio and Klingebiel (1996), and Demirgüç-Kunt and Detragiache (1997).[9] Since these studies provide only annual data, monthly data were interpolated by assuming that the crisis lasted from January of the year in which it started until December of the year in which it ended.

3. Characterizing Undervaluations and Crises

In this section we present several characteristics of the undervaluation episodes in our sample. In particular, we analyze the number of episodes with different magnitudes of undervaluation, the average duration of the undervaluation episodes, the proportion of cases in which banking problems were also experienced (the twin crises cases), and the proportion of cases in which monetary policy was tight.

3.1 Number of Cases

The number of episodes clearly depends on the cutoff used to define an undervaluation. We identified ninety-nine cases of undervaluation using a 10 percent cutoff: that is, there are ninety-nine cases in our sample where the RER overshot by at least 10 percent. When the definition is made stricter by raising the cutoff, the number of undervaluation cases declines. Thus, the number of cases with more than a 15 percent undervaluation declines to seventy-seven, and there are just twenty-eight cases in which the RER is found to be undervalued by more than 30 percent. These results are presented in table 1.

Table 1 also shows the proportion of banking crises in the sample. We identified about 45 to 55 percent of the undervaluation cases to be twin crises cases; in other words, about half of the undervaluation

8. The nominal and real exchange rates have been defined such that an increase is an appreciation.

9. Problems in the banking sector may take either or both of the following forms. First, the banks may be unsound, that is, they may have a high share of nonperforming assets in their portfolio; second, there may be a run on the banks. We include both types of cases to define a fragile banking sector.

Table 1. Composition of Undervaluation Episodes

Threshold for RER overshooting (percent)	*No. of episodes above threshold*	*Proportion with concurrent banking crises (percent)*	*Proportion of all episodes with tight monetary policy (percent)*
10	99	...	32.3
15	77	45.4	29.2
20	49	46.9	22.5
25	36	50.0	17.2
30	28	57.1	13.6

Source: Authors' calculations.

cases are accompanied by a fragile banking sector.[10] This confirms previous results in the literature finding strong evidence for the simultaneous occurrence of banking and currency crises. The proportion of these cases increases for larger undervaluation thresholds. This means that once the degree of undervaluation reaches 15 percent, further undervaluation alters the likelihood of having a banking crisis.

We find monetary policy to be tight in nearly one-third of the cases with more than a 10 percent undervaluation. The percentage of such cases declines when the threshold used to define undervaluation is increased.

3.2 Duration of Undervaluations

We also examined the average duration for which an undervaluation in terms of the RER persisted after a currency crisis. The average duration was found to be about thirty months for cases with more than a 15 percent undervaluation. The average buildup phase (the history-to-peak phase) is 9.5 months, which is considerably shorter than the reversal phase (the peak-to-end phase), which averages about 20.4 months. These results are summarized in table 2. We also present in figure 2 a frequency histogram of the duration of the buildup phase and the reversal phase.

As can be seen from figure 2, there is a marked asymmetry in the durations of the two phases. On one hand, in more than 45 percent of the cases the buildup takes only one to three months, and in almost 80 percent of the cases it takes less than a year. On the other hand, reversal takes much longer: in only 35 percent of the cases does reversal take less than a year.

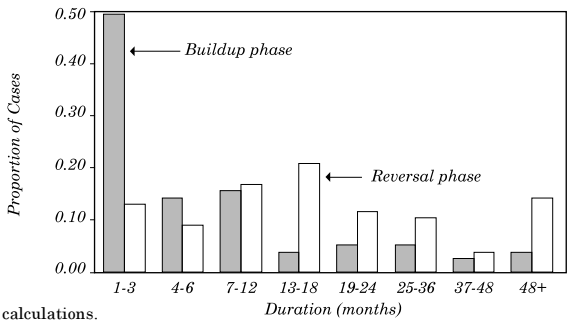
10. See Kaminsky and Reinhart (1998) and Gupta (1997) for evidence on the existence of twin crises and various explanations of why such crises may arise.

Table 2. Average Duration of Undervaluation Episodes

Phase of episode	*Months*
Buildup	9.5
Reversal	20.4
Total	29.9

Source: Authors' calculations.

Figure 2. Phases Duration Histogram



Source: Authors' calculations.

4. Characterizing Reversals

In this section we address the main questions raised in this paper. What is the probability that a reversal will occur through nominal appreciation rather than through higher inflation? What is the effect of a tight monetary policy on the probability of a successful reversal? Does the condition of the banking system alter the effectiveness of monetary policy?

We first analyze the proportion of success cases. Then we identify the proportion of successes among cases in which interest rates were kept high. In light of the recent debate on how the state of the banking system may influence the relationship between interest rates and exchange rates, we analyze the effect of the health of the banking sector on the probability of successful reversal.

4.1 Unconditional Reversals: Proportion of Nominal Appreciation versus Inflationary Returns

We first analyze the success cases among cases of undervaluation of at least 15 percent. We consider several alternative definitions of

success by varying the percentage of reversal that is required to be brought about through nominal appreciation. The results are presented in table 3 and figure 3. The number of success cases declines when a stricter definition is used.

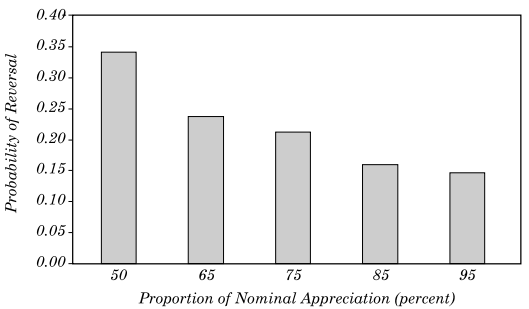
Figure 4 presents the probability of reversal through nominal appreciation for varying degrees of undervaluation. Here we define successful cases as those in which nominal appreciation is responsible for at least 50 percent of the reversal in the RER. We find that in a significant number of cases the reversal comes about through a nominal appreciation of the currency: 35 percent of cases of more than 10 percent undervaluation were found to be success cases. The percentage of success cases declines for undervaluations of greater magnitude, but not significantly: about 29 percent of undervaluations of greater than 30 percent were reversed through nominal appreciation. This implies that the magnitude of the overshooting does not significantly affect the probability of reversing the undervaluation through nominal appreciation.

Table 3. Probability of Success at Alternative Success Thresholds[a]

Minimum share of reversal achieved through nominal appreciation (percent)	*Probability of success (unconditional)*
50	0.32
65	0.22
75	0.19
85	0.14
95	0.13

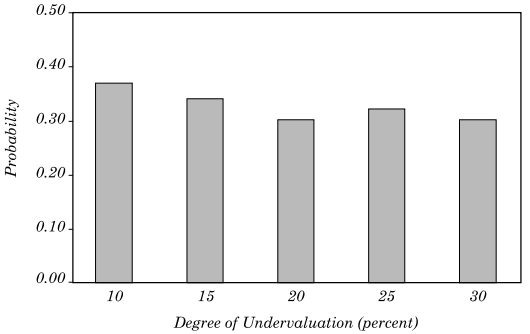
Source: Authors' calculations.
a. Only episodes of undervaluations greater than 15 percent are included.

Figure 3. Probability of Reversing Undervaluations as a Function of Success Definition



Source: Authors' calculations.

Figure 4. Probability of Reversing Undervaluations Through Nominal Appreciation



Source: Authors' calculations.

4.2 Conditional Reversals: Proportion of Successful Cases with Tight Monetary Policy

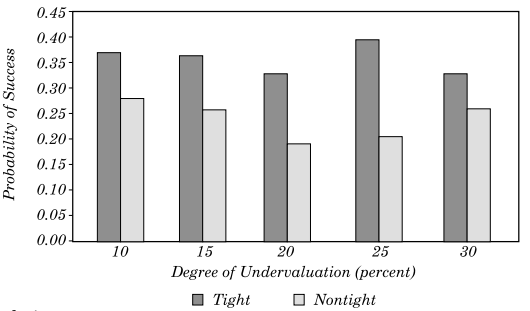
Table 4 and figure 5 address one of the main questions of the paper, namely, What is the effect of tight monetary policy in bringing about the reversal of an undervaluation through nominal appreciation? The probability of success conditional on using tight monetary policy is substantially higher than the probability of success conditional on nontight policy. Thus, whereas the probability of success is only 26 percent for undervaluations of at least 15 percent for the nontight sample, that probability increases to 37 percent when tight monetary policy is used. This result is confirmed for all degrees of undervaluation.

Table 4. Unconditional versus Conditional Probabilities of Success

Threshold for RER overshooting (percent)	*Probability of success*[a]			
	Unconditional	*Tight monetary policy*	*Nontight monetary policy*	*Result of significance test*[b]
10	0.35	0.38	0.28	Significant
1	0.32	0.37	0.26	Significant
20	0.29	0.33	0.19	
25	0.31	0.40	0.21	
30	0.29	0.33	0.26	Significant

Source: Authors' calculations.
a. Success is defined as a greater than 50 percent reversal of undervaluation achieved through nominal appreciation.
b. "Significant" indicates that the probabilities are different at a significance level greater than 85 percent.

Figure 5. Probability of Success with Tight and Nontight Monetary Policy



Source: Authors' calculations.

These results may lend support to the use of tight monetary policy to correct an undervaluation of the currency. However, one has to interpret the results with caution. Since there is no truly exogenous policy variable in this exercise, the higher incidence of successes under high real interest rates could be driven by a third factor.

Nonetheless, the fact that our results do show a positive correlation between tight policies and nominal appreciations is interesting. A typical "endogeneity" argument is that interest rates and exchange rates are both driven by a deterioration in investors' confidence during a crisis. This increases the risk premium and consequently raises interest rates and at the same time depresses the exchange rate. This would typically generate a negative correlation, not a positive correlation as obtained here.

4.3 Proportion of Successful Cases among Cases Where Banking Problems Are Also Present

The presence of vulnerable banking and corporate sectors raises the often-mentioned trade-off between banking sector fragility and exchange rate stability that a policymaker faces when choosing monetary policy. Policymakers may be less willing to raise the interest rate to defend the currency when the banking sector or the corporate sector is exposed to interest rate increases.[11] This is compounded by the fact that interest rate increases may affect investors' expected

11. Other factors affecting monetary policy may include the stock of government debt and the increased burden of debt servicing.

return. Interest rates may affect the probability of default by increasing the debt-servicing burden of corporations, by depressing the economy and reducing profits, by altering the net worth of corporations adversely exposed to interest rate changes, or finally, by affecting the health of the banking system, which tends to be naturally exposed to interest rate changes.[12]

In fact, we find that policymakers are less likely to choose tight policies when they are simultaneously facing a banking crisis. In table 5 we find that, for higher undervaluation thresholds, the unconditional probability of choosing a tight monetary policy is higher than the probability of choosing a tight policy conditioned on having a banking crisis. For undervaluations of at least 15 percent, the probability of choosing tight monetary policy declines from 29 percent for the entire sample to 25 percent in the twin crises cases.

Moreover, when tight monetary policy is adopted in such cases, it diminishes the probability of a successful recovery. Table 6 and figure 6 show that the probability of success falls from 45 percent to 29 percent when tight monetary policies are adopted, for undervaluations greater than 15 percent. This means that the relationship between high interest rates and stable currencies hinges crucially on the state of the banking system.[13]

Table 5. Unconditional versus Conditional Probabilities of Choosing Tight Monetary Policy

Threshold for RER overshooting (percent)	*Probability of choosing tight monetary policy*	
	Unconditional	*Conditional on presence of banking crisis*
10	0.32	0.34
15	0.29	0.25
20	0.23	0.21

Source: Authors' calculations.

12. Ideally, one would like to analyze the effect of the health of the banking sector as well as of the corporate sector on the reversal process and on the relationship between real interest rates and the RER. However, because of data limitations we analyze only the effect of the banking sector.

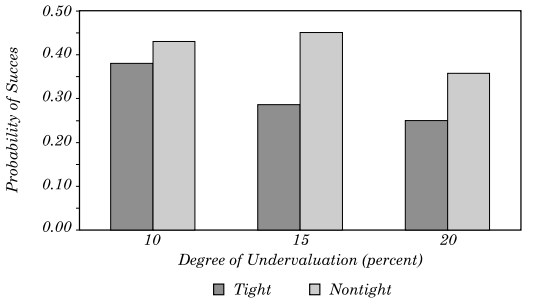
13. An important caveat is that there are very few cases in our sample in which tight policy was used in the presence of banking problems.

Table 6. Unconditional versus Conditional Probabilities of Success in Twin Crisis Cases

Threshold for RER overshooting (percent)	*Probability of success*[a]			*Result of significance test*[b]
	Unconditional	*Tight monetary policy*	*Nontight monetary policy*	
10	0.33	0.38	0.43	
15	0.34	0.29	0.45	Significant
20	0.30	0.25	0.36	Significant

Source: Authors' calculations.
a. Success is defined as a greater than 50 percent reversal of undervaluation achieved through nominal appreciation.
b. "Significant" indicates that the probabilities are different at a significance level greater than 85 percent.

Figure 6. Probability of Success under Twin Crises with Tight and Nontight Monetary Policy



Source: Authors' calculations.

5. Econometric Analysis

The analysis so far has treated each currency crisis as a single event and has not analyzed the time-series relationship between interest rates and exchange rates in the aftermath of currency crises. To fill this gap, we further analyze the effectiveness of monetary policy in correcting a real undervaluation by estimating a fixed-effects model using monthly panel data. We consider undervaluations greater than 15 percent and hence consider seventy-seven episodes of undervaluation in this exercise. The panel data consist of time-series observations for the cases of undervaluation. Since the duration of the undervaluation differed across cases, we estimated the model with an unbalanced panel.

We estimated the model by regressing the deviation of the RER from the equilibrium RER (which measures the extent of undervaluation) on the real interest rate, controlling for case-specific fixed effects. The model specification is given as

$$y_{it} = \alpha_i + \alpha x_{it} + u_{it},$$

where y is the deviation of the RER from equilibrium, and the subscript it refers to the ith case and the time period. Notice that t is different across cases. α is the constant term, which is assumed to differ across cases. The term x denotes the real interest rate, and u is an error term with a mean of zero and constant variance.

Table 7 presents the main results from this regression exercise. For the entire sample, the coefficient on the real interest rate is found to be positive and highly significant (at the 1 percent level; first column, first row), which implies that high real interest rates help in correcting an undervaluation.

In light of the recent debate on the effectiveness of monetary policy (see section 1) in the presence of a fragile banking sector, it is also interesting to see how the latter affects the relationship between the RER and the interest rate. Hence we divided the sample into two subsamples. One subsample included those observations for which, along with an undervaluation, the country is also experiencing a fragile banking sector (the twin crises cases). The second subsample included those observations for which the banking sector is supposedly healthy (the currency-crisis-only cases). We reestimated the model separately for each subsample. The results are presented in the second and third columns of the first row of table 7. The coefficient on the real interest rate is again positive and significant at the 1 percent level for the sample that excludes the twin crises cases. For the sample consisting of the twin crises cases only, we find that the coefficient of the real interest rate is still positive, but much smaller and significant only at the 5 percent level. This confirms our suspicion that banking sector problems may dampen the effect of higher interest rates on the exchange rate.

To compare the relationship between real interest rates and the RER across regions, we estimated the panel regressions separately for subsamples consisting of each of four country groups: Latin America, Africa, Europe, and Asia. We performed the exercise three times for each set of countries: once taking the entire sample of currency crises, next including only the twin crises cases in the sample, and finally excluding those cases that had banking crises.

Table 7a. Panel Data Regressions of Deviations of the Real Exchange Rate from Equilibrium on Real Interest Rates[a]

Sample	*All cases*	*Twin crisis cases only*	*Cases with only a currency crisis*
Entire sample	0.05542* (8.02)	0.0236** (2.49)	0.0801* (8.37)
Latin American countries	0.04249* (5.18)	−0.0065 (−0.606)	0.1379* (10.6)
African countries	0.2169* (9.66)	0.2407* (8.518)	0.1350* (3.68)
European countries	0.06103** (2.26)	0.1706* (3.17)	0.0483 (1.45)
Asian countries	−0.0149 (−1.28)	−0.251* (−3.40)	−0.0162 (−1.45)

Source: Authors' calculations.
a. Numbers in parentheses are *t* statistics. * and ** denote statistical significance at the 1 percent and the 5 percent level, respectively.

Table 7b. Panel Data Regressions of Deviations of the Real Exchange Rate from Equilibrium on Real Interest Rates, New Set of Cases[a]

Sample	*All cases*	*Twin crisis cases only*	*Cases with only a currency crisis*
Entire sample	0.14674* (13.6)	0.1484* (9.01)	0.1531* (10.7)
Latin American countries	0.1531* (10.83)	0.0869* (3.374)	0.1972* (11.834)
African countries	0.1765* (8.39)	0.2190** (9.251)	0.1020* (2.611)
European countries	0.0566 (1.878)	0.1525** (2.116)	0.0483 (1.45)
Asian countries	−0.008 (−0.124)	−0.2768* (−3.45)	−0.108 (−1.16)

Source: Authors' calculations.
a. Numbers in parentheses are *t* statistics. * and ** denote statistical significance at the 1 percent and the 5 percent level, respectively.

Some interesting comparisons result from these panel regressions. For the Latin American countries, the coefficient on the real interest rate is positive and significant at the 1 percent level, both for the entire sample and for the sample that excludes banking crises. For this group of countries the coefficient is negative, but insignificant, when the sample consists of the twin crises cases only. This means that, for the Americas, monetary policy is effective in stabilizing the exchange rate provided there is no banking crisis.

For the African countries the coefficient on the real interest rate is positive and significant at the 1 percent level when all the cases are included in the sample. The coefficient remains positive and significant when only twin crises cases or only currency crisis cases are included. Thus, irrespective of the health of the banking sector, the real interest rate is found to affect the RER positively and significantly in Africa. The results for the European countries are somewhat similar to those for the African countries. The coefficient on the RER is positive for all three samples, but not significant when only currency crisis cases are included.

At the opposite end of the spectrum is the experience of the Asian countries: here the coefficient on the real interest rate is found to be negative, although insignificant, when all the cases are included in the sample. The coefficient becomes more negative and is significant at the 1 percent level when only the twin crises cases are included, thus providing evidence that the coexistence of a banking crisis dampens the effect of interest rates on the exchange rate. The coefficient remains negative but is insignificant when only currency crisis cases are included in the sample.

6. Conclusion

This paper provides empirical evidence for the debate about the effectiveness of tight monetary policies in stabilizing exchange rates in the aftermath of currency crises. Although exogenous monetary policy variables are not available, at least for a large set of countries, and true claims of causality cannot be made, the relationships encountered in this paper provide food for thought. We find that in a large set of undervaluations in the aftermath of currency crises, tight monetary policy substantially increases the probability of reversing an undervaluation through nominal appreciation rather than through higher inflation. However, the opposite is true when the country is also facing a banking crisis: tight policies then decrease the probability of a reversal through changes in the nominal exchange rate.

Even if one is willing to accept that tight monetary policy helps stabilize the exchange rate, and therefore that there may a benefit of this policy, one also has to take into account the costs involved in raising interest rates. A natural extension of this paper would be to look at the costs of tight policies by analyzing several variables, including output loss and higher debt service in the aftermath of currency crises.

APPENDIX

Argentina
Australia
Austria
Bahrain
Bangladesh
Belgium
Bolivia
Brazil
Burkina Faso
Burundi
Cameroon
Canada
Central African Republic
Chile
China, P.R.
Colombia
Costa Rica
Denmark
Ecuador
Egypt
El Salvador
Ethiopia
Finland
France
Gabon
Germany
Ghana
Greece
Guatemala
Haiti
Honduras
Hungary
India
Indonesia
Ireland
Israel
Italy
Jamaica
Japan
Jordan
Kenya
Korea
Madagascar
Malawi
Malaysia
Mexico
Morocco
Nepal
Netherlands, The
New Zealand
Nigeria
Norway
Pakistan
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Portugal
Romania
Rwanda
Senegal
Sierra Leone
Singapore
South Africa
Spain
Sri Lanka
Sweden
Switzerland
Thailand
Togo
Trinidad and Tobago
Tunisia
Turkey
United Kingdom
United States
Uruguay
Venezuela
Zambia
Zimbabwe

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Japanese Banking Problems: Implications for Southeast Asia

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During the late 1980s, Japanese banks substantially increased their global presence. In part the expansion was undertaken to help service Japanese companies that were increasingly involved in foreign direct investment. However, this expansion also can be attributed to Japan's position as the world's preeminent source of surplus capital. And because Japanese banks faced only limited foreign competition for domestic deposits, Japan's high saving rate provided them with large and growing volumes of low-cost deposits. The substantial rise in Japanese stock prices raised the value of the extensive cross-holdings of equity shares by Japanese banks, providing the increase in the bank capital base that supported their dramatic asset growth. This expansion catapulted many Japanese banks into the ranks of the largest banking organizations in the world, with Japanese banks accounting for thirteen of the world's fifteen largest banks in 1994.

While Japanese banks expanded quite dramatically worldwide, much of their rapid growth initially occurred outside of Southeast Asia.[1]

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1. For purposes of this paper, Southeast Asia is defined to include Indonesia, Malaysia, the Philippines, the Republic of Korea, Taiwan, Thailand, Hong Kong, and Singapore. Korea is included despite its different geographical location for ease of exposition. The offshore banking centers of Hong Kong and Singapore are considered separately from the other six Southeast Asian economies in the figures and tables.

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The focus was on Japan's largest trading partners, such as the United States.[2] Another motivation for the surge in foreign lending by Japanese banks was to avoid Bank of Japan window guidance (Frankel and Morgan, 1992).

In the 1990s the lending focus of Japanese banks was redirected to Southeast Asia. As with the expansion in the 1980s in the United States, much of the initial expansion in Southeast Asian lending was to subsidiaries and affiliates of Japanese firms.[3] These firms increasingly were using the relatively low-cost labor in other Asian countries to maintain price competitiveness.[4] As the influx of foreign direct investment buoyed the economies of these countries, the Asian markets began to appear to be attractive lending markets because of their own expected rapid domestic growth, rather than just as sources of bank loans to Japanese affiliates that were using these countries as low-cost production platforms. Through the mid-1990s, Japanese banks aggressively expanded their lending to Southeast Asia, and by the end of 1997 they accounted for one-third of cross-border loans by foreign banking organizations to customers in Southeast Asian countries.

The recent economic crisis in Southeast Asia has called into question the future role of Japanese banks in the region. Their much-heralded difficulties with nonperforming loans in their domestic portfolios and the depletion of their risk-based capital ratios resulting from the dramatic declines in Japanese stock prices in the early 1990s have caused Japanese banks to decrease their foreign lending (McCauley and Yeaple, 1994). For example, Peek and Rosengren (1997, 1998) have found the decline in lending by Japanese banks in the

2. For example, from June 1986 to June 1990, total lending by Japanese banks in the United States increased by over $97 billion, according to U.S. call report data. In comparison, using the Bank for International Settlements (BIS) data for total cross-border claims, a broader category than the definition of loans in the U.S. call reports, the increase in Japanese claims in the set of six Southeast Asian countries that excludes the two offshore banking centers was only about $6 billion.

3. Several papers (Seth and Quijano, 1991, 1993; Nolle and Seth, 1996) have found that Japanese banks did initially appear to follow their customers abroad. However, they then typically expanded their customer base. For example, by the late 1980s Japanese banks operating in the United States had substantially broadened their customer base to include numerous domestic U.S. companies.

4. Goldberg and Klein (1998) discuss the sectoral and temporal patterns of foreign direct investment by Japan to Southeast Asia. They note that much of the investment was to the same industries that accounted for much of Japanese production in the early 1980s. This is consistent with outsourcing, frequently to subsidiaries, of goods that can be produced at lower cost abroad.

United States to be strongly associated with problems at the Japanese parent banks.

This paper examines the Japanese banks' response to home- and host-country shocks in Southeast Asia. The paper finds that Japanese lending in Southeast Asia appears to be far less sensitive to home-country problems than their lending in the United States. In fact, the pattern of lending to date has more closely followed trends in Japanese domestic lending than it has followed Japanese lending outside of Asia. However, as lending problems continue to swell and more restrictive disclosure rules are adopted, lending by Japanese banks to both domestic and Southeast Asian markets may be adversely affected. These problems could be compounded as Japan's "big bang" deregulation exposes Japanese banks to greater competition in their previously insulated domestic market (Gibson, 1998; Hanazaki and Horiuchi, 1998). Thus the continuing problems plaguing Japanese banks may impede the ability of the Southeast Asian economies to rebound from the serious domestic economic problems they currently face.

Section 1 of the paper examines recent patterns in the global expansion of Japanese banks and documents their organizational trends. Section 2 examines patterns of Japanese lending in Southeast Asia compared with their lending at home and in the United States. Section 3 examines the impact of Southeast Asian loans on problems at Japanese banks. Section 4 considers how Japanese operations in Southeast Asia compare with those of their banking competitors from Europe and the United States. Section 5 examines the penetration of Japanese banks in Southeast Asia. Section 6 draws conclusions and speculates on future trends in Japanese bank operations in Southeast Asia.

1. Recent Trends in the Global Operations of Japanese Banks

Table 1 illustrates the increase in the global importance of Japanese banks, based on the volume of assets measured in U.S. dollars. As recently as 1980, only one Japanese bank appeared among the ten largest banks in the world, although four more were among the five poised to enter the top-ten list. By 1988 Japanese banks accounted for all of the ten largest banks in the world, and by 1994 for thirteen of the top fifteen. However, shortly thereafter the tide ebbed: the

Table 1. Fifteen Largest World Banking Organizations, Based on Total Assets, Selected Years

	1980		*1988*		*1994*		*1997*	
Rank	*Name*	*Country*	*Name*	*Country*	*Name*	*Country*	*Name*	*Country*
1	Citicorp	United States	Dai-Ichi Kangyo Bank Ltd	Japan	Sanwa Bank Ltd	Japan	Bank of Tokyo-Mitsubishi, Ltd.	Japan
2	Banque Nationale de Paris	France	Sumitomo Bank Ltd	Japan	Dai-Ichi Kangyo Bank Ltd	Japan	Deutsche Bank, AG	Germany
3	Bank America Corp	United States	Fuji Bank, Ltd	Japan	Fuji Bank, Ltd	Japan	Sumitomo Bank Ltd	Japan
4	Credit Agricole Mutuel	France	Mitsubishi Bank Ltd	Japan	Sumitomo Bank Ltd	Japan	Credit Suisse Group	Switzerland
5	Credit Lyonnais	France	Sanwa Bank Ltd	Japan	Sakura Bank, Ltd	Japan	HSBC Holdings, Plc	United Kingdom
6	Societe Generale	France	Industrial Bank of Japan, Ltd	Japan	Mitsubishi Bank Ltd	Japan	Dai-Ichi Kangyo Bank Ltd	Japan
7	Barclays Bank Ltd	United Kingdom	Norinchukin Bank	Japan	Norinchukin Bank	Japan	Sanwa Bank Ltd	Japan
8	Deutsche Bank	Germany	Tokai Bank Ltd	Japan	Industrial Bank of Japan, Ltd	Japan	Credit Agricole Mutuel	France
9	National Westminster Bank Ltd	United Kingdom	Mitsui Bank, Ltd	Japan	Mitsubishi Trust & Banking Corp	Japan	Fuji Bank, Ltd	Japan
10	Dai-Ichi Kangyo Bank Ltd	Japan	Mitsubishi Trust & Banking Corp	Japan	Long Term Credit Bank of Japan Ltd	Japan	ABN-AMRO Bank, N.V.	Netherlands
11	Chase Manhattan Corp	United States	Credit Agricole Mutuel	France	Deutsche Bank, AG	Germany	Societe Generale	France
12	Fuji Bank, Ltd	Japan	Citicorp	United States	Sumitomo Trust & Banking Co Ltd	Japan	Sakura Bank, Ltd	Japan
13	Mitsubishi Bank Ltd	Japan	Sumitomo Trust & Banking Co, Ltd	Japan	Tokai Bank Ltd	Japan	Union Bank of Switzerland	Switzerland
14	Sumitomo Bank Ltd	Japan	Banque Nationale de Paris	France	Mitsui Trust & Banking Co, Ltd	Japan	Norinchukin Bank	Japan
15	Sanwa Bank Ltd	Japan	Barclays PLC	United Kingdom	Credit Agricole Mutuel	France	Barclays Bank Plc.	United Kingdom

Source: *American Banker,* various issues.

number of Japanese banks counted among the world's largest fell to five of the top ten and seven of the top fifteen by the end of 1997.[5]

The rapid expansion of Japanese banks was encouraged by a number of favorable trends. First, because the investment options of Japanese savers were restricted, Japanese banks could attract deposits at relatively low cost. Second, because Japanese banks held a large number of shares in other Japanese firms, the substantial rise in the Nikkei stock index increased bank capital. Furthermore, this increase in share values allowed the banks to boost their core capital by realizing some of the accrued gains on their extensive cross-holdings of shares, and it provided an attractive environment in which to issue new equity of their own. Third, many Japanese firms were undertaking extensive foreign direct investment, frequently relying on their Japanese bank to fund their expansion abroad.

With funds available and new lending opportunities overseas, Japanese banks began aggressively expanding abroad. Since Japanese banks frequently had cost advantages over their foreign competitors, they could undercut prices for transactions with blue chip firms. These loans had relatively low risk and did not require extensive retail operations or private knowledge about the borrower. Large market shares could be quickly obtained by pricing competitively.[6] To service their Japanese customers with foreign operations, as well as to expand wholesale banking operations, Japanese banks substantially increased their presence in the United States and Europe.

Table 2 provides an organizational overview of the expansion of foreign branches and agencies, sub-branches, and representative offices of Japanese banks from 1986 through 1997.[7] From 1986 to 1990, Japanese banks added twenty-nine branches and agencies in the United States (a 46 percent increase), nineteen in Europe (a 39 percent increase), and eight in Asia (a 14 percent increase). Most of this expansion was undertaken by the large, internationally active Japanese city banks, whose branches expanded in number from thirty-nine to fifty-six in Europe and from forty-six to seventy in the United States.

5. The large swings in the yen-dollar exchange rate contributed to the rise and subsequent fall in the number of Japanese banks among the largest banks worldwide, as measured by assets denominated in U.S. dollars.

6. Such policies likely contributed to the low profitability of Japanese banks. Although they are among the largest banks worldwide, they are also among the least profitable (Bank of Japan, 1993).

7. This table includes only the nineteen largest banks, composed of the city banks, long-term credit banks, and the major trust banks. It does not include the regional banks, which have some international operations but are primarily domestically focused.

Table 2. Japanese Banking Affiliates Worldwide, by Region

Host country or region	*Branches and agencies*				*Sub-branches*				*Representative offices*			
	1986	*1990*	*1993*	*1997*	*1986*	*1990*	*1993*	*1997*	*1986*	*1990*	*1993*	*1997*
United States	63	92	98	67	1	1	10	2	40	39	20	35
Latin America	10	8	5	5	8	6	4	0	45	46	39	27
Europe	49	68	75	66	1	2	2	1	52	61	52	34
Asia	59	67	97	121	14	26	38	30	103	107	94	103
Total	181	235	275	259	24	35	54	33	240	253	205	199

Source: Federation of Bankers Associations of Japan and bank annual reports.

From 1990 through 1993, following the sharp decline in the Nikkei, the number of new branches grew more slowly in Europe and the United States, while accelerating in Asia. The slower growth in Europe and the United States is not surprising, since several Japanese banks had reported interim risk-based capital ratios below the 8 percent required by the Bank for International Settlements (BIS), as a consequence of the decline in capital associated with the sharp decline in Japanese stock prices. More surprising is how rapidly branch activity had begun to grow in Asia, despite the serious and mounting problems at the Japanese parent banks. In part, this lending growth was related to a surge in foreign direct investment by Japanese companies in Southeast Asia during the late 1980s and early 1990s (Goldberg and Klein, 1998).

Between 1993 and 1997, the differences between, on one hand, the Asian activities of the Japanese banks and, on the other, their European and U.S. activities became even more striking. Over that four-year period, Japanese banks reduced the number of branches in the United States by almost one-third and that in Europe by one-eighth, while increasing the number of Asian branches by one-fourth.[8] The increased focus on Asia may be attributed to a perception (at the time) of better risk-return prospects in Asia (McCauley and Yeaple, 1994).

The nature of the expansion in Asia also changed between 1986 and 1997. Table 3 lists the numbers of Japanese bank branches and agencies, sub-branches, and representative offices in China and each of the economies in Southeast Asia. In 1986 over two-thirds of these

8. As part of the recently proposed assisted merger of the Long Term Credit Bank with Sumitomo Trust, the Long Term Credit Bank agreed to cease its international operations. Similar actions are likely in the future as the consolidation of problem banks in Japan continues. This will likely result in further significant decreases in Japanese branches abroad.

Table 3. Japanese Bank Affiliates in Other East Asian Countries

	Branches and agencies				*Sub-branches*				*Representative offices*			
Host country	*1986*	*1990*	*1993*	*1997*	*1986*	*1990*	*1993*	*1997*	*1986*	*1990*	*1993*	*1997*
China	3	4	16	26	0	0	0	3	53	58	48	44
Hong Kong	21	24	24	21	11	22	23	15	1	0	0	0
Singapore	20	20	19	17	1	1	1	1	1	0	0	0
Thailand	2	2	8	21	1	1	1	1	9	2	7	9
Korea	9	13	14	13	0	0	0	0	6	7	5	4
Indonesia	1	1	1	2	1	2	3	3	14	13	13	11
Malaysia	1	1	11	11	0	0	10	7	14	13	12	10
Taiwan	1	1	3	6	0	0	0	0	0	0	1	2
Philippines	1	1	1	2	0	0	0	0	5	4	4	5
Total	59	67	97	119	14	26	38	30	103	107	90	85

Source: Federation of Bankers Associations of Japan and bank annual reports.

Japanese branches were located in Hong Kong and Singapore. Both are major offshore banking centers, and activity in those locations more likely reflects wholesale bank lending to established borrowers rather than retail banking operations. Thus the initial Japanese bank activity in Asia was focused much as it had been in the United States, on syndicated loans to blue chip borrowers whose business could be attracted by exploiting cost advantages over foreign competitors, and on loans to large Japanese corporations seeking to finance their foreign direct investment.

However, in the early and middle 1990s Japanese banks reduced the number of their branches in Hong Kong and Singapore while substantially increasing their presence in other Asian countries, particularly China, Thailand, and Malaysia. This trend reflected a shift in emphasis toward retail banking operations, where margins were higher than those available in the wholesale lending market (McCauley and Yeaple, 1994). Japanese banks increasingly lent to affiliates of Japanese companies that were expanding their operations in Asia (often with guarantees from the parent), as well as to the local suppliers of these Japanese subsidiaries.

2. Patterns in Japanese Lending in Southeast Asia

The organizational trends follow a pattern very similar to that for lending by Japanese banks. Unfortunately, individual Japanese banks do not regularly provide data on their exposures in individual

countries or regions. We therefore used publicly available data on the exposures of Japanese banks gathered by the BIS, which provides semiannual reports on cross-border exposures of banks from eighteen major industrialized countries (called here the reporting countries).[9]

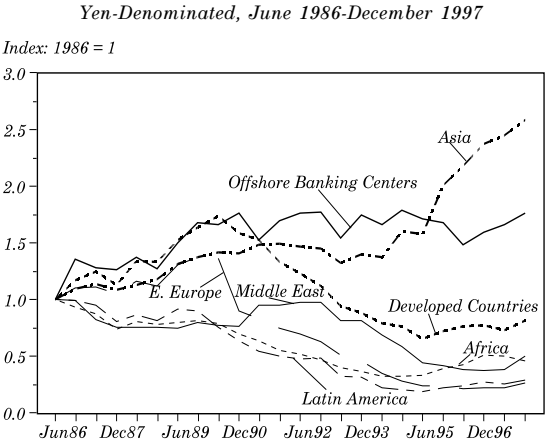
Banks headquartered in the reporting countries are asked to report their entire exposure to customers in a borrowing country. This includes all cross-border exposures of all the bank's offices worldwide, including local claims of foreign affiliates of the bank. The assets and liabilities in local currency of foreign bank affiliates are included as a confidential memorandum item and thus are not included in our data.[10] The BIS data exclude positions between different offices of the same bank, as well as claims on other banks from the reporting countries, to avoid double counting. The claims of the banks include deposits and balances with other banks, loans and advances to banks and nonbanks, holdings of securities, and participations. The data are also disaggregated by the maturity of the claim and by whether the borrowing entity is in the public sector, the private nonbank sector, or the banking sector. However, the detailed data by source country are confidential.

Figure 1 shows the patterns of Japanese lending to groups of borrowing countries, based on the semiannual BIS data. Because we want to examine this lending from the perspective of the Japanese banks, we converted the BIS data, reported in dollars, to Japanese yen, using the exchange rate as of the last day of the reporting period (June and December). Given that Japanese bank capital is denominated in yen, the value of these banks' risk-based capital ratios will depend on the yen value of their assets. And because many of the assets of Japanese banks are denominated in dollars (and other foreign currencies), they will be sensitive to fluctuations in the exchange rate. For example, any

9. Our data actually include only seventeen of these reporting countries. Switzerland is omitted because it provides data only on a confidential basis. The BIS also reports a quarterly series, although this does not include coverage on a worldwide consolidated basis, and an interbank series, which provides bank claims on related offices of the same institution and those on unrelated banks.

10. When we combined the confidential local-currency claims with the cross-border claims to obtain a measure of total lending by a reporting country to each borrowing country, regardless of the currency in which the loan is denominated, the qualitative stories in the figures and tables were not significantly affected. However, although the local-currency exposures were generally small relative to the cross-border exposures, the recent sharp declines in the values of the local currencies cause both the yen and the dollar values of this broader measure of cross-border lending to rise less (or decline more) in 1997.

Figure 1. Cross-Border Lending by Japanese Banks



Source: Bank for International Settlements.

depreciation of the yen would inflate the yen value of their non-yen-denominated assets, reducing their capital ratios. In fact, exchange rate movements during the period under consideration have been substantial and have significantly altered the yen value of risk-weighted assets. To the extent that lending patterns are affected by Japanese banks' shrinking of assets to satisfy BIS capital requirements, nonyen lending by capital-impaired Japanese banks can significantly increase the risk that the bank may need to shrink to maintain the required risk-weighted capital ratio.

For purposes of presentation in the figure, the (yen-denominated) BIS data were scaled by their 1986 value (the index equals 1 in 1986) to highlight which geographic areas were the focus of expanded Japanese lending during this period. "Offshore banking centers" in the figure includes Hong Kong and Singapore in Asia, as well as such centers as the Cayman Islands and the Bahamas. The Asia aggregate includes all countries in the BIS Asian category, which excludes Hong Kong and Singapore.

Figure 1 shows Japanese banks reducing their exposure to many parts of the world after 1989. The largest proportional declines are in the developed countries other than the eighteen reporting countries (nonreporting developed countries), Eastern Europe, and Latin America. Japanese banks also decreased their exposure to

the Middle East following a temporary increase in the aftermath of the war with Iraq. The need to shrink assets to satisfy capital ratios, the strong competition from non-Japanese banks, and a decision to focus on more strategic markets each likely contributed to the significant decrease in lending by Japanese banks in these areas.

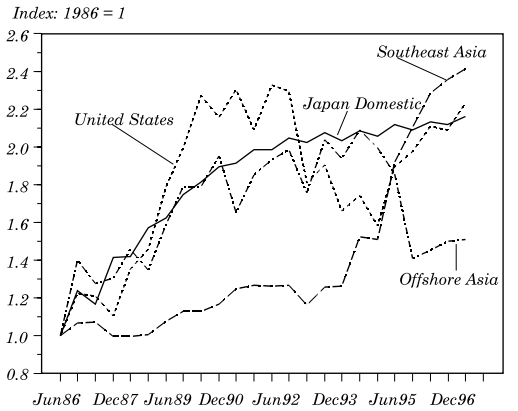
The two major exceptions to the widespread declines in Japanese bank lending shown in figure 1 are the offshore banking centers and Asian markets. Lending by Japanese banks to the offshore banking centers shows no upward or downward trend in the 1990s. In part, this may be an artifact of the dramatic changes in the exchange rate. The yen appreciated sharply from 1990 until mid-1995. Since 1995 it has experienced a sharp reversal in its value. Thus, when offshore lending is expressed in dollars, it reaches a sharp peak in 1995 before falling even more steeply than it had risen, and then leveling out in late 1996. Since many of the offshore loans are dollar-denominated, it is likely that the volume of lending by Japanese banks has declined since 1995. In fact, it is possible that the depreciation of the yen in the most recent period placed added pressure on Japanese banks to shrink such dollar-denominated lending in order to ease the pressure on their capital ratios, as the yen value of dollar-denominated assets rose relative to the banks' yen-denominated capital.

Japanese bank loans to Asian economies, not including loans to the offshore banking centers of Hong Kong and Singapore, rose only gradually in yen terms during the early 1990s. However, the series then experienced a burst of rapid growth. Asia is the only area where Japanese banks expanded their lending aggressively in 1996 and 1997. However, when stated in dollars rather than yen, Japanese bank lending to Asia actually declined in 1997, suggesting that loan growth there may be coming to an end.

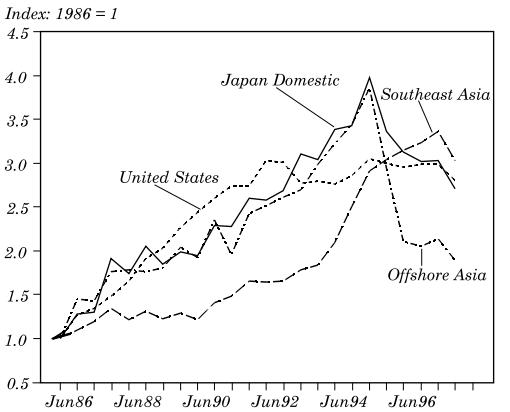
Figure 2 shows cross-border Japanese bank lending to offshore Asia, Southeast Asia, and the United States, as well as domestic lending by Japanese banks. The series for offshore Asia (Hong Kong and Singapore) and Southeast Asia (Indonesia, Korea, Malaysia, the Philippines, Taiwan, and Thailand) are based on BIS data; the U.S. data are taken from bank call reports; and the domestic Japan lending data come from the Bank of Japan. Although the definitions of lending vary across these three sources, each individual series is defined consistently over time. For figure 2a the BIS and call report data have been converted from dollars to yen (as in figure 1) and then scaled by their 1986 values. For figure 2b the BIS dollar magnitudes have been scaled by their 1986 values.

Figure 2. Japanese Bank Lending to Selected Markets

a. Yen-Denominated, June 1986-December 1997



b. Dollar-Denominated, June 1986-December 1997



Source: U.S. Call Reports, Bank for International Settlements, Bank of Japan.

Perhaps the most striking series in figure 2a is that for domestic Japanese loans. Despite suffering a major economic slowdown and declines in excess of 60 percent in both Japanese commercial real estate prices and Japanese stock prices, Japanese domestic lending did not decline; it merely grew more slowly. This may reflect a major

advantage of a main bank system from the perspective of the borrowers: In time of crisis, such banks will be less likely to sharply reduce credit to their customers (Hoshi, Kashyap, and Sharfstein, 1990, 1991). Moreover, Japanese banks may have been "evergreening" loans already on their balance sheets to avoid having to classify problem loans as nonperforming; that is, they may have continued to lend to a troubled borrower to enable that borrower to meet interest payments on an existing loan. However, the downside of a main bank system is that if a bank has financial difficulties and reacts by shrinking lending, it may be difficult for its loan customers to find alternative sources of credit (Gibson, 1995; Kang and Stulz, 1998).

In contrast, Japanese bank lending to the United States (denominated in yen) grew much more rapidly during the 1980s, leveled off (on average) in the early 1990s, and then declined from 1993 into 1995, even though the U.S. economy was expanding. The entire rise since that time is accounted for by the depreciation of the yen. Figure 2b shows that, in dollar terms, Japanese bank lending to the United States fell, even as the U.S. economy continued its expansion.

In yen terms, the growth in Japanese bank lending to the offshore banking centers of Southeast Asia (Hong Kong and Singapore) slowed, on average, in the early 1990s following the sharp declines in the Nikkei and in Japanese commercial real estate prices, and then declined sharply after 1994. In dollar terms, the growth in Japanese bank lending to these centers was much more rapid in the early 1990s, and the peak occurred later, in June 1995 rather than December 1994. However, the subsequent decline was even larger because of the sharp depreciation in the yen.

In contrast, Japanese bank lending to Southeast Asia accelerated in recent years, whether denominated in yen or in dollars. After rising gradually from 1986 to 1992 and then declining temporarily, lending to these countries surged. Denominated in yen, Japanese bank lending to Southeast Asia began to slow only in the last half of 1997. The growth rate of the dollar-denominated series slowed in 1995, and the series actually declined sharply in 1997.

The recent sharp decline in Japanese bank lending to offshore banking centers, whether denominated in yen or in dollars, and the decline to the United States in dollar terms, although more moderate until 1997, are consistent with Japanese banks pulling out of low-margin wholesale markets. Such a response in these highly competitive markets might be expected, since Japanese banks have lost much of the competitive advantage that emanated from their traditionally

low-cost funding sources. First, the decline in the Nikkei raised the cost of capital for Japanese banks. More recently, the cost to Japanese banks of attracting (or retaining) funds has been increased by two factors. The first is the country's severe banking problems, which have forced Japanese banks to pay a "Japan premium" in order to raise funds in the interbank market, and the second is the opening of Japanese financial markets to foreign financial firms, which has made the market for bank deposits much more competitive.

A reasonable response might be to turn increasingly to markets where margins are higher. In particular, Japanese banks might be expected to shift their emphasis in the direction of retail markets where lending relationships are more important, such as domestic lending in Japan and loans to Japanese affiliates and other private sector firms in Southeast Asia. And in fact, even though Japanese banks did retrench in Hong Kong and Singapore recently, loan growth to customers in Southeast Asian countries accelerated. It only slowed in yen terms (and declined in dollar terms) after the financial crisis hit Southeast Asia. Moreover, even in the face of continuing economic stagnation in Japan, Japanese banks have continued to increase domestic lending.

Figure 3 shows the volume of Japanese bank loans in each of the Southeast Asian countries, including Hong Kong and Singapore. In terms of the volume of lending, Singapore and Hong Kong received the vast majority of cross-border loans by Japanese banks to this region. Figure 3a shows that both of these offshore markets experienced a substantial decline in Japanese bank lending beginning in 1995, although the decline began earlier in Hong Kong. The declines in these two offshore markets more than offset any increases in the other Southeast Asian economies. Indonesia, Korea, and Thailand—all countries that experienced substantial difficulties recently—were recipients of the largest volumes and experienced the highest growth rates of loans from Japanese banks. Lending to Malaysia, another country that suffered greatly from the Southeast Asian financial crisis, was next in terms of volume and experienced a similar increase during the past two years. Taiwan and the Philippines account for the smallest volumes of Japanese bank lending among the economies of Southeast Asia.

Figure 3b tells much the same story. The primary difference is that, when denominated in dollars rather than yen, Japanese bank lending to Hong Kong and Singapore rose more in the early 1990s and declined more sharply after June 1995. Furthermore, the dollar-denominated data show declines, rather than just a slowing in growth, in the last half of 1997 for most economies.

Figures 2 and 3 are consistent with Japanese banks withdrawing from wholesale lending markets while continuing to lend in retail markets with higher margins and with more established lending relationships. Thus, offshore markets such as Hong Kong and Singapore are likely to experience a continued decline in Japanese bank lending, as those banks come under increasing pressure from mounting loan problems both at home and in Southeast Asian markets. On the other hand, lending to Southeast Asia is likely to follow a pattern closer to that of domestic Japanese lending, since many of these loans are to affiliates of Japanese firms. For example, loans to customers in countries such as Indonesia and Thailand include a particularly large proportion of loans to Japanese-affiliated companies. As a result, after the initial retrenchment associated with the Southeast Asian financial crisis, Japanese bank lending to these countries may decline only to the degree that these banks choose (or are forced) to retrench their domestic lending. However, continued pressure on Japanese banks to shrink lending in order to raise capital ratios may slow lending in both Japan and Southeast Asia. How severe these pressures are and how long they continue will depend on how (and when) the Japanese banking crisis is finally resolved.

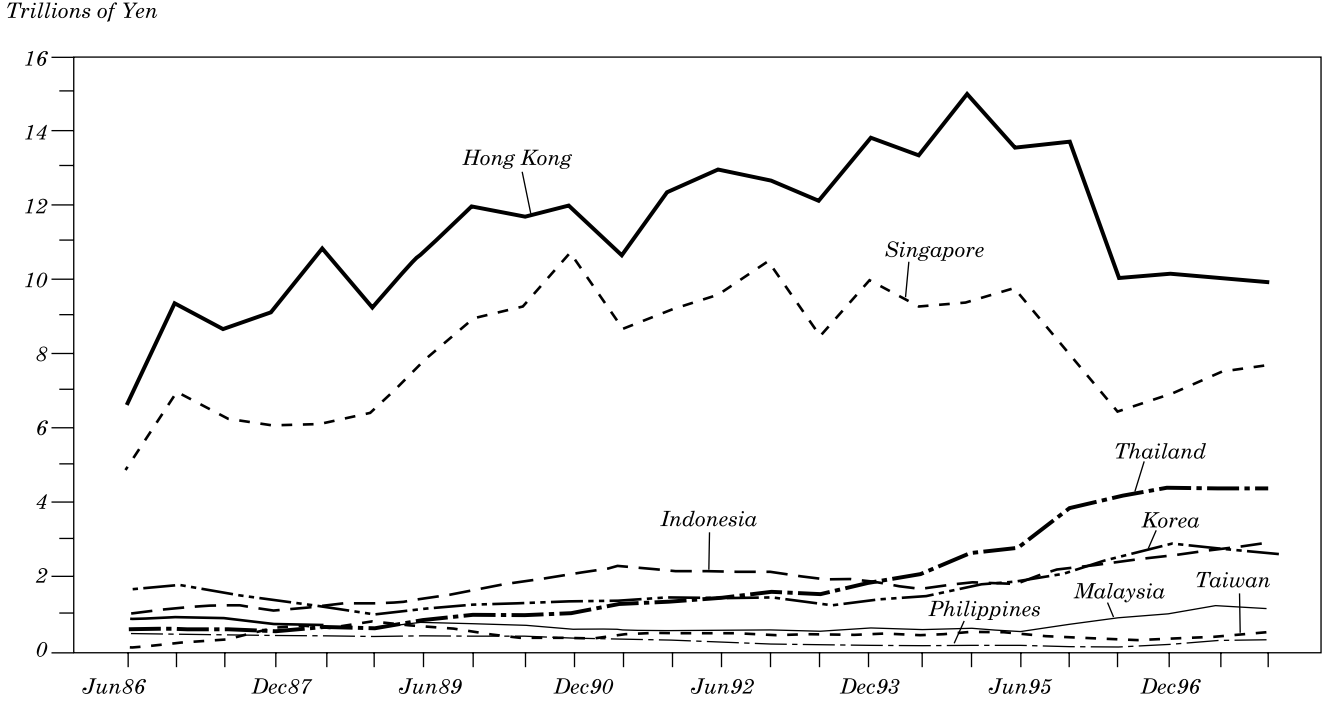
3. Impact of Southeast Asian Loans on Problems at Japanese Banks

Lending to Southeast Asia is also important to Japanese banks because of its contribution to their already sizable volume of nonperforming loans. The Asian exposure, as reported by Japanese banks as of March 1998, totaled almost 18 trillion yen, for which very limited loan-loss reserves have been set aside (table 4). Although many of these loans are to Japanese affiliates whose Japanese parent serves as guarantor, and the extent to which these loans will eventually be written off is difficult to determine, one might reasonably expect losses on these loans to greatly exceed such meager reserves.[11]

11. In their 1998 annual reports, some banks provided more details of their exposure in Southeast Asia. For example, Sanwa Bank, with one of the largest exposures, reported a $16 billion total exposure, $5 billion of which was to Japanese companies. Of course, the net exposure of $9.4 billion was much smaller than the total exposure. However, the annual report gave no specific description of which categories of loans were considered classified. To put the extent of the exposure in perspective, total assets and total equity capital of Sanwa were $431 billion and $14 billion, respectively.

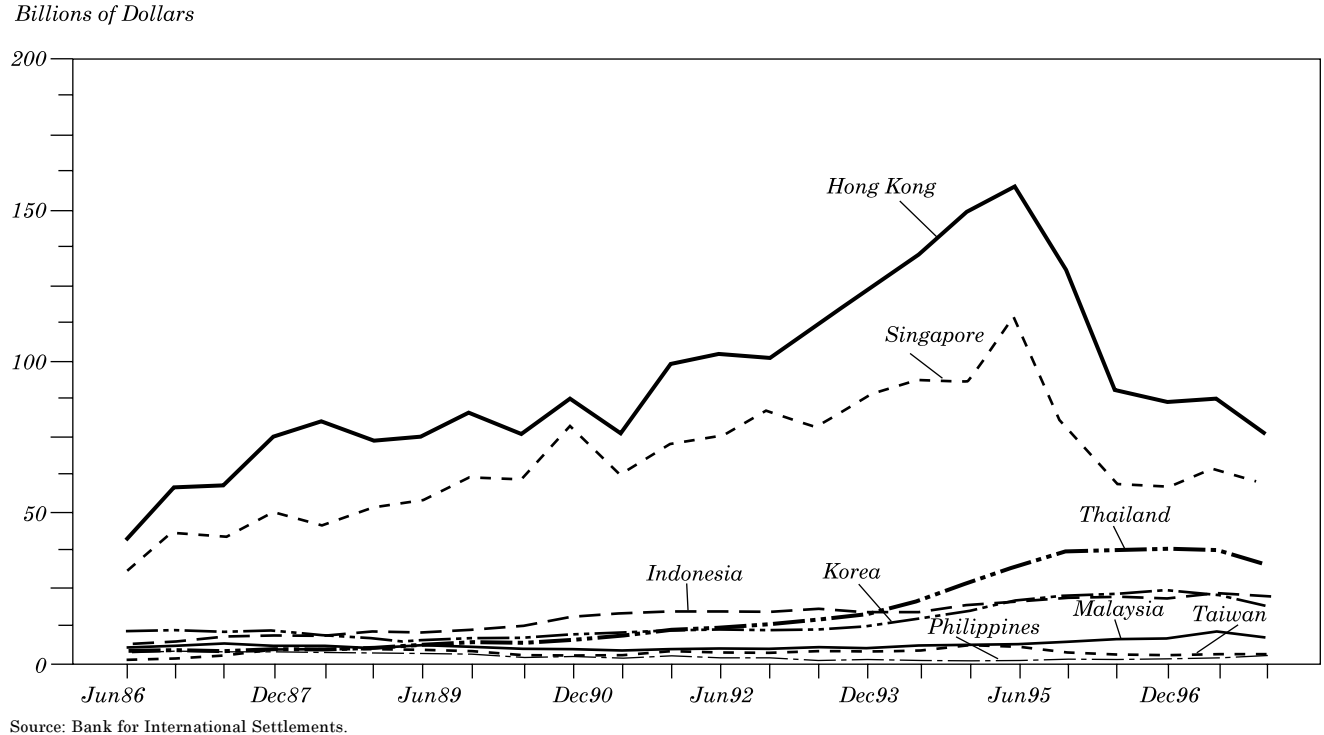
Figure 3. Japanese Bank Lending to Southeast Asian Economies

a. Yen-Denominated, June 1986-December 1997



Source: Bank for International Settlements.

b. Dollar-Denominated, June 1986-December 1997



Source: Bank for International Settlements.

To put the Southeast Asian exposure of 18 trillion yen in perspective, Japanese banks had 77 trillion yen in classified assets as of September 1997, according to the Ministry of Finance.[12] However, 65 trillion yen of the classified loans were considered to be in category 2, which refers to loans that are impaired but not expected to result in losses. It appears that Japanese banks included many of their Southeast Asian exposures in category 2, likely reflecting an overly optimistic view of the prospects for these loans.

The largest Asian exposures are held by Bank of Tokyo-Mitsubishi and Sanwa Bank. Both are among the healthiest of the major Japanese banks. The only banks to have announced significant loan-loss reserves against their Asian exposures as of September 1998 were Daiwa Bank, Nippon Credit Bank, and Mitsui Trust. Both Daiwa and Nippon Credit had relatively small Asian exposures, but Moody's placed them among the lower-rated banks.

It is likely that the extent of problem loans has remained underreported. Many of the loans are to Japanese affiliates, and Japanese banks assume that the Japanese parents will serve as a source of strength. Similarly, in countries with large local exposures, such as Thailand and Indonesia, many of the loans are to borrowers of significant size that have long-standing ties to the Japanese lender. However, the extent of possible underreporting of problem loans is impossible to estimate accurately using the information that is publicly available.

Figure 4 uses BIS and Bank of Japan data to calculate Japanese bank exposure in Southeast Asia as a percentage of total (domestic plus overseas) Japanese bank loans outstanding. Lending to Hong Kong and Singapore, which includes a high percentage of loans to blue chip companies and affiliates of major Japanese companies, haddeclined substantially by the end of 1997 and equaled roughly 3.5 percent of total Japanese bank loans. At the same time, the exposure of Japanese banks to the other Southeast Asian economies had increased to

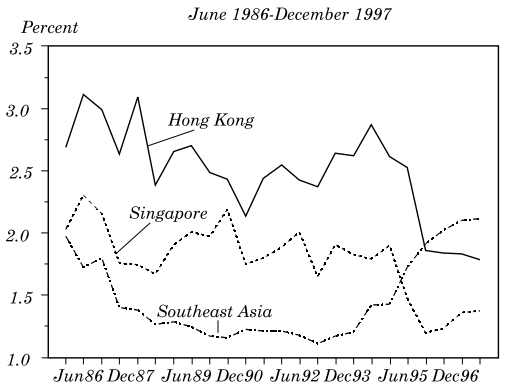
12. "Classified" refers to the banks' own assessment of their loans, the preliminary results of which were released in aggregated form by the Ministry of Finance in September 1997. However, the individual bank data are not required to be disclosed. Banks were asked to classify their loans into four categories. Category 1 includes loans with no credit risk (this includes reserved portions of exposures). Category 2 loans require credit management if losses are to be avoided. Category 3 includes loans with serious concerns and loans that are likely to result in losses. Category 4 loans no longer have value. The banks use their own policies in assigning loans to categories, and so loans may not be classified consistently across banks. Furthermore, classified loans do not relate directly to the nonperforming loans classification.

Table 4. Asian Exposure of Japanese Banks as of March 31, 1998

Bank	*Exposure (billions of yen)*	*Reserved (percent)*
Bank of Tokyo-Mitsubishi	4,401	2.1
Sumitomo Bank	1,760	3.0
Sanwa Bank	2,100	1.4
Dai-Ichi Kangyo Bank	1,600	2.8
Sakura Bank	1,553	1.9
Fuji Bank	1,470	2.0
Tokai Bank	959	0.5
Asahi Bank	463	1.0
Daiwa Bank	328	7.3
All city banks	14,634	2.4
Industrial Bank of Japan	906	1.2
Long Term Credit Bank	593	1.3
Nippon Credit Bank	41	5.6
All long-term credit banks	1,541	2.7
Mitsubishi Trust and Banking	517	0.8
Mitsui Trust and Banking	222	10.1
Sumitomo Trust and Banking	408	2.4
Yasuda Trust and Banking	223	2.5
Chuo Trust and Banking	44	1.6
Toyo Trust and Banking	223	2.4
All trust banks	1,637	3.3
All banks	17,811	...

Source: Moody's Investors Service, *Banking System Outlook—Japan,* July 1998, table 7.

Figure 4. Japanese Bank Lending to Hong Kong, Singapore, and Southeast Asia as a Share of Total Japanese Bank Loans



Source: Bank of Japan, Bank for International Settlements.

over 2 percent of total loans. By itself, this loan exposure to Southeast Asia should not pose a major threat to most Japanese banks. However, the low level of loan-loss reserves associated with these loans (table 4) and the size of some banks' Asian exposures, on top of the already well-established problems with nonperforming loans at home, may be particularly troublesome for some of the weaker Japanese banks.

4. Were Japanese Bank Lending Patterns Different from Those of U.S. and European Banks?

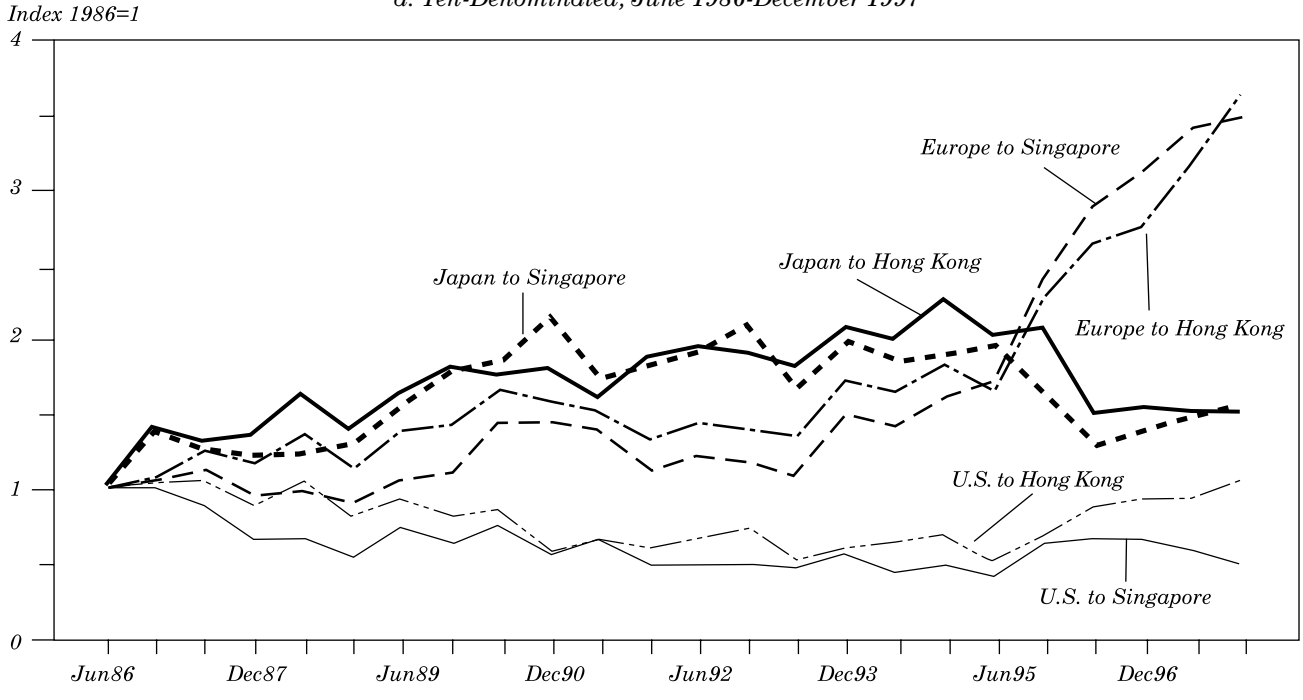
Although all foreign banks faced the same economic environment of growth and subsequent slump in the Southeast Asian economies, the financial conditions of the foreign banks varied considerably. During the late 1980s, Japanese banks were well capitalized, while U.S. banks were rebuilding their capital. More recently, Japanese banks have been constrained by low capital ratios, while banks in the United States and Europe have been well capitalized and better positioned to continue to lend. Thus, examining the differences in lending behavior may help identify the extent to which Japanese lending patterns are being driven by home-country problems, and the extent to which the patterns reflect concerns with economic prospects in Southeast Asia.

Figure 5 shows cross-border lending to Hong Kong and Singapore by Japanese, European, and U.S. banks over the decade ending in 1997. The behavior of the Japanese banks is quite different from that of their European and U.S. competitors. Figure 5a shows that Japanese banks steadily increased their exposure until late 1994, when they began to substantially decrease their lending in Hong Kong and Singapore. Much of this decrease was offset by European banks, which sharply increased their lending in both Hong Kong and Singapore beginning in 1994. On the other hand, U.S. lending in Hong Kong and Singapore remained relatively flat over the past decade, declining steadily until 1995 before rebounding somewhat.

The story is much the same when lending is denominated in dollars rather than yen (figure 5b). However, the rise and fall of Japanese bank lending to Hong Kong and Singapore in the 1990s is much more pronounced. Furthermore, the acceleration in lending by European banks occurs sooner, and the series shows a slowdown for Hong Kong and a decline for Singapore in 1997. Finally, recent lending by U.S. banks to Hong Kong shows more of an upturn, and that to Singapore shows less of a downturn, when stated in dollars.

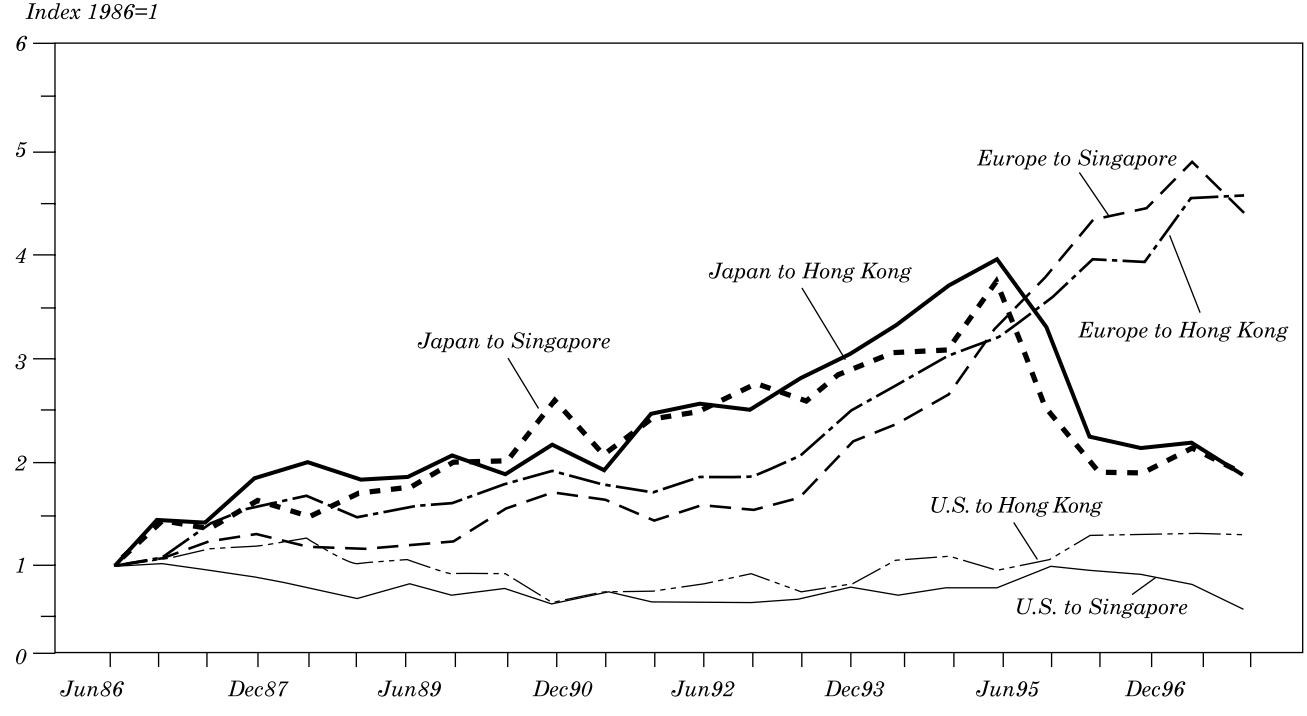
Figure 5. Cross-Border Bank Lending to Hong Kong and Singapore from Japan, the United States, and Europe

a. Yen-Denominated, June 1986-December 1997



Source: Bank for International Settlements.

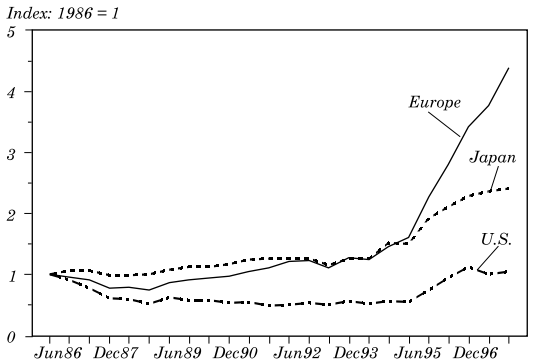
b. Dollar-Denominated, June 1986-December 1997



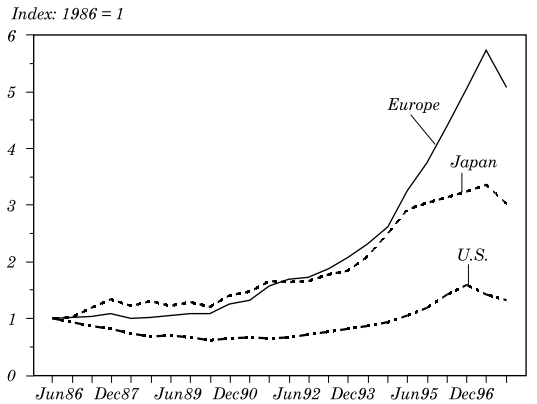
Source: Bank for International Settlements.

Figure 6. Cross-Border Bank Lending to Southeast Asia from Japan, the United States, and Europe

a. Yen-Denominated, June 1986-December 1997



b. Dollar-Denominated, June 1986-December 1997



Source: Bank for International Settlements.

Figure 6 shows cross-border lending by European, Japanese, and U.S. banks in Southeast Asia over the same decade. The expansion in exposures to Southeast Asia was quite similar for European and Japanese banks during the first half of the 1990s. However, the recent acceleration in European bank lending greatly exceeded

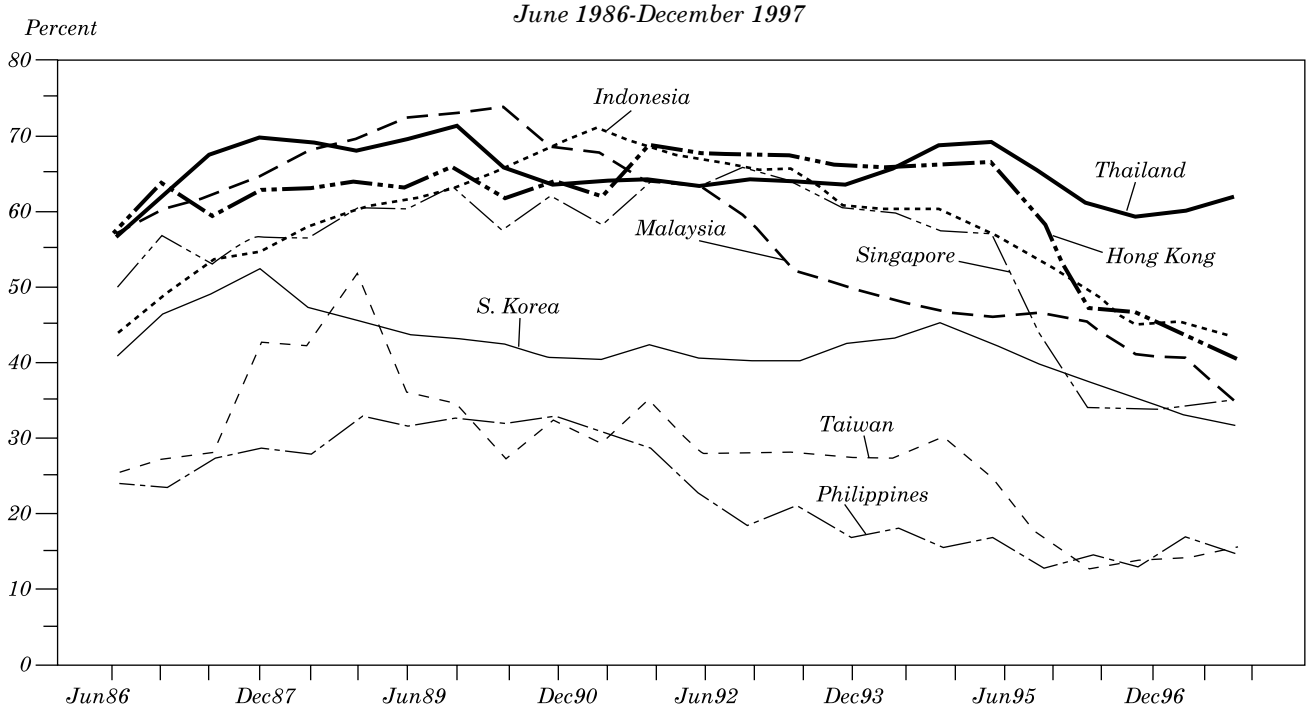
that by Japanese banks. U.S. banks also expanded lending to Southeast Asia, but the increase was much more muted. Furthermore, U.S. banks began reducing their lending at the end of 1996, whereas Japanese banks only slowed the rate of increase in their yen-denominated lending, although their dollar-denominated lending declined in 1997. In contrast, European lending rapidly increased through 1997 when denominated in yen, whereas the dollar-denominated series exhibits a sharp decline in that year.

5. Southeast Asian Penetration by Japanese Banks

Japanese banks had the largest foreign banking presence in most Southeast Asian economies over the decade from 1986 to 1997. Figure 7 shows Japanese bank cross-border claims for individual Southeast Asian economies (measured relative to the total for all BIS reporting countries) from June 1986 through December 1987. Thailand, a major recipient of Japanese foreign direct investment, consistently had roughly 60 to 70 percent of its BIS claims from Japan. Indonesia and Malaysia had substantial Japanese shares in the 1980s, although that share declined substantially for both countries in the 1990s. Hong Kong and Singapore also show major declines recently, as Japanese banks have sought to reduce their wholesale lending activities in those economies. The Japanese bank share in Korea declined from roughly 50 percent in the late 1980s to about 35 percent in 1997. The Philippines and Taiwan historically have been less dependent on Japanese financing, and that has been the case recently, with Japanese claims accounting for less than 20 percent of total BIS claims to those economies.

Japanese banks now have at least four incentives to reduce their exposure in Southeast Asia. First, their problems with domestic loans have resulted in a significant level of classified loans, which, along with continued weakness in the Japanese stock market, is likely to keep most Japanese banks close to the BIS capital ratio threshold. And this pressure on capital ratios will be even stronger if Japanese banks are forced to fully disclose all the problems on their balance sheets. Second, the increase in the cost of funds that Japanese banks have experienced will make them less able to compete in world credit markets. Third, the continued low returns on assets posted by Japanese banks will force them to refocus their activities from attaining market share to improving profitability. And finally, the Asian currency crisis and associated political risks have substantially increased the risk premium required for bank loans to firms located in Southeast Asia.

Figure 7. Cross-Border Bank Lending by Japanese Banks to Southeast Asian Economies Measured as a Share of Lending by All Reporting Countries



Source: Bank for International Settlements.

Despite the substantial declines in its share of cross-border lending, Japan remains the single largest foreign lender in most of Southeast Asia. And to the extent that Japanese banking problems further inhibit lending, any additional retrenchment is likely to weaken firms whose access to external credit is already impaired. Thus the internal capital market decisions of Japanese banks may have important ramifications for Southeast Asia.

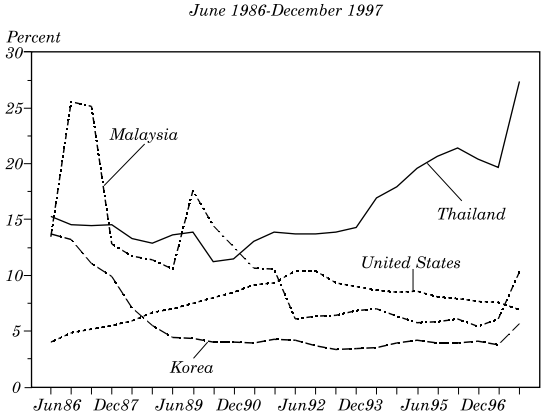
Figure 8 provides a crude measure of the penetration of Japanese banks into each of several Southeast Asian economies. The figure shows Japanese bank cross-border BIS claims as a percentage of total loans in the country, as approximated by the international financial statistics produced by the International Monetary Fund (IMF). We exclude Hong Kong and Singapore because of their extensive offshore banking operations. We also exclude Indonesia because of missing data and the Philippines because of data inconsistencies.[13] For comparison, we include Japanese penetration into the United States, although this requires the use of U.S. call report data, which are not directly comparable to the BIS and IMF data.[14] Nonetheless, the comparison does provide a benchmark for measuring the degree of penetration of Japanese banks into Southeast Asia.

To calculate Japanese penetration, we use BIS data on Japanese lending to a particular country divided by total nonfinancial claims as reported by the IMF. This calculation is fraught with difficulties in obtaining a consistent series. The BIS data are focused on the cross-border claims of the lending country, and so they include Japanese lending to a particular country regardless of whether the funds are lent directly from the parent bank in Japan or from affiliates in the host country. The IMF data focus on total bank credit in the host country, and so they generally include lending by foreign branches located in the host country, but not lending on the books of the parent bank in the home country. Thus the denominator will be

13. For Indonesia the IMF data have missing observations in 1993, 1994, and December 1997. For the Philippines the ratio of total BIS claims to total loans in the Philippines exceeds 100 percent for the first three years of our sample. Since the foreign share obviously cannot exceed the total, the comparability problems were so severe that we omitted these data from this analysis.

14. We use total loans as reported in the call reports. However, Japanese banks have a much greater penetration in U.S. markets for commercial and industrial loans and for commercial real estate loans than for total loans. Peek and Rosengren (1997) note that, at the peak in 1990, Japanese banks accounted for 18 percent of all commercial and industrial loans to borrowers located in the United States. Peek and Rosengren (1998) find that Japanese banks accounted for one-fifth of all commercial real estate loans in the United States.

Figure 8. Japanese Bank Loans as a Share of Total Loans in Selected Countries



Source: Bank for International Settlements, International Monetary Fund.

understated to the extent that foreign banks lend from home as well as from their foreign branches and subsidiaries, causing this measure of Japanese penetration to be overstated.

Because individual countries collect data differently, the series are not necessarily consistently defined across countries. In addition, the BIS data include deposits of Japanese banks in host-country financial institutions, in effect treating these as loans. We have excluded the IMF data on financial institutions' claims, to avoid the double counting that can occur when a financial institution has a deposit at another institution, which then lends the funds to the private sector. We treat this transaction as if the depositing institution had instead lent directly to the private sector; this is consistent with the BIS treatment intended to avoid double counting.

Figure 8 shows, albeit somewhat crudely, that the penetration by Japanese banks is substantial. For example, Japanese banks held between 11 and 15 percent of claims in Thailand in the early 1990s. In the last three years of the period their penetration became much greater, accounting for 27 percent of claims as of December 1997. For Malaysia and Korea, the share of loans provided by Japanese banks has generally fallen since the mid-1980s but accounts at the end of the period for a still-sizable 10 percent of loans in Malaysia and 6 percent of loans in Korea. However, as was the case for Thailand, the Japanese penetration recently has increased.

This degree of penetration poses potential problems if Japanese banks should decide to pull back from Southeast Asian credit markets. For example, the penetration by Japanese banks in the United States, included for comparative purposes, was also quite substantial: as high as 10 percent in the early 1990s before falling to 7 percent by the end of 1997. Peek and Rosengren (1998) have shown that the withdrawal from U.S. commercial real estate lending by Japanese banks resulted in an economically significant reduction in construction activity in those U.S. states with a large Japanese bank presence. If withdrawal by Japanese banks can affect real activity in the United States, with its far deeper and better-developed credit markets than those in Southeast Asia, this suggests that the effect of a Japanese withdrawal on economies much more dependent on bank financing could be substantial.

6. Conclusion

It is too soon to assess the full impact of the evolving problems in Southeast Asia, or to know the full reaction of the Japanese banks to their problems at home and abroad. Thus any conclusions must be preliminary and will likely evolve as the problems continue to unfold. However, this paper has highlighted some trends in Japanese lending to Southeast Asia that make it different from Japanese lending to other parts of the world and different from lending by non-Japanese competitors in Southeast Asia.

Japanese banks have been refocusing their global operations toward Southeast Asia. Both the locations of their branches and their lending patterns reflect expansion in Southeast Asia and retrenchment in most other parts of the world. Despite often-binding capital constraints, Japanese banks appear to have decided that loans to customers in Southeast Asia will provide longer-run profitability, even given the current difficulties. Japanese banks also appear to be withdrawing from wholesale operations in both Singapore and Hong Kong, much as they have withdrawn from many wholesale operations in the United States. This may reflect a need to use scarce capital for more profitable lines of business. It may also reflect the less competitive position of Japanese banks as their cost of funds has increased, both because of the substantial premium they have had to pay to borrow in interbank markets, associated with their weaker financial position, and as a result of the opening of Japanese domestic financial markets to foreign competition.

Japanese banks' underreserving for potential loan losses and their failure to fully disclose the extent of the problems in their Southeast Asia portfolios likely will result in greater reported loan losses in the future. Nonetheless, the losses from these loans probably will be dwarfed by the problems created by the nonperforming loans in their domestic portfolios.

Any further pullback by Japanese banks would pose significant problems for the Southeast Asian economies. Japanese penetration into these markets is still large, and retrenchment would make external financing quite difficult for firms that are now viewed as far riskier than they were before the crisis. Some of the retrenchment that has already occurred has been partially offset by the willingness of European banks to enter the market. U.S. banks, however, have continued to hold relatively small positions in Southeast Asia. To date, it appears that Japanese banks will retain a major presence in Southeast Asia, but with a diminished role in the wholesale loan market. However, the future path of Japanese bank lending in Southeast Asia depends on the financial condition of the economies in the region as well as on the banking and regulatory policies undertaken as Japan restructures its banking industry.

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Market Discipline and Exuberant Foreign Borrowing

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The debt crisis of the 1980s confirmed what most economists already knew well: the public sector cannot be trusted to make the right choices on behalf of society, especially in matters—such as foreign borrowing—whose ultimate costs may not be fully internalized by voters. The failure of the public sector suggested market discipline as the solution for the efficient channeling of foreign savings into capital-scarce developing countries, to be implemented through the liberalization of the capital account and fiscal restraint. The crises of the 1990s, however, call into question the power, and perhaps the wisdom, of market discipline as a mechanism to produce efficient foreign borrowing.

The case for market discipline through capital account liberalization is parallel to the case for trade liberalization, and therefore appears to be on very solid ground. However, financial markets can play tricks that markets for goods and services do not; for good reason the phrase "irrational exuberance" has been coined in connection with the stock market. First, financial transactions involve promises to deliver resources in the future, and those promises can be broken, especially in cross-border transactions (in the absence of enforceable international law). Second, financial flows can move extremely quickly in search of profitable opportunities, and in so doing they magnify the impact of

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minor economic distortions, generate rational (self-validating) bubbles and panics, and, perhaps, irrational exuberance as well.[1]

In this paper we examine cases in which market discipline has contributed to inefficient foreign borrowing, either because of flaws in the market mechanism due to externalities or because it exacerbates existing distortions in the economy. These results should not be interpreted as reasons for discarding market discipline concerning foreign borrowing; except perhaps in extreme cases, the elimination of market discipline can be expected to be detrimental. Rather, these results are intended to illuminate the complementary policy interventions that would be appropriate to rectify the market where it fails.[2]

There are two possible economic justifications for policy intervention in foreign borrowing (see Stiglitz, 1998). The first is that the social valuation differs from the private valuation, which calls for a policy intervention, be it a tax, a regulation, or an institutional reform, to close the gap between them. The second is that the private valuation of the market is flawed; that is, the market is irrational, which is of course a more fundamental indictment of market discipline. From the point of view of the borrowing country, what matters for this second case is the rationality of domestic agents, irrespective of the behavior of foreign investors to which small countries need to adapt as part of the external environment. In this paper we assume full market rationality, and therefore we restrict ourselves to the first class of market failures.

This paper does not pretend to be a general treatment of the role of market discipline in foreign borrowing, but simply an analysis of some cases in which the market fails. We start by reviewing the moral hazard failures that have been already advanced in the literature to explain recent crises. All have in common the prediction that if market discipline is not interfered with by outside forces that induce moral hazard, typically in the form of official guarantees, it will deliver the efficient outcome. The notion that market discipline is intrinsically

1. These concerns are supported by the literature on market overreaction and noise trading, as in DeLong and others (1990) and Shiller (1981). James Tobin's proposal of throwing "sand in the wheels" of the financial mechanism is designed to address these risks.

2. As discussed in Fernández-Arias and Montiel (1996) in a general setting, the design of appropriate policy on foreign borrowing requires the precise identification of the market failure. The policy discussion of the cases analyzed in this paper supports this conclusion.

efficient also pervades a second strand of recent explanations—not covered in this paper—that stress that the information provided to market participants is incomplete and often unreliable. The associated policy recommendations call for better information to be made available to market agents, to allow them to make the right choices.[3]

We then present two vignettes in which we sketch simple models that challenge the notion that market discipline is necessarily virtuous and fails only because of limitations imposed upon it. To show how the market mechanism itself may be inefficient, we assume economies that are undistorted (that is, not subject to moral hazard) and in which all agents are fully informed. In the first vignette it is shown that country risk is a market externality leading to overborrowing. In the second it is shown that the market exposes the economy to excessive risk of panic crises.

Accordingly, the rest of the paper is organized as follows. We first review, in section 1, the existing literature on the corrosive effect of moral hazard on market discipline. In the rest of the paper we add to that literature by concentrating on failures of market discipline resulting from externalities, that is, weaknesses of the market mechanism itself, with an emphasis on appropriate policy intervention. In section 2 we motivate externalities resulting from country risk and from multiple equilibria, which are formally developed in the following two sections. Section 3 models the country risk case, and section 4 models the multiple equilibria case. Concluding remarks follow in section 5.

1. Moral Hazard

Most of the literature concerning the inefficiency of market foreign borrowing and most explanations of the recent payments crises in emerging markets are based on third-party guarantees that give rise to moral-hazard incentives on the part of market participants. In this line of thinking, market discipline fails to deliver efficiency because it is limited by a form of interference. The following is a brief review of this important strand of the literature, in which each paper focuses on different guarantees and emphasizes different aspects of the resulting inefficiency.

3. However, it may very well be the case that more truthful information accelerates crises. Unlike the case of moral hazard, this informational strand requires further research to explore its implications.

It is well known that underpriced loan guarantees (including, of course, implicit guarantees) lead to greater lending, by virtue of a lower cost of capital, and to riskier lending, in order to maximize the value of the guarantee. It is less well known, however, that the existence of such moral-hazard problems in the financial system of a given economy may be an argument for impeding international financial integration. In fact, ample access to international financial markets may lead to dangerous levels of overconsumption and overinvestment, far beyond what would be possible based on relatively inelastic domestic savings. McKinnon and Pill (1997) present a model to explain the Mexican crisis of December 1994 in which deposit insurance and asymmetric information deliver these results; they deserve credit for pointing out the importance of this issue for international finance.

More recently, in a series of notes, Paul Krugman has underlined the importance of moral hazard in the 1997 Asian crises. He claims that, although creditors of financial institutions did not receive explicit guarantees from governments, they did believe that they would be protected from risk. Such expectations were based on the political connections of the owners of financial institutions and the tradition of public influence in credit allocation—an argument that may perhaps be extended to direct corporate external borrowing as well. Krugman (1998) presents an extreme model in which a free total guarantee leads to investment projects being evaluated in terms not of their expected value but of the best possible value they can attain (what he calls "Panglossian values"). As a result, real investment is too large and too risky. For similar reasons, the price of assets in inelastic supply shoots up.

Overborrowing based on moral hazard may end in crisis in a number of ways. In Krugman (1998) the realization of any return other than the best possible return requires the use of guarantees and causes a crisis. Importantly, if it is anticipated that the use of the guarantees will lead to reform and the end of the guaranteed system, the resulting crisis is magnified. In fact, such magnification makes multiple equilibria possible: asset prices may collapse because of the expectation that guarantees will disappear, which prompts a self-validating crisis. Corsetti, Pesenti, and Roubini (1998), following Krugman, limit the value of the guarantees on the basis of the solvency of the public sector, which determines the timing of the crises. Finally, in Dooley (1997) guarantees are based on the government's accumulation of reserve assets for self-insurance reasons.

Still another class of moral hazard issues is generated by the guarantees implicit in official rescue packages such as those systematically put together after the Mexican and the Asian crises. Fernández-Arias (1996) analyzes this problem and shows that the critical issue is whether the guarantee can be credibly restricted to liquidity crises, that is, crises in which solvency can be regained through debt restructuring. If not, moral hazard may easily lead to an actual increase in the risk of crisis and, in extreme cases, make the program counterproductive.

One obvious policy implication of these papers is that the proper pricing, or elimination, of the guarantee would lead to the efficient allocation of foreign savings. This may be infeasible, especially in the case of implicit guarantees, whose value depends on their credibility. And even if the removal of a guarantee is feasible, it may not be advisable, because guarantees serve useful purposes, such as protecting the payment system against "panic runs."

If mispriced guarantees are not eliminated, moral hazard subsists. In this case the usual policy recommendation is to control it through regulation and supervision, at least in the banking sector. The difficult question is what to do if it is not feasible to implement a satisfactory regulatory and supervisory system with sufficiently broad coverage in the short run—a situation that may be prevalent in many emerging markets. In that case impediments to financial integration concerning the types of liabilities more likely to benefit from guarantees may constitute a second-best solution.

2. Market Externalities

The analysis based on moral hazard issues of the workings of a market economy ignores the relevance of market externalities outside the microeconomic lending structure under examination. However, the seminal works of Harberger (1980) and Eaton and Gersovitz (1989) start from the premise that aggregate macroeconomic conditions are key, and they focus on the role that overall indebtedness plays in determining market terms and behavior.[4] In this alternative view, market discipline fails to deliver efficiency because it does not internalize some of the social costs it creates.

4. See also Díaz-Alejandro (1984).

Here we justify the relevance of country risk and briefly review these early insights. We then discuss the relevance of multiple equilibria, which have been advanced as a key alternative explanation of recent payment crises, as a source of market failure concerning the accumulation of short-term debt. In the next two sections we sketch models that analyze these two possible sources of market externalities and discuss policies to address the corresponding failures.

2.1 Aggregate Debt and Country Risk

It is difficult to dispute that, in practice, sovereign risk is relevant to market risk premiums. The following quote from Standard & Poor's (1997) says it all: "Sovereign credit risk is always a key consideration in the assessment of the credit standing of banks and corporates. . . Past experience has shown time and again that defaults by otherwise creditworthy borrowers can stem directly from a sovereign default. In the case of foreign currency debt, the sovereign has first claim on available foreign exchange, and it controls the ability of any resident to obtain funds to repay creditors."

In theory, the proposition that the sovereign is relevant to the creditworthiness of national private agents is easily established, because the technology to enforce debt contracts across national jurisdictions is virtually absent.[5] It is clear that in the same way that the sovereign may socialize private debts, it also has the power to impede payments or acquiesce in nonpayments by domestic agents, and will find it cost-effective to do so if overall debt is sufficiently high and costly to service. A welfare-maximizing government would therefore push all agents to (possibly partial) default in that case even if debtors are solvent.[6] In fact, the whole debt literature concerning the question of sovereign willingness to pay and the determination of public sector external credit ceilings, begun by Eaton and Gersovitz (1981) and Bulow and Rogoff (1989), could be adapted along these lines for the determination of an overall country credit ceiling, inclusive of private debts. This result can explain the market practice of considering sovereign risk in assessing private sector risk and justifies the modeling of private credit risks in terms of aggregate indebtedness indicators.

5. Calvo (1998a) reaches a similar conclusion concerning this proposition in the context of analyzing why international financial flows and crises differ from interstate financial flows and crises.

6. This assumes that the costs of default would not be smaller if default were selective.

The seminal work by Harberger (1980) models the market risk premium as an increasing function of overall country indebtedness. He perceptively points out, however, that if lenders and borrowers assess default similarly—both its probability and its payoff—then the effective cost of capital, in expected terms, will be the risk-free rate irrespective of the overall debt (assuming competitive lenders). Harberger dismissed this case as uninteresting and moved away from it by assuming, alternatively, that lenders and borrowers differ in their beliefs regarding default probabilities or that borrowers somehow do not fully value the benefit of nonpayment in default states. Depending on what is assumed in this regard, for which there is no particular justification, the fact that overall debt is external to market participants may lead to either under- or overborrowing.

By contrast, Eaton and Gersovitz (1989) provide a fully consistent framework in which the default scenario is explicitly modeled. However, contrary to practical experience and the implications of efficient renegotiation, they assume that under default no payment is made and sanctions are applied, rather than that partial payments are negotiated. Such renegotiation would eliminate the deadweight cost of default that drives their results.

The emphasis of our model in the next section is that excessive overall indebtedness prompts costly crises. The seemingly uninteresting case dismissed by Harberger is in fact interesting if its implications are fully pursued, because the fact that the effective cost of capital is always the risk-free rate holds true only until access to external credit is lost, that is, until the realization of country risk. When that happens, interest rates shoot up to their autarkic level and a costly crisis ensues. The more rapidly debt accumulates when there is access, the more frequent the crises, the more costly the market externality, and the more inefficient the market allocation. By design, our model in the next section eliminates all other possible contributions to inefficiency by assuming the absence of uncertainty, which implies that the cost of capital is the risk-free rate and that default does not occur. The market is inefficient because it does not internalize the cost of external credit rationing.

2.2 Aggregate Short-Term Debt and Multiple Equilibria

Multiple equilibria have been advanced as a leading explanation of the recent Asian crisis, for example by Calvo (1998b) and by Radelet

and Sachs (1998). Multiple equilibria exist when firms are solvent if debt falling due is rolled over, but are not solvent if it is not. In the latter case, the resulting insolvency validates the failure to roll over, because otherwise, if the firm is solvent, current or other creditors would be willing to lend to it.

These conditions imply that the liquidity squeeze adversely affects solvency. A liquidity squeeze at the level of the individual firm may reduce solvency in many ways, for example because of the inefficiency involved in liquidating assets, reducing investment, or accelerating production. A massive liquidity squeeze in the aggregate may also negatively impact the individual firm through distortions in interfirm commercial and financial relations and, importantly, through prices in foreign currency if the swing in the country's capital account leads to a real depreciation. These two sources of illiquidity are mutually reinforcing in general equilibrium, especially through the domestic financial system, which comes under pressure from both the asset and the liability side (see Calvo, 1998b, for an analysis of these issues and their potential for generating multiple equilibria).

The importance of the maturity profile of outstanding debt in this explanation has been emphasized by Guillermo Calvo since the failure of Mexico to roll over its *tesobonos* (see Calvo, 1998a). A massive withdrawal of funds is necessary to effect a liquidity impact large enough to cause a switch from one equilibrium to another. This requires a large volume of debt coming due at one time (and a sufficient degree of coordination among creditors not to roll it over). A large amount of debt falling due in the short term is a necessary condition for multiple equilibria and, one may speculate, is also important for the likelihood of the panic equilibrium when it exists, because the larger its amount, the lower the required degree of coordination among creditors.

The recognition that short-term debt has this undesirable characteristic has led to policy proposals to impede these flows through capital controls that discriminate against them. This argument implicitly assumes that the market does not properly internalize this cost, a proposition that to our knowledge has not been formally analyzed in the literature so far. In a later section we show that the costs associated with aggregate rollover risk, which depends on aggregate short-term debt, are not internalized by the market. As a result, too much short-term debt can be expected to emerge, and policies to counteract this failure become appropriate.

3. Country Risk

In this section we develop a model in which we show that significant country risk leads to market overborrowing. This model is condensed and adapted from our own work in Fernández-Arias and Lombardo (1998), to which the reader is referred for details, proofs, and extensions.

To keep things simple, we use a very standard setup. We consider a small, open economy that consumes a single tradable good. The economy is a price taker in both goods and financial world markets, which are assumed to be time invariant. To simplify, we abstract from uncertainty and imperfect information.

The economy is inhabited by a continuum of identical agents uniformly distributed in [0 1] (indexed by $g \in [0\ 1]$).The representative agent has a time-separable utility function based on concave felicity functions:

$$U = \int_0^\infty e^{-\delta s} u(F_s) \mathrm{G}s \,. \tag{1}$$

The world risk-free lending rate is r, and external creditors are competitive. To simplify, we assume that impatience is not a motive for external borrowing:

$$\delta = r \,. \tag{2}$$

For the sake of simplicity, we assume that this is an endowment economy.[7] Every agent has an endowment that is temporarily lower:

$$y_t = \begin{cases} y(1-\alpha), & t < T \ (\alpha > 0) \\ y, & t \geq T \,. \end{cases} \tag{3}$$

The motive for borrowing from abroad then results from the desire to smooth consumption over the lifetime of the economy in anticipation of income recovery.[8]

7. The incorporation of investment or intermediate inputs does not alter the qualitative results.

8. The above simplifying assumptions about the rate of time discounting and the income process are not critical to the results. An alternative polar case in which borrowing is motivated by the desire to tilt consumption forward leads to qualitatively identical results. This case, available upon request, is obtained by assuming impatience ($\delta > r$) and constant income ($\alpha = 0$).

In the aggregate, private debts b_t^g cannot exceed the country's credit ceiling L, which is far below the country's technical solvency:[9]

$$\int_0^1 E_t^g \mathrm{G}g = B_t \leq L \ . \tag{4}$$

This simple setup is consistent with models developed by Bulow and Rogoff featuring a credit ceiling that results from a bargaining game in which creditors have a punishment technology at their disposal and are able to extract from debtors some level of payment equal to L in present value (see, for example, Bulow and Rogoff, 1989). A welfare-maximizing government would follow the same strategy concerning national debt as a whole, including private debt.

In order to concentrate on the role of country risk, we assume that the individual solvency of market agents is not in question; that is, commercial risk is zero in the relevant range. However, as discussed above, in this model the individual credit risk of debt claims b_t^g includes sovereign risk.[10] Market practice, by both lenders and rating agencies, fully agrees with this theoretical pricing framework of corporate risk.[11] Under these conditions each individual agent has perfect access to international borrowing at the risk-free rate r as long as $B_t < L$ (sovereign risk equals 0), and has no access to international borrowing when $B_t \geq L$ (sovereign risk equals 1).[12] Notice that if all agents are equally indebted by a (density) amount b_t, then aggregate debt $B_t = b_t$.

Starting from an initial (gross) debt of b_0, the (gross) debt dynamics b_t implied by a consumption program c_t of the representative agent is

$$\dot{E}_t = \mathrm{U}E_t + F_t - y_t \ , \quad \text{given } E_0 \ . \tag{5}$$

9. The reader should not be disturbed by the presence of the credit ceiling in the absence of uncertainty. For a model where such a feature arises endogenously see Detragiache (1996).

10. This sharply differs from the model in Atkeson and Ríos-Rull (1996), in which country risk is not a factor. Their result, that the market mechanism is efficient, depends critically on the implicit assumption that sovereign risk is irrelevant.

11. For example, the International Finance Corporation adds a country-specific macroeconomic spread, set in line with rates charged by international banks for loans to governments, to the project-specific spread. Similar pricing methodologies are followed by both official and commercial banks financing the private sector.

12. The reader should not be disturbed by our consideration of sovereign risk in the absence of uncertainty. Sovereign risk refers to nonpayment, as opposed to the variability of payments, and therefore exists as long as there is an attainable credit ceiling, irrespective of the degree of uncertainty. Uncertainty concerning the credit ceiling would simply add a discrete range for aggregate debt in which risk would take intermediate values between 0 and 1.

Several remarks are in order regarding this standard identity. First, it assumes risk-free lending, because otherwise, competitive creditors would charge a risk premium over the risk-free rate. This assumption is justified in this model as long as the credit ceiling is not exceeded, which will not happen in equilibrium because there is no uncertainty. Second, it holds irrespective of the maturity of the loans. Our preferred interpretation of this condition is that debt takes the form of consols, which are loans with infinite maturity that pay a constant stream of interest. Otherwise, losing access to external borrowing means that new borrowing is limited to rolling over debt amortization so that the credit ceiling is not exceeded.[13]

3.1 The Efficient Borrowing Path

A natural benchmark with which to compare the market economy's allocation is the solution to a benevolent central planner's utility maximization problem. In the unconstrained case, the solution to such a problem is fairly standard: given no (relative) time impatience, the consumption path will be flat, at a level consistent with the representative agent's lifetime resources (a permanent income type of result):

$$c^* = y(1-\alpha) + y\alpha e^{-rT} - rb_0. \tag{6}$$

Under a credit ceiling, the central planner's problem becomes[14]

$$\max_{\{c_t\}_0^\infty} \int_0^\infty e^{-\delta s} u(F_s)\,ds$$

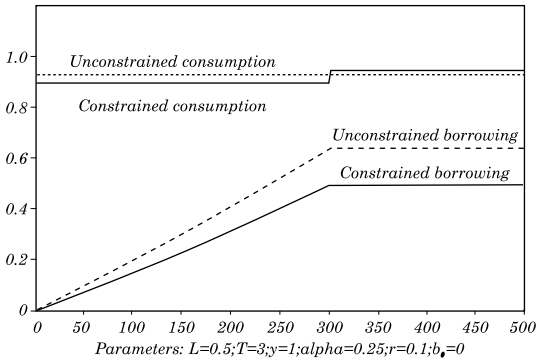
$$\text{subject to } \dot{E}_t = rE_t + F_t - y_t, \text{ given } E_0, \quad E_t \le L \text{ for all } t. \tag{7}$$

13. Finally, the condition involves two simplifying assumptions: first, that more flexible debt instruments, such as future debt contracts and credit lines, are not available; and second, that there is no available storage technology for the consumption good, either physically or financially (lending to abroad). These assumptions are relaxed in Fernández-Arias and Lombardo (1998).

14. For the problem to be interesting, we assume that the credit ceiling is binding. This can be shown (from the solution to the unconstrained problem) to be the case if and only if $L < b_0 + \alpha \frac{y}{r}(1 - e^{-rT})$.

It can be shown that it is optimal for the central planner to hit the limit and then keep the debt at that level thereafter. More completely, the resulting optimal consumption and debt paths, denoted by c_t^P and b_t^P, can be characterized as follows (see figure 1 and Fernández-Arias and Lombardo, 1998, for a proof):

Figure 1. Optimal borrowing



Source: Authors' calculations.

Proposition 1: Optimal Program. In the constrained central planner solution the economy hits the credit ceiling L exactly at T ($\tau = T$), and debt remains at the ceiling thereafter. The consumption level is constant up to T (at a level c_0^P) and is constant from T onward (at a level c_T^P), in such a way that

$$b_t^P < b_t^*,$$
$$c_0^P < c^* < c_T^P .$$

This constrained optimal program can be interpreted by noticing that the optimality condition, that consumption be constant while there is access to external borrowing, holds in this constrained optimum, until access is lost at time T. The upward jump in consumption from c_0^P *to* c_T^P does not open an arbitrage opportunity, because advancing borrowing to increase low consumption and smooth the jump is not feasible because of the credit ceiling (which implies that it would not be optimal not to hit the ceiling). After T, constant income allows for full smoothing of consumption without additional borrowing. Since all consumption programs are equal in present value, the constrained optimal consumption levels bracket unconstrained optimal consumption c^*.

3.2 Market Borrowing

How does a decentralized market economy behave under the preceding assumptions? It is useful to show right from the start that the market equilibrium differs from the optimal program just described. To this end, we check whether the representative agent would have an incentive to deviate from such an optimal program. An individual agent facing the consumption jump from c_0^P *to* c_T^P a would find it in his or her interest to unilaterally deviate from such a program and borrow more before access is lost. In that way, the agent would smooth the consumption discontinuity by increasing low consumption through borrowing and decreasing high consumption when debt is serviced after T.

The fact that market discipline is not an efficient mechanism under imperfect access to international credit markets is in stark contrast with the two polar cases conventionally analyzed in the literature, namely, perfect access to international markets (L is not binding) and no access to international markets ($L = 0$).[15] Notice that the arguments supporting the suboptimality of the market equilibrium are quite general. We conjecture that the conclusion holds true with generality as long as the country credit ceiling is a binding constraint under some states of the world—that is, as long as sovereign risk is relevant.

The key to finding the market equilibrium (that is, a feasible allocation from which no individual has an incentive to deviate) is to observe that each agent rationally anticipates that at some point the economy as a whole, and therefore that agent individually, will lose access to external borrowing. Since there is no uncertainty, the *particular instant* τ when the credit ceiling will be hit can be perfectly foreseen. Each representative agent takes this instant as given when making borrowing decisions, which generate an individually optimizing debt demand path b_t. Of course, in equilibrium τ is determined by the aggregation of these paths according to the market clearing condition $b_\tau = L$.

The representative agent maximizes the following equation:[16]

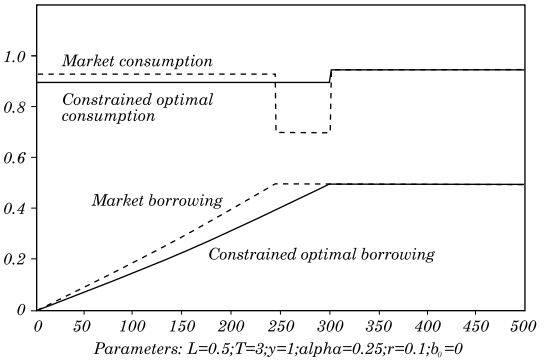
$$\max_{\{c_t\}_0^\infty} \int_0^\infty e^{-\delta s} u(F_s)\,ds$$

$$\text{subject to } \dot{E}_t = rE_t + F_t - y_t, \quad \text{given } E_0, \; E_t \le E_\tau \; \forall \, t \ge \tau. \tag{8}$$

15. See, for example, Blanchard and Fischer (1989).

16. Market agents can also borrow domestically from each other. Because agents are identical, the domestic financial market can be ignored for the purpose of finding the equilibrium consumption allocation.

Figure 2. Market borrowing



Source: Authors' calculations.

The solution to the above constrained problem, in which consumption and debt paths will be denoted by c_t^M and b_t^M, can be characterized as follows (see figure 2, and Fernández-Arias and Lombardo, 1998, for a formal proof):

Proposition 2: Market Equilibrium. In the constrained market equilibrium the economy hits the credit ceiling L at τ, with $0 < \tau < T$, and loses access thereafter. The consumption level is constant up to τ at a level c_0^M (phase 1), drops to a recessionary level c_T^M until T (phase 2), and then jumps to a level c_τ^M from T onward (phase 3), in such a way that

$$b_t^M > b_t^P \quad \text{for } t < T$$

$$b_t^M = b_t^P = L \quad \text{for } t \geq T \ ,$$

$$y(1-\alpha) - rL = c_\tau^M < c_0^P < c_0^M < c_T^M = c_T^P = y - rL \ .$$

The two main features of this result have been already interpreted and commented upon. First, the market overborrows; that is, $\tau < T$. The aggregate credit ceiling generates a (dynamic) commons problem, with ensuing "overfishing" from the pool of loans. Second, after access is lost there is an abrupt recession, which is fully consistent with actual crisis experiences.

These two features of the solution are a stark difference between the suboptimal market equilibrium and the optimal program. During the boom, market borrowing is uniformly higher than optimal borrowing until access is lost ($b_t^M > b_t^P$), which leads to suboptimally high market consumption: $c_0^M > c_0^P$. (It can be shown that, until the recession, market investment would be efficient and overborrowing would only finance overconsumption.) This consumption boom comes at the cost of a subsequent recession, entailing suboptimally low market consumption: $c_\tau^M < c_0^P$. These events—overborrowing, consumption boom, and recession—are perfectly foreseen by the representative agent but cannot be avoided, because of a failure in the market mechanism.[17]

4. Panic Risk

In this section we deal with the possibility of multiple equilibria, a situation in which an economy that is fundamentally sound under normal credit conditions may lose its soundness and end up in a crisis if foreign investors panic and massively pull out of the country. In turn, the possibility and likelihood of such a run depend on the level of outstanding short-term claims previously contracted. Here we sketch a model in which we analyze whether market discipline leads to an efficient debt maturity profile and find that it fails to do so: the debt maturity structure in the market equilibrium is tilted too much toward short-term debt.

Imagine a stationary economy with a zero capital account, in which foreign debt coming due is rolled over to finance highly productive investment period after period. This is the good equilibrium for this economy. Now imagine that at some point foreign creditors collectively refuse to roll over their debts in a given period. If debt coming due at this time is large, this amounts to a large capital account deficit. In the first round, this shock leads to a sizable real depreciation of the currency, which massively bankrupts firms and cuts them off from credit, thus eroding the productivity of their investments. In the second round, the collapse engulfs the economy through financial, supply, and demand linkages (see Calvo, 1998b, for a fuller account).

17. Fernández-Arias and Lombardo (1998) investigate optimal policies in the context of this model. They show that a consumption tax (during the phase in which there is access to external debt) can be structured to completely solve the problem. They therefore interpret market overborrowing as resulting from overconsumption, rather than the other way around.

A large enough collapse would validate the creditors' decision not to roll the debt over. This is the bad equilibrium for this economy.[18]

In this section we sketch the simplest possible model that captures the key features of this economy by considering a two-period economy, in which the second period can be thought of as a condensation of all future periods. We concentrate on the first period and analyze the financial conditions under which capital outflows in that period can generate a self-validating collapse in the second period along the lines of the previous description, as well as the likelihood of such an occurrence. In order to evaluate market performance, we add a period 0 in which the financial choices relevant for the future are made.

In this economy, borrowing and investment take place in period 0. Projects in this economy are designed to yield a handsome return y in terms of foreign currency in period 2 in the absence of capital outflows in period 1; however, the larger the capital account deficit in period 1, the lower the yield. Let t be the aggregate (net) withdrawal amount (again, in terms of foreign currency units) in period 1, that is, the amount of debt obligations falling due in period 1 that are not rolled over. It is assumed that

$$y = y(\cdot), \quad \text{with } y_W \le 0 \text{ and } y_{WW} \le 0.$$

This condition says that high net outflows of foreign exchange in period 1, by putting downward pressure on the domestic currency, reduce the foreign currency value of home-country production of nontraded goods.

Let w denote the corresponding creditors' withdrawal in the project. (Throughout this section, lowercase letters represent individual project variables and capital letters represent their aggregate counterparts.) Then returns are w in period 1 and $y(t) - w$ in period 2. (We can also expect that the project's yield will be negatively affected by its own net payments w because of inefficiencies in liquidating assets or accelerating production. We choose to ignore this possibility to simplify the algebra.[19])

18. Eventually the economy can be expected to regain its good equilibrium path after the currency appreciates and restores some of the damage, but such a roller coaster path for the economy is highly inefficient.

19. The inclusion of this additional liquidity factor is not critical for the conclusions on market inefficiency, because it would make long-term debt more preferable to both the firm and the planner.

As before, we consider a small, open economy and abstract from uncertainty and imperfect information. We assume a continuum of identical firms (indexed by g in [0 1]) and two alternative scenarios: a free market economy and a command economy in which the value of the representative firm is maximized. External creditors are competitive; to simplify the algebra we assume that the discount rate is zero.

Contrary to the model in the previous section, in this setup each firm borrows from abroad to invest in one project.[20] To simplify, we assume that each project requires a one-unit investment, which allows us to take the overall borrowing amount as given and to focus on the debt maturity structure. We abstract from sovereign risk, already shown to be an externality, and assume instead that credit risk depends entirely on corporate risk (that is, the risk that the project's yield will not be sufficiently high to pay debt obligations).

Foreign banks offer a contract schedule (s, $1 - s$) to each firm, where s is the share of short-term debt assumed by the (representative) firm, maturing in period 1, and $(1 - s)$ is the share of long-term debt (maturing in period 2, assumed to take the form of a zero-coupon loan to simplify the algebra), at gross rates $R_1(S,s)$, and $R_2(S,s)$ which are set competitively.[21] In what follows, we focus on symmetric equilibria.[22] Taking into account depositors' liquidity preferences and bank managers' risk aversion, we allow for the possibility that banks assess a liquidity premium $\rho \geq 0$ on long-term debt.[23]

In period 1 the withdrawal amount t is realized, and so is the yield $y(t)(=Y(t))$. At that point, banks are also considering whether to roll over financing under the prevailing conditions. It is clear that if the firm is solvent ex post, rollover financing is risk-free and a zero interest rate will be assessed. This is the case if the firm's yield is high enough

20. As before, we abstract from the domestic financial system, which would be irrelevant in this symmetric setting. For an interesting treatment of the problems generated by a malfunctioning domestic banking system, see McKinnon and Pill (1997).

21. Of course, although it is an equilibrium condition that in this symmetric setting the variables in lowercase must equal the variables in capitals, at the individual firm's level the aggregate variables are taken as given.

22. We will later show that restricting our attention to symmetric equilibria does not involve any loss of generality.

23. This feature, which we impose exogenously in the model, appears to accurately reflect the reality in emerging market countries that long-term debt is "too expensive" given the risks involved (or simply unavailable).

to pay all of its debt obligations as contracted. Alternatively, if the firm is not solvent ex post, rollover financing will not take place at any rate.[24]

We assume that the project yield under normal financial conditions (that is, all debt payments due in this economy in period 1 are rolled over, so that $t = 0$) is large enough to make the investment worthwhile. This implies that all debt obligations will be paid if creditors do not panic:

$$y(0) = Y(0) \geq sR_1(S,s) + (1-s)R_2(S,s) \ . \tag{9}$$

A self-validating panic (that is, a panic crisis) occurs when the creditors' withdrawal leads to insolvency ex post:

$$y(W) = Y(W) < sR_1(S,s) + (1-s)R_2(S,s) \ . \tag{10}$$

Notice that the default and efficiency losses caused by the panic are unnecessary because the firm and the economy are fundamentally solvent.

Withdrawals in period 1 are limited by the short-term debt to be serviced then, so that $t \leq SR_1(S)$ and $w \leq sR_1(S,s)$, where $SR_1(S)$ is the aggregate net repayment. (We have defined $R_1(S) \equiv R_1(S,S)$). Therefore, if $y(SR_1(S)) \geq sR_1(S,s) + (1-s)R_2(S,s)$, then panics are not rational ex post. In this case there is no panic equilibrium, and a risk-free rollover would take place in each firm, so that $t = w = 0$. In fact, in this case perfect foresight implies that the debts are risk-free.

Alternatively, if short-term debts are large, so that $y(SR_1(S)) < sR_1(S,s) + (1-s)R_2(S,s)$, then panics are rational ex post if enough creditors coordinate to withdraw. In this case there are multiple equilibria: a good one in which there is no withdrawal, as before ($t = w = 0$), and a bad one in which creditors withdraw as much as they can from insolvent firms ($t = w = SR_1(S,S)$).

Let p be the probability that such coordination takes place when the conditions for rational panic are set, which we assume to be strictly positive to allow for liquidity crises if short-term debt is large ($0 < p \leq 1$). In most of our analysis we conservatively take this conditional probability p as a given constant. However, it is interesting to also consider the case in which the probability of panic increases

24. This assumes, for example, that creditors share the bankrupt firm's equity according to their shares in the debt principal. This, of course, depends on bankruptcy procedures.

with short-term debt, because the critical mass of investors that need to coordinate to generate a rational panic is smaller, the higher the aggregate share of short-term debt.[25]

We will need the following notation. Define $\underline{S}$ as the maximum amount of short-term debt (symmetrically distributed across firms) that is incompatible with a panic equilibrium: $\underline{S}$ is defined implicitly by

$$Y(\underline{S}) - \underline{S} = (1 - \underline{S})/(1 - \rho) . \tag{11}$$

This condition states that, at the fair rates R_1 and R_2 for which panic is not possible (hence $R_1 = 1$ and $R_2(S,S)=1/(1 - \rho)$), the firm is just solvent, so that more short-term debt would push it into the panic region (where multiple equilibria are possible). Next, define $\overline{S}$ as

$$Y(\overline{S}) = \overline{S} . \tag{12}$$

From equation (12) we see that $\overline{S}$ is the maximum level of risk-free short-term debt, in the sense that, up to $\overline{S}$, a run by the short-term creditors will always allow them to recover the promised payment by the firm. We assume $\overline{S} < 1$.

If the conditions specified in equations (9) and (10) are satisfied, a creditors' run on the firm is justified if and only if $\underline{S} < S \leq 1$. We define the indicator function as

$$\mathcal{I}(S) = \begin{cases} 1 & \text{if } \underline{S} < S \leq 1 \\ 0 & \text{otherwise.} \end{cases}$$

The repayment schedules have to guarantee zero profits to the lenders. With the definition of q and p, it is clear that the unconditional probability of panic is pq. So $R_1(S,s)$ and $R_2(S,s)$ satisfy

$$\begin{aligned} &S\mathcal{I}(S)\pi_1^R(S,s) + (1 - S\mathcal{I}(S))R_1(S,s) = 1 , \\ &S\mathcal{I}(S)\pi_2^R(S,s) + (1 - S\mathcal{I}(S))R_2(S,s) = 1/(1 - \rho) , \end{aligned} \tag{13}$$

25. Formally, let $\tilde{S}$ be the critical mass required to precipitate a self-fulfilling run (that is, $\tilde{S}$ is defined as $Y(\tilde{S}\, R_1(\tilde{S},\tilde{S}) = \tilde{S}\, R_1(\tilde{S},\tilde{S}) + (1 - \tilde{S})R_2(\tilde{S},\tilde{S}))$). The degree of coordination can be measured then by $1/\tilde{S}$. Therefore, in a natural way, $p = p(S)$, with $p' \geq 0$.

where $\pi_1^R(S,s)$ and $\pi_2^R(S,s)$ are the repayment on the short-term and the long-term debt contracts, respectively, per unit of principal, if the quota of short-term financing is s, aggregate short-term borrowing is S, and there is a run on the firm's assets (the superscript R stands for the "run" scenario).

In turn, the repayments in the case of panic are as follows. Short-term debt payment $\pi_1^R(S,s)$ is

$$\pi_1^R(S,s) = R_1(S,s) \text{ if } y(\cdot) \geq R_1(S,s),$$
$$\pi_1^R(S,s) = y(\cdot) \text{ if } y(\cdot) \leq s.$$

The long-term debt payment $\pi_2^R(S,s)$ is[26]

$$(1-s)\,\pi_2^R(S,s) = max\left(y(W) - \pi_1^R(S,s), 0\right).$$

Consequently, we can distinguish three ranges for the equilibrium financial schedules offered by banks. To simplify the exposition, we do not present out-of-equilibrium cases in which a single firm is in a regime differet than that of the whole economy.[27]

If $0 \leq S \leq \underline{S}$, then $q(S) = 0$, and

$$R_1(S,s) = 1, \tag{14}$$

$$R_2(S,s) = 1/(1-\rho). \tag{15}$$

If $\underline{S} < S \leq \bar{S}$, then $q(S) = 1$, and

$$psR_1(S,s) + (1-p)sR_1(S,s) = s \Rightarrow R_1(S,s) = 1 \tag{16}$$

26. A run will only happen if the firm is insolvent on at least its long-term debt.

27. Notice that, since we make the schedules R_1 and R_2 depend on the firm's choice for s, we are assuming that creditors are able to perfectly monitor the financial structure of the firm. Under the alternative polar assumption, s is unobservable to the creditors. Whereas in the present model the market equilibrium would not have been affected, in a more general model in which y is also a function of the firm's idiosyncratic net outflow w in period 1, the incentives of the agents to overborrow in the short term would be even stronger. This is because they would not face the price increase from the increased risk of more short-term debt.

$$S[y(S)-s]+(1-S)(1-s)R_2(S,s)=\frac{1-s}{1-\rho} \tag{17}$$

$$\Rightarrow R_2(S,s)=\frac{1-s-p(y(S)-s)(1-\rho)}{(1-p)(1-s)(1-\rho)}\ . \tag{18}$$

If $S > \bar{S}$, then $q(S) = 1$ and

$$py(S)+(1-p)sR_1(S,s)=s \Rightarrow R_1(S,s)=\frac{s-py(S)}{(1-p)s} \tag{19}$$

$$S0+(1-S)(1-s)R_2(S,s)(1-\rho)=1-s \tag{20}$$

$$\Rightarrow R_2(S,s)=\frac{1}{(1-p)(1-\rho)}\ . \tag{21}$$

For brevity, we define $F(S,s)$ as the financial cost of borrowing, that is, the function

$$F(S,s)=sR_1(S,s)+(1-s)R_2(S,s)\ . \tag{22}$$

4.1 The Efficient Maturity Structure

The central planner internalizes the fact that, when taking on more short-term debt, he or she may be deteriorating the long-run prospects of the economy in the event of a panic run. That is, the planner internalizes the impact of aggregate short-term debt on both $q(S)$ and $Y(S)$.

Therefore the planner's problem is stated as follows:

$$V(S)=\max_S (1-ST(S))[Y(0)-(SR_1(S,S))+(1-S)R_2(S,S)] \tag{23}$$

Define S^* as the value that minimizes $F(S,s)$ over the range S∈ [$\underline{S}$ 1], provided that the parameterers are such that $\underline{S} \le S^*$:

$$Y'(S^*)=-\frac{\rho}{p(1-\rho)}\ . \tag{24}$$

Although this problem does not lend itself in general to a straightforward general analytical solution, it is easy to see that the following proposition holds:

Proposition 3: For $\rho > 0$, the optimal S, S^p, belongs to the discrete set $X = \{\underline{S}, S^*\}$; for small ρ the optimal maturity structure is $\underline{S}$. (For $\rho = 0$, all $S \leq \underline{S}$ are optimal.)

By way of proof, consider the values of S in the interval [0 $\underline{S}$]. As argued above, in this range the probability of panic is zero, so that there is no panic pricing in borrowing short term, and therefore the cheapest option is $\underline{S}$ (weakly so in the case of $\rho = 0$). By definition, S^* dominates all values of S greater than $\underline{S}$.

Which value among those in u is indeed the best choice depends on the parameters, in particular on ρ and p. For low values of ρ (and/or high values of p), the best alternative is to eliminate panic risk by borrowing very little short term (at $\underline{S}$). For higher values of ρ (and/or lower values of p), the optimum will be reached at S^*; that is, there will be a positive probability of panic.

4.2 The Market Equilibrium

For the firm, S is given. Therefore the firm will maximize its expected payoff over the choice of s:

$$\underset{s\in[01]}{Max}\, U(s) = (1 - pq(S))\left[y(0) - F(S,s)\right] . \tag{25}$$

As an equilibrium condition under symmetry, it is required that the choice of the representative firm be equal to the average:

$$s^M(S) = S = S^M . \tag{26}$$

Proposition 4: For $\rho > 0$ the market equilibrium is characterized by $s^M = S^M = 1$ and a positive probability p of an inefficient panic equilibrium. (If $\rho = 0$, all values of $S \in [01]$ are equilibria. This includes equilibria subject to panic risk as well as efficient equilibria for lower values of S.)

It will be useful to spell out this financial cost function (once again, in equilibrium $s = S$, and therefore the ranges also coincide):

$$F(S,s) = \frac{1-\rho s}{(1-\rho)} \quad \text{if } 0 \le S \le \underline{S}$$
$$= \frac{1-\rho s - py(S)(1-\rho)}{(1-p)(1-\rho)} \quad \text{if } \underline{S} < S \ . \tag{27}$$

Notice that for $s = S$ this function is continuous. From equation (27) it is clear that, for any positive ρ, we can show that the only possible equilibrium is one in which $s^M = S^M = 1$ (so that q must be 1 in equilibrium). To see this, one can show that the function $F(S,s)$ is always minimized by $s = 1$ for all S:

$$F_s(S,s) = -\frac{\rho}{(1-\rho)} < 0 \quad \text{if } 0 \le s \le \underline{S}$$
$$= -\frac{\rho}{(1-\rho)(1-p)} < 0 \quad \text{if } \underline{S} \le s$$

Hence, for any positive ρ the market equilibrium is characterized by exclusively short-term debt and a positive probability of an inefficient, panic equilibrium.[28]

It is then easy to check that if ρ = 0, the function $F(S,s)$ does not depend on s. Therefore all values of s (= S) are equilibrium values, including those that allow panic equilibria. Clearly, all these possible equilibria are Pareto-ranked, with those with $q(S^M) = 0$ being preferred, since the financing cost is lower if the economy is out of the panic region and no run can occur.

Therefore the general result is that, in equilibrium, S^P, the optimal level of short-term debt in the centrally planned economy, is at least weakly smaller than S^M (the market equilibrium aggregate short-term debt). The market equilibrium involves an inefficiently high panic risk (a generally higher probability of panic and a higher cost when it occurs).

If p depends on the aggregate level of short-term debt S as previously mentioned (see footnote 25), then the externality effects we have discussed are made stronger and, as a consequence, the relative inefficiency of the market allocation mechanism is increased.

28. For any ρ > 0, the equilibrium must be symmetric, because for each firm $s = 1$ is a dominant strategy.

4.3 Policy Implications

Despite its stylized nature, this model suggests a few policy implications concerning not only tax policy but institutional design as well. Regarding tax policy, consider a tax on short-term debt (to be redistributed as a lump sum immediately back to the firms), so that the effective payment in period 1 is $\tilde{R}_1(S,s) = (R_1(S,s))/(1-\rho)$. It is easy to see in equation (27) that now $F(S,s)$ does not depend on s, and therefore optimal borrowing can be attained by the market. This result would support taxes on short-term capital inflows. More generally, tax policy should be geared toward penalizing borrowing that contributes to the bunching of the aggregate debt profile. (Notice also that a subsidy on long-term debt that reduces obligations in period 2 by ρ percent obtains the same result.)

However, the previous tax policy makes the market indifferent and does not guarantee that it would pick the first-best solution. A more general and precise approach to finding Pigouvian taxes is to find the interest rate wedges that would make the market problem identical to the central planner's. A simple way to find an optimal solution is to consider how market interest rate schedules should be distorted (as a function of aggregate debt). In this case this is accomplished by inspecting the interest rate schedules in equations (16) through (22). The policy analysis is simplified in the case in which there is panic risk at all levels of short-term debt. Consequently, here we analyze in detail the case $\underline{S} = 0$.[29] In this case the relevant equations are equations (16) through (21). If $s > y(S)$ (short-term debt is risky), equations (19) and (21) apply. In this case optimal policy can be implemented by leaving long-term market interest rates unchanged but marginally taxing short-term rates as short-term borrowing increases with an extra term $-py(s)$ in order for the firm to internalize the aggregate term $-py(S)$ in equation (19). If $s < y(S)$ (short-term debt is risk-free), equations (16) and (18) apply. In this case optimal policy can be implemented by leaving short-term rates unchanged but marginally subsidizing long-term rates as long-term borrowing increases, again with an extra term $-py(s)$ in order for the firm to internalize the aggregate term $-pY(S)$ in equation (18).

29. Panic risk at all levels of short-term debt would be the general case in a model with solvency risk, which by definition implies the possibility of default with zero withdrawal. $\underline{S} = 0$ accommodates this case in this model without solvency risk, so that with zero withdrawal the value of the firm equals debt obligations.

Creating a liquidity facility that can be accessed in case of panic is another way of reducing or eliminating panic risk (as in the literature on bank runs). In this context of foreign borrowing, the liquidity has to be provided by foreign sources. For example, an amount of foreign exchange equal to $u(t) = SR_1(S, S) + (1 - S) R_2(S, S) - Y(t)$ in equation (10) would alleviate the capital account shock enough to make firms solvent, which would therefore eliminate the realization of panic. Notice that indeed $u(t)$ would probably be more than is actually needed for the purpose, since its availability ex post would make creditors willing ex ante to lend on more favorable terms to the firms.

This facility would be useful not only to reduce or eliminate market inefficiency but also to increase the efficiency of optimal borrowing by relaxing a constraint on foreign borrowing. (Since the market contracts more short-term debt, the size of a facility that eliminates panic risk would be larger.) In this model the elimination of panic risk through a liquidity facility is fully efficient and costless for the providers of liquidity, which in theory would deter panic crises without the facility ever being disbursed. In models in which there are other sources of crises, such as country risk, and withdrawals need not be caused by panic, such a facility would also carry moral hazard costs (unless the commitment can be credibly made that it would not be used except for panic crises).[30]

5. Concluding Remarks

Recent crises in developing and newly industrialized markets have put the problem of the financial fragility of these economies under closer academic and policy scrutiny. The crises in Mexico and some East Asian countries have brought back memories of the early 1980s, when crises primarily of a financial nature imposed a burden on Latin American and African countries that, according to many, was one of the major determinants of the "lost decade" in their economic development.

Yet some have pointed out important differences between the crisis episodes of the late 1990s and those of the early 1980s, and rightly so. The first wave of crises hit countries with an oppressive economic involvement of the public sector, afflicted by constant political turmoil

30. On the problems of an excessively liberal lending policy under the assurance of international rescue packages, see Fernández-Arias (1996).

and closed to financial and real transactions with the rest of the world. The same cannot be said (or at least not to the same extent) of the second wave, which hit a reforming Mexico (by then already a partner in NAFTA) and the fast-growing East Asian economies (which had made outward-oriented trade policies the key ingredient in their recipes for sustained growth). On the other hand, some have argued in favor of a temporary isolation of the Russian economy from external financial markets, in view of the significant "unpreparedness" of its domestic real economy.

We do not deny the importance of the explanations put forth in the literature, based mainly on moral-hazard problems (on both sides of the financial transactions) connected with implicit and explicit guarantees by the domestic government or by international institutions. However, we believe that other factors make the workings of the market allocation mechanism particularly shaky in the context of foreign borrowing.

We have presented two simple models of what we call market externalities in this paper. In section 3 we introduced a model of private sector overborrowing due to the presence of a country credit ceiling, which necessarily emerges given the virtual nonexistence of credible international mechanisms to enforce debt contracts against the will of a sovereign debtor. We characterized the problem in terms of overconsumption in the domestic economy.

In section 4 we presented a model of financial fragility based on investors' self-fulfilling loss of confidence in the debtor country's prospects. We outlined a reasonable scenario in which a massive withdrawal of foreign credit adversely affects the repayment possibilities of domestic debtors per se (for example, because it causes a real devaluation, making debt repayment too onerous for firms in the nontraded sector). We showed that, in such a scenario, market allocation is characterized by an excessive use of short-term debt (in lieu of long-term debt, which is more expensive for the single firm but less troublesome for the macroeconomic balance of the entire economy). This model justifies selective interference with capital inflows: short-term debt should be penalized, or long-term debt fiscally favored, or both.

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Capital Controls in Chile: Were They Effective?

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Controls on international capital flows have no place in a world without policy distortions and market failures. Capital controls can only be justified as second-best measures to compensate for nonremovable policy distortions, including inadequate regulation and supervision of the financial and corporate sectors and excessive insurance against exchange rate risk under limited exchange rate flexibility, among others. However, even in the presence of policy distortions and market failures, it is difficult to argue for imposing second-best measures such as capital controls. Here the conventional argument applies that a better alternative to capital controls is to address directly the distortions that cause "excessive" capital flows. Finally, the argument has been made that international distortions affecting the supply of capital—ranging from contagion and bandwagon effects in private markets to moral hazard problems caused by international rescuers of last resort—are

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not removable by recipient countries. Therefore, according to this argument, international distortions in the supply of capital should be offset by domestic capital controls aimed at limiting excessive capital inflows in good times, in order to reduce the likelihood of a crisis or, worse, a twin (currency and financial) crisis in bad times.

Chile's long experience with capital controls—of both the administrative and the quantitative sort—has caught the interest of policymakers and academic economists in a world of highly volatile capital flows, especially since Mexico's crisis in 1994-95. An increasing number of recent studies provide an empirical evaluation of the macroeconomic effects of Chile's quantitative restrictions on capital inflows. This took the form of an unremunerated reserve requirement (URR) imposed by the Central Bank of Chile on selective (mostly short-term and financial) capital inflows during 1991-98. This study extends this literature in four directions. First, it provides an alternative measure of the financial cost of the reserve requirement, one that differs significantly in both magnitude and effects from conventional measures used in previous research. Second, this paper broadens the study of capital controls to include other administrative controls on capital flows and their effects. Third, it extends the study of the URR by assessing its determinants as well as the determinants of other capital controls, identifying the central bank's motives in setting these controls. Finally, the paper covers a significantly extended time period, adding two years before and two years after the operation of the URR—an important extension to include relevant control periods.

The rest of the paper is organized as follows. Section 1 provides a brief review of existing empirical studies on Chile's URR. In section 2 we describe both quantitative and administrative controls on capital flows in Chile. Section 3 reports results for both the determinants and macroeconomic and financial effects of all categories of capital controls in Chile using monthly data for 1989-2000. The paper concludes with a brief summary of the benefits and costs of Chile's capital controls.

1. Previous Findings and Remaining Questions

Chile's controls on capital inflows adopted in the early 1990s—mostly in the form of an unremunerated reserve requirement—

have been studied extensively. This section summarizes this literature and its main findings, and raises some of the questions that have not been answered yet and hence will be addressed in the next sections of this paper.

A detailed summary review of the studies on the Chilean URR is provided in appendix A. This literature has addressed four related questions, namely:

1. Has the URR raised the effectiveness of monetary policy, under conditions of limited exchange-rate flexibility?[1]

2. Has the URR contributed to a more depreciated real exchange rate?

3. Has the URR reduced total capital inflows or changed their composition from short-term (or financial) to long-term (or nonfinancial) inflows?

4. In the context of the 1997-99 international turmoil, has the URR diminished contagion from international shocks to the Chilean economy?

These questions are directly related to the policy objectives pursued by the Central Bank of Chile in imposing the URR in June 1991 and maintaining it through September 1998.

The existing empirical research on this subject has addressed these questions adopting a variety of econometric approaches that range from single-equation models (SEM, including OLS and instrumental variable techniques) to multiequation models, including vector autoregressive (VAR) models and generalized auto regressive conditional heteroskedasticity (GARCH) models.

1.1 Single Equation Models

Using quarterly data for 1987-96, the seminal paper by Soto and Valdés-Prieto (1996) concludes that the imposition of the URR did not change the trend appreciation of the real exchange rate during the 1990s. In that paper and two subsequent papers (Valdés-Prieto and Soto, 1998 and 2000), they conclude that the URR did lead to a change in the composition of capital flows, reducing the share of taxed

1. An exchange rate band was in place until September 1999, when a free float was adopted.

short-term flows and raising the share of exempt flows.[2] Hence total short-term flows were not affected by the URR.

Using monthly 1991-96 data, Eyzaguirre and Schmidt-Hebbel (1997) reach a different conclusion regarding the composition of inflows. They find that the URR did lead to a reduction of total short-term flows but did not have any statistically significant effect on total flows. They also find that the URR increased the effectiveness of monetary policy (by increasing the wedge between domestic and foreign parity interest rates) and led to a temporary real exchange rate depreciation. However, the latter two effects are rather weak and not robust to different specifications for the estimated equations.

Regarding the impact of capital controls on the effectiveness of monetary policy, Edwards (1998) uses monthly 1988-96 data to estimate an equation for the domestic-foreign interest rate differential. He finds that during the post-1992-93 period, when the URR increased in importance, there was no direct effect of the URR on the level of the interest rate differential, but it affected the degree of inertia of the differential. Consequently, Edwards concludes that the URR allowed the central bank a higher degree of policy autonomy only on a temporary basis.

Using quarterly 1985-94 data, Laurens and Cardoso (1998) conclude that the URR had no effect on the composition of inflows. The authors also conclude that the URR affected neither the real exchange rate nor the interest rate differential. However, the way the model is estimated in this study casts doubts on the authors' conclusions.[3]

Larraín, Labán, and Chumacero (2000) use quarterly data from 1986 to 1997. They study separately the behavior of long-term, exempt short-term, and taxed short-term flows. Using a threshold model technique (which allows differentiating the determinants of capital flows during different endogenously determined regimes), they find that the URR has a negative, permanent effect on taxed short-term flows (operating through an increase in the relevant interest rate differential), a positive transitory effect on exempt short-term flows,

2. Valdés-Prieto and Soto (2000) state that taxed flows could be associated with those that use legal channels and have secure access to the interbank foreign exchange rate.

3. The capital control—or URR—index used here is positively correlated with the dependent variable (inflows) by construction, biasing the estimated coefficient on the URR variable upwards. In addition, the sample period includes years when capital inflows were not entirely voluntary; voluntary flows to Chile resumed only in 1989.

and no effect on long-term flows. Summing up, the results indicate that the URR has a nonlinear, negative, and significant effect on both short-term and total capital flows.

The main shortcomings of the preceding studies is that they do not control for changes in other capital account regulations (namely, liberalization of capital outflows and inflows) and for changes in the URR other than the tax rate (that is, changes in coverage and presence of loopholes).[4] The recent paper by De Gregorio, Edwards, and Valdés (2000) overcomes some of these limitations by including a new variable aimed at measuring the presence and extent of loopholes (an index measuring the power of the URR). Using a SEM and quarterly data for 1987-96, the authors conclude that the URR provided the central bank with additional room to maneuver (allowed for a higher domestic interest rate) and changed the composition of inflows toward long-term flows. However, like previous studies, they are still unable to find any significant effect of the URR on the real exchange rate (RER).

1.2 System Models

The lack of response of the RER to a change in the URR presents a puzzle, since the higher level for the domestic interest rate—supported by the URR—could be expected to lead to a more depreciated RER through the expenditure channel. The fact that this effect has not been found in the empirical papers based on SEMs is likely due to misspecification problems. This is suggested by the results reported in the two studies that apply VARs: Soto (1997) and De Gregorio, Edwards, and Valdés (2000). Using monthly data for 1991-96 and 1991-98, respectively, these papers report that a temporary shock to the URR depreciates the real exchange rate on a temporary basis.[5] Furthermore, Soto (1997) finds that increases in the URR lead to a reduction in the volatility of the RER. The three papers using a VAR approach (Soto, 1997; Edwards, 1999; and De Gregorio, Edwards, and Valdés, 2000) also confirm the previous findings regarding the level of domestic interest rates, the composition of inflows, and the absence of any significant effect on total flows.

4. For a critical review of the literature—without rigorous empirical analysis—see Nadal-De Simone and Sorsa (1999).

5. However, using a similar approach, Edwards (1999) finds no effect of the URR on the RER.

Regarding the impact of the URR on the volatility of other macroeconomic prices, Edwards (1999) estimates a GARCH model using weekly data from September 1994 to January 1999, for the volatility of short-term central bank nominal repo rates and the stock market index. His results indicate that the URR has a negative and significant effect only on the volatility of the stock market index.

Finally, Edwards (1999, 2000) analyzes whether capital controls isolated Chilean interest rates from external shocks. Using weekly data for 1994-99, and both SEM and VAR models, he finds that the URR was not able to reduce contagion effects from foreign interest rate shocks to domestic interest rates.

In sum, there is ample evidence showing that the URR has led to higher domestic interest rates—or a larger differential with international interest rates—and a change in the composition of inflows, without affecting the real exchange rate. Yet the effect of the URR on total flows remains controversial, with all studies except Larraín, Labán, and Chumacero (2000) finding no significant effect.

Two broad open questions on the effectiveness of Chile's capital controls warrant a new empirical study. First, what explained the behavior of the Central Bank of Chile in setting and modifying the URR and other controls on capital inflows and outflows during 1989-2000? Second, how robust are the previous findings to the use of better and longer data sets and controlling for better and broader measures of capital controls? We address these issues in section 3, after describing the extent and use of capital controls in Chile in the past decade.

2. Capital Controls in Chile during the 1990s

Chile has a long history of controls on capital account transactions, starting in the 1930s and continuing through the mid-1970s. Controls were gradually liberalized in the late 1970s and early 1980s, but were tightened again in the aftermath of the debt crisis of the 1980s.

The resumption of voluntary capital flows to emerging market economies led to a new wave of inflows to Chile starting in 1988. After a growing tide of inflows during 1988-90, the central bank imposed new quantitative restrictions in the form of a URR on

selective inflows in 1991,[6] and started to liberalize existing administrative controls on outflows. At the same time, however, other quantitative and administrative controls on capital inflows were also lessened. Next we summarize the specific restrictions on outflows and inflows, discussed in more detail by Gallego, Hernández, and Schmidt-Hebbel (1999). We rely heavily on the methodology developed in that paper to quantify the different capital controls in Chile.

2.1 Unremunerated Reserve Requirement

The URR is an obligation to hold an unremunerated fixed-term (mostly one-year) reserve at the central bank, equivalent to a fraction of capital inflows in certain categories. Hence the URR is equivalent to a tax per unit of time that declines with the permanence or maturity of the affected capital inflow. The quantitative nature of this restriction (that is, its tax equivalence) is made more explicit by its alternative form: instead of depositing the unremunerated reserve fraction with the central bank, foreign investors are allowed to pay the central bank an up-front fee. This is determined by the product of the relevant foreign interest rate and the fraction of capital subject to the restriction.

Various features of the URR were altered during its existence. The central bank modified the required rate or fraction of deposit, the coverage of capital inflow categories subject to it, the foreign currency denomination of the reserve deposit or fee payment, the holding period, the restrictions on the rollover of maturing investments, and other administrative requirements related to the URR.

A simple equation that reflects the cost of the URR (*urr*) is the following:

$$urr = \frac{\tau}{(1-\tau)} \frac{h}{k} i^* \quad , \tag{1}$$

where τ is the fraction of the capital inflow required to be held as a deposit or reserve with the central bank, h is the required holding period, k is the average maturity of the foreign investment for which the URR is calculated (equal to six months in the empirical

6. This lasted through September 1998.

estimations reported below), and i^* is the equivalent foreign interest cost for a k-month operation.[7]

Measures of *urr* similar to that defined in equation (1) have been used in previous empirical studies. They can be termed "naive" in the sense that they do not reflect the option value of reinvesting or rolling over the capital after maturity (this option existed until 1996) as calculated by Herrera and Valdés (2001).

The resulting time series for *urr* reflects both changes introduced by the central bank (affecting τ, h/k, and the applicable i^*) and changing market conditions (affecting i^*).[8] Starting at a rate of 20 percent in June 1991, τ was raised to 30 percent in May 1992 and maintained at that level through June 1998, when it was reduced to 10 percent; this was followed by a further reduction to zero in September 1998 (figure 1). Other administrative changes introduced by the central bank altered the maturity (h/k) and the relevant i^*,[9] although the latter was also affected by changing market conditions. The *urr* series that takes into account all these factors is depicted in figure 2 and shows a trend increase until late 1997, largely explained by the rising share of up-front fee payments.[10] From June 1991 through September 1998, *urr* averaged 4.24 percent a year, with a standard deviation of 2.14 percent. Its maximum was 7.7 percent in November 1997.

An indirect measure of how binding the URR was for capital inflows to Chile is provided by the total amount collected as deposits. The latter consists of the actual capital stock deposited as required reserves at the central bank, and the capital stock equivalent to the up-front fee payments. At its peak in August 1997, the URR implied a total equivalent to $2.2 billion in reserve deposits, consisting of $0.8 billion in actual deposits and $1.4 billion in fee-equivalent deposits (figure 3). This is a sizable amount, equivalent to 2.9 percent of Chile's 1997 GDP, or 30.0 percent of that year's net capital inflows. During the whole 1991-98 period the total equivalent reserve deposit attained an average of 1.9 percent of GDP.

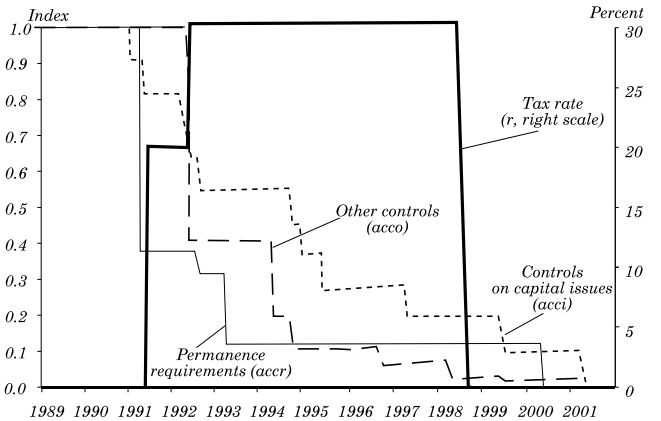
7. For details on the applicable i^* see Gallego, Hernández, and Schmidt-Hebbel (1999).

8. See appendix B for data definitions, sources, and frequency for all variables. The data are available on request.

9. The central bank changed from yen or dollar rates to dollar rates only in November 1994.

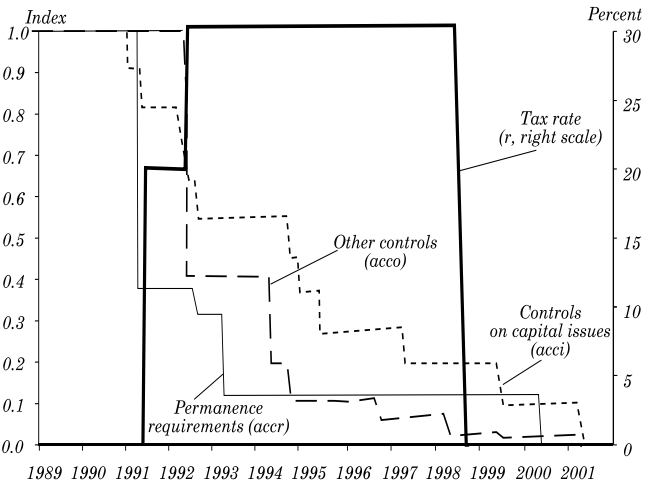
10. The fee option appears to be more expensive than depositing funds with the central bank, because of the spread of 2.5 percent (or 4 percent) applied to it on top of the foreign interest rate i^*.

Figure 1. URR Tax Rate, Index of Foreign Investment Permanence Requirements, Index of Controls on Capital Issues, and Index of Other Administrative Controls on Capital Flows, 1989-2001



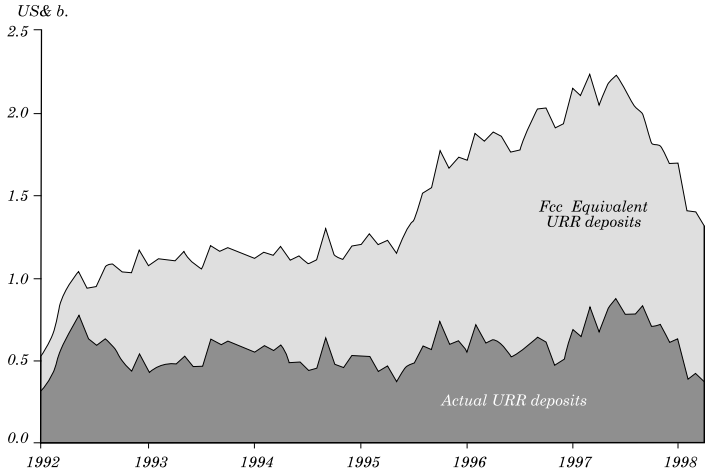
Source: Central Bank of Chile and authors' calculations.

Figure 2. URR Cost, URR Power, and URR Effective Cost, 1991-98 (%)



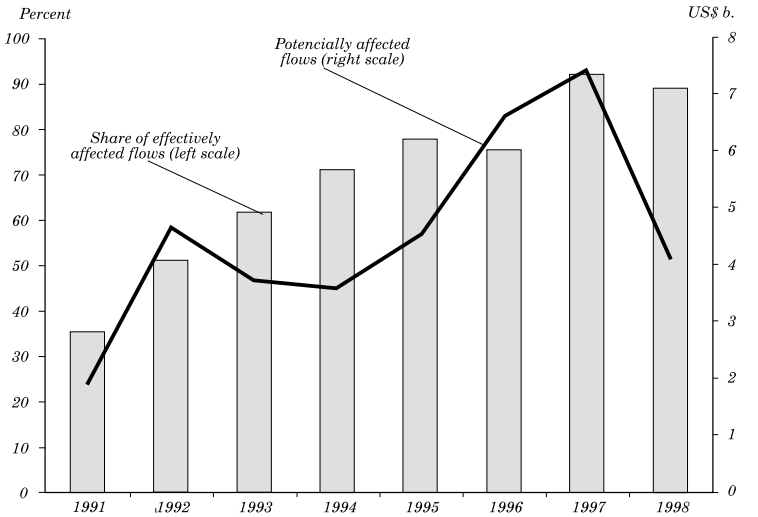
Source: Central Bank of Chile and authors' calculations.

Figure 3. Actual and Fee-Equivalent URR Deposits at the Central Bank, 1992-98



Source: Central Bank of Chile and authors' calculations.

Figure 4. Potentially Affected Flows and Share of Effectively Affected Capital Flows, 1991-98



Source: Central Bank of Chile and authors' calculations.

However, as with any other tax, the URR provided an incentive for tax avoidance and tax evasion.[11] Comparing actual and required total reserve deposits provides a measure of the tax effectiveness, or power, of the URR. This is estimated by the ratio between the flows actually taxed by the URR—either by making a deposit or paying the equivalent up-front fee—and the total amount of new flows that were potentially subject to the URR:

$$pow_t = (\text{actual flows paying the URR})_t / (\text{potential taxable flows})_t \,, \qquad (2)$$

where the potential taxable flows are derived after adjusting recorded capital inflows for flow relabeling that occurred through various loopholes.

Figure 4 depicts average annual time series of the potentially affected flows and the share of effectively affected flows. Figure 2 reports the monthly time series for the power index. The latter suggests that the URR gained effectiveness over time, although this happened because of the central bank's continuing effort to close loopholes in URR regulations, in part by increasing its coverage. For instance, in January 1992, six months after its introduction, the URR power index stood at 50 percent, mainly because of extensive relabeling of several forms of capital inflows as dollar-denominated deposits, which were exempted from the URR. When these deposits became subject to the URR in February 1992, the power index increased to 78 percent (although other loopholes were discovered and used by arbitrageurs). A more formal analysis to explain the behavior of the power of the URR is presented in section 3 below.

Combining the simple measure of the cost of the URR, adjusted for changes in its coverage of the capital base (*cov*), and its effectiveness or power allows one to obtain a measure of the effective cost of the reserve requirement (*err*):

$$err = urr * cov * pow \,. \qquad (3)$$

Figure 2 depicts the time pattern of *urr* and *err*. Both show a rising trend until late 1997. The effective cost of the reserve requirement attained a sample average of 3.84 percent and a standard deviation of 2.30 percent during 1991-98.

11. Le Fort and Sanhueza (1997) provide a detailed description of the avoidance of the URR that was observed in the 1990s.

2.2 Other Restrictions on Capital Flows

The central bank largely liberalized administrative restrictions on both capital inflows and outflows during the 1990s and abolished all remaining restrictions in April 2001. This can be seen both as part of the country's overall economic liberalization and as a (temporary) substitution of quantitative restrictions on inflows (the URR) for administrative controls.

Regarding capital inflows, the two main quantitative restrictions—other than the URR—are minimum solvency requirements on domestic issuers of foreign liabilities (bonds and American depository receipts, or ADRs) and size requirements on issues of foreign liabilities by corporations and banks. Both restrictions were partly liberalized during the last decade, as reflected in their liberalization index (*acci*), depicted in figure 1.

Minimum permanence requirements before repatriation of capital and profits may be interpreted as restrictions on both capital inflows and outflows. Technically they affect outflows of capital because they are imposed on capital that has entered at some point in time; that is, they restrict the repatriation of principal and cumulative profits accrued on past investments. However, in an ex ante sense they deter additional foreign investment, and hence negatively affect future capital inflows (Labán and Larraín, 1997).

Permanence requirements on foreign investment—both portfolio and direct—were reduced from an average of eight to three years in 1991, and further to two and a half (in 1992) and to one year (in 1993), before being completely eliminated in May 2000 (*accr* in figure 1). This liberalization was implemented in an ex post way: existing foreign capital was allowed to leave the country after complying with the new, shorter permanence requirement. For this reason one may expect to observe larger capital outflows at the times when permanence requirements were relaxed—as the central bank intended—and this is why we classify the requirement as a capital outflow restriction. At the same time, however, this outflow liberalization provides an incentive for larger inflows, implying that the total effect on net capital flows is ambiguous in the short term.

Other regulations on capital outflows that were liberalized during the last decade include ceilings on foreign asset holdings by domestic financial institutions and surrender requirements imposed on export proceeds (both were abolished in July 1995).

An aggregate index for these and a host of other secondary administrative controls on outflows is depicted as *acco* in figure 1.

The various indexes in figure 1 show significant and simultaneous progress in the liberalization of both capital inflows and outflows, largely concentrated during 1991-95. This downward trend in the restrictiveness of controls is summarized by the (simple) average of the three indexes, *accf* (not shown).

3. Empirical Results

This section reports estimation results for two sets of variables. First we specify and estimate equations to explain the adoption by the central bank of quantitative and administrative capital controls. We attempt in their specification to reflect the motivation of the central bank in setting the URR and the average level of administrative controls. Next we specify the effect of capital controls on the relevant macroeconomic and financial variables, following the model spelled out in Gallego, Hernández, and Schmidt-Hebbel (1999).

3.1 Sample Period, Data, and Estimation Strategy

Our sample period covers 1989-2000, thus spanning the period from 1989 to June 1997, when Chile had relatively unhindered access to voluntary foreign capital markets, and from July 1997 through 2000, when voluntary flows to emerging market economies (including Chile) became more scarce. We use monthly data for all regressions, implying a maximum sample of 144 observations. Data definitions and sources are provided in appendix B.

The estimation strategy addresses potential econometric problems derived from spurious correlations, endogeneity of right-hand-side variables, and inefficient estimation due to heteroskedasticity and autocorrelation of residuals. These problems are addressed by conducting appropriate diagnostic tests and using appropriate estimation techniques. Most estimations are performed on first differences of our structural equations. The order of integration of individual variables varies between 0 and 1. A significant number of variables are I(1), justifying estimation in first differences. When appropriate, cointegration tests were conducted, with generally acceptable results. Finally, to account for dynamic behavior, we introduce lagged dependent variables, polynomial distributed lag structures for independent variables, or error correction models.

3.2 Capital Controls

We start by studying the URR, focusing on the determinants of its simple cost measure (*urr*), its power (*pow*), and its effective cost measure (*err*). The behavioral equation for *pow* reflects both the incentives of arbitrageurs to avoid or evade the URR and the effectiveness of the measures developed by the central bank to raise its power. The incentives for avoidance and evasion increase with the URR tax rate and the difference between the domestic and the foreign interest rate, adjusted for devaluation expectations and the country risk premium. The power of the URR is reflected in changes in URR coverage and currency denomination:

$$pow_t = \underset{}{\omega_0} + \underset{(-)}{\omega_1}\tau + \underset{(-)}{\omega_2}(r - r^* - \hat{e}^e - \rho) + \underset{(+)}{\omega_3}D922 + \underset{(+)}{\omega_4}D9411 + \underset{(+)}{\omega_5}DYEN$$
$$+ \underset{(+)}{\omega_6}D957 + \underset{(-)}{\omega_7}T957 + \underset{(+)}{\omega_8}D9610 + \underset{(-)}{\omega_9}T9610 + \underset{(+)}{\omega_{10}}pow_{t-1}\ , \tag{4}$$

where τ is the URR tax rate, r is the domestic interest rate, r^* is the international interest rate, $\hat{e}^e$ is the expectation of real currency depreciation, and ρ is the country risk premium. $D922$, $D9411$, $D957$, and $D9610$ are dummy variables for regulatory changes affecting dollar-denominated deposits, the currency denomination of the required deposit with the central bank, the issue of secondary ADRs, and requirements to classify inflows as foreign direct investment, respectively. $T957$ and $T9610$ are trend variables for the period after dummies $D957$ and $D9610$ take a value of 1, and $DYEN$ is a dummy for 1994, when the interest rate on yen-denominated assets was well below that on dollar-denominated international assets. Expected coefficient signs are presented below the corresponding variables.[12]

The power of the URR rises with changes in URR coverage and other regulations aimed at reducing its avoidance and evasion. This is shown by the positive and significant coefficients reported for the regulatory dummies (table 1). All these changes had permanent effects on the power of the URR.

12. All of the variables except ($r - r^* - \hat{e}^e - \rho$) are included in first differences.

Table 1. Regression Results for the Power of the URR [a]

Independent variable	*Regression coefficient*
Constant	0.004
	(1.5)
D(τ)	–0.11
	(5.8)
$r - r^* - \hat{e}^e - \rho$	–0.0011
	(1.7)
D(*D*922)	0.27
	(10.4)
D(*D*941)	0.02
	(2.8)
D(*DYEN*)	0.01
	(1.3)
D(*D*957)	0.02
	(4.0)
D(*T*957)	–0.001
	(0.2)
D(*D*9610)	0.01
	(3.2)
D(*T*9610)	–0.00
	(0.1)
D(pow_{-1})	0.23
	(2.1)
Summary statistic	
Adjusted R^2	0.78
Durbin's *h*	0.26

Source: Authors' calculations.
a. Results are based on estimation of equation (4) by the ordinary least-squares method. The dependent variable is the first difference of the power of the URR (*pow*). D(.) is the first-difference operator. The sample period is 1991.7 to 1998.8. Newey-West-consistent *t* statistics are reported in parentheses.

The results also show that the power of the URR declined with the differential between domestic and foreign interest rates (adjusted by country risk), and the level of the URR tax rate τ (a Laffer-like effect). These results attain statistical significance and economic importance. For instance, for an interest rate differential of 4.5 percent (equal to the sample period average), by the

time τ was lowered to zero in September 1998, the URR would have lost, ceteris paribus, about 72 percent of its initial power. This result shows that the URR cannot be used to sustain an interest rate differential on a permanent basis.

We now proceed to specify behavioral equations for the simple cost measure of the URR (*urr*) and its effective cost (*err*). In line with the objectives declared by the central bank when imposing the URR, we posit that the central bank alters the components of *urr* or *err* so that both these variables will increase with the deviation of inflation from its official target level (reflecting a concern with price stability) and with total net capital inflows to Chile and to developing countries (reflecting concern with excessive foreign indebtedness). On the other hand, *urr* and *err* should fall with the share of long-term net capital inflows in total inflows in Chile (reflecting concern with excessive short-term indebtedness) and with the rate of currency depreciation (reflecting concern with excessive competitiveness losses). The central bank also reacts to a decline in the power of the URR. The external interest rate, adjusted for country risk, is positive when included contemporaneously (by definition of *urr*) and negative when included as lags, because of the diminishing effect of this variable on capital inflows to Chile (reflecting concern with excessive foreign indebtedness).

As the specification is almost the same for *urr* as for *err*, we illustrate it for the former here:

$$urr_t = \alpha_0 + \underset{(+)}{\alpha_1\, PDL\left(\pi_t - \pi t_t\right)} + \underset{(+)}{\alpha_2\, PDL\left(\frac{e_t\, kf_t}{y_t}\right)} + \underset{(-)}{\alpha_3\, PDL\left(\frac{e_t\, kfl_t}{y_t}\right)}$$

$$+ \underset{(-)}{\alpha_4\, PDL\left(\frac{e_t - e_{t-1}}{\bar{e}_{t-1}}\right)} + \underset{(+)}{\alpha_5 \frac{wkf_{t-1}}{wy_{t-1}}} + \underset{(+)}{\alpha_6(r_t^* + \rho_t)} + \underset{(-)}{\alpha_7(r_{t-1}^* + \rho_{t-1})} \qquad (5)$$

$$+ \underset{(+)}{\alpha_8\, urr_{t-1}} + \underset{(-)}{\alpha_9\, PDL\left(pow_t\right)},$$

where $\pi - \pi t$ is the difference between actual and target inflation, e is the real exchange rate, kf is total net capital inflows to Chile, y is real

domestic output of Chile, *kfl* is long-term net capital inflows to Chile, *wkf* is total net capital inflows to all developing countries, and *wy* is world real output. Expected signs on the coefficients are noted below the corresponding variables. Many independent variables are specified here (and in other equations below) as polynomial distributed lags (PDL); their lags and orders are determined empirically. The only difference between equation (5) and the corresponding equation for *err* is that the latter includes its own lags, instead of urr_{t-1}, and omits the last independent variable, since by definition *pow* is part of *err*.

The results in tables 2 and 3 confirm the significance of the right-hand-side variables in equation (5) in explaining the central bank's use of the URR. For both measures of the cost of the URR (*urr* and *err*), all variables have the expected signs, and most are statistically significant at conventional levels. The URR was altered in response to changing conditions in world capital markets —it was reduced with the lagged cost of funding ($r^*_{t-1} + \rho_{t-1}$) and raised with the overall availability of funds to developing countries. The central bank raised the URR in response to increased capital inflows but lowered it in response to increased long-term inflows—in other words, it responded strongly to larger short-term inflows. The URR was raised in response to a higher rate of currency appreciation, reflecting a concern with deteriorating foreign competitiveness. It is also interesting to note that *urr* falls with its own power (table 2); thus the central bank raised the URR in response to a loss in its power or efficiency due to avoidance or evasion of the reserve requirement. Surprisingly, the URR is generally not sensitive to deviations of inflation from target levels; the only (and marginal) exception to this finding is in the first equation in table 3.

As noted above, the central bank started in the early 1990s to lift administrative controls on capital inflows and outflows. Here we use our aggregate index of administrative controls on the capital account (*accf*) to test the central bank's behavior in liberalizing capital flows. We posit that administrative controls are systematically reduced throughout the 1990s, consistent with a trend of abolishing restrictions on capital movements worldwide. Next we consider the interaction of administrative controls with URR policy and effectiveness: administrative controls should increase with the effective cost of the URR if both instruments are applied as complements, and decline if they are considered substitutes.

Table 2. Regression Results for the Cost of the URR[a]

	Regression coefficient	
Independent variable	*(1)*	*(2)*
$\pi - \pi t$	0.03	0.04
	(0.5)	(0.8)
PDL($\frac{e_t kf_t}{y_t}$; –6, –9, 2)	2.84	2.87
	(3.8)	(3.6)
PDL($\frac{e_t kfl_t}{y_t}$; –3, –14, 1)	–7.98	–7.33
	(6.1)	(5.9)
PDL(D($\frac{e_t - e_{t-1}}{e_{t-1}}$); –2, –8, 2)	–42.26	–53.60
	(3.5)	(5.3)
D($\frac{wfk_{-1}}{wy_{-1}}$)	30.00	39.10
	(1.8)	(2.0)
D(r*) + D(ρ)	0.73	0.77
	(5.6)	(5.9)
D(r_{-1}*)	–0.03	...
	(0.2)	...
D(ρ_{-1})	–1.15	...
	(1.6)	...
D(r_{-1}*)+ D(ρ_{-1})	...	–0.17
	...	(1.7)
PDL(D(*pow*(–1)),9,3)	–3.13	–4.29
	(2.5)	(2.8)
D(urr_{-1})	0.44	0.46
	(2.1)	(2.0)
Summary statistic		
Adjusted R^2	0.51	0.46
Durbin's h	0.10	0.18

Source: Authors' calculations.
a. Results are based on estimation of equation (5) by the ordinary least-squares method. The dependent variable is the first difference of the cost of the URR (*urr*). PDL(*X*; A, B, C) is a polynomial distributed lag for variable *X*, where A and B are the first and last lag, respectively, and C is the order of the polynomial. D(.) is the first-difference operator. The sample period for both equations is 1991.6 to 1998.9. Newey-West-consistent t statistics are reported in parentheses.

Among the components of our aggregate index of administrative controls, those that restrict outflows dominate, while controls on inflows play a secondary role. During the surge in net capital inflows from the late 1980s through the 1990s, the overriding concern of the

Table 3. Regression Results for the Effective Cost of the URR [a]

	Regression coefficient	
Independent variable	*(1)*	*(2)*
$\pi - \pi t$	0.15	0.07
	(1.6)	(1.0)
PDL($\frac{e_t kf_t}{y_t}$; –6, –9, 2)	2.05	2.50
	(1.8)	(1.9)
PDL($\frac{e_t kfl_t}{y_t}$; –3, –14, 1)	–4.14	–4.57
	(2.0)	(2.0)
PDL(D($\frac{e_t - e_{t-1}}{e_{t-1}}$); –2, –8, 2)	–33.39	–45.43
	(2.0)	(2.0)
D($\frac{wfk_{-1}}{wy_{-1}}$)	36.31	33.32
	(1.7)	(1.5)
D(r^*) + D(ρ)	0.63	0.70
	(5.3)	(5.8)
D(r_{-1}^*)	–0.02	...
	(0.1)	...
D(ρ_{-1})	–1.17	...
	(2.5)	...
D(r_{-1}^*)+ D(ρ_{-1})	...	–0.23
	...	(1.1)
D(err_{-1})	0.51	0.43
	(2.0)	(2.5)
Summary statistic		
Adjusted R^2	0.39	0.33
Durbin's h	0.48	0.37

Source: Authors' calculations.

a. Results are based on estimation of equation (5) by the ordinary least-squares method. The dependent variable is the first difference of the effective URR (*err*). PDL(*X*; A, B, C) is a polynomial distributed lag for variable *X*, where A and B are the first and last lag, respectively, and C is the order of the polynomial. D(.) is the first-difference operator. The sample period for both equations is 1991.6 to 1998.9. Newey-West-consistent *t* statistics are reported in parentheses.

central bank was to stem inflows. Hence the variables that led the central bank to raise the URR could also have led it to reduce administrative controls. Here we posit that a real depreciation contributes to raising controls, whereas a surge in net capital inflows contributes

to reducing them. The corresponding equation for the administrative controls for capital flows is the following:

$$accf_t = \beta_0 + \beta_1\, trend + \beta_2\, trend^2 + \beta_3\, PDL\left(err_t\right) + \beta_4\, PDL\left(\frac{e_t\, kf_t}{y_t}\right) + \beta_5\, PDL\left(\frac{e_t - e_{t-1}}{e_{t-1}}\right) + \beta_6\, accf_{t-1}, \tag{6}$$

(–) (?) (?) (–) (+) (+)

where *trend* is the time trend variable. A quadratic relationship is considered here, with a negative coefficient expected for the linear term, and with the expectation for the quadratic term ambiguous. For *err* the expected coefficient is positive if the administrative controls on capital flows and the URR were used as complementary policy instruments, and negative if they were substitutes.

The results in table 4 confirm the expected coefficient signs at conventional significance levels for all variables except the real depreciation variable. Capital account liberalization shows a significant downward time trend, but at a decreasing pace. Controlling for the latter trend, administrative controls were lowered with a reduction in the effective cost of the URR, validating the notion that administrative controls on capital flows were used as complements to the URR. Capital account liberalization was also intensified in response to larger net capital inflows. Finally, these results, as well as those for the URR-related variables above and the economic variables below, confirm a gradual response of the dependent variable to changes in the independent variables, reflected in a large positive and significant coefficient for the lagged dependent variable.

3.3 Macroeconomic and Financial Variables

Now we turn to the behavior of the key macroeconomic and financial variables that are potentially affected by capital controls. We briefly spell out the key features of a two-sector, dynamic, open

economy that embeds our model equations.[13] Domestic interest rates reflect imperfect international arbitrage à la Edwards and Khan (1985), where both risk-adjusted arbitrage and domestic credit market conditions play a role. Net foreign asset accumulation is determined by the current account surplus, itself a function of the determinants of the excess supply of traded goods net of foreign factor receipts (in other words, the excess of saving over investment). Nontraded goods equilibrium relates the equilibrium RER to nontraded supply and demand determinants, which are similar to those included in the current account equation. Our equations add short-term good and asset market rigidities and nominal shocks, as well as capital controls, to the determinants found in standard small open economy models.

Table 4. Regression Results for Administrative Controls on Capital Account[a]

Independent variable	*Regression coefficient*
trend	–0.01
	(2.2)
$trend^2$	4.36e-5
	(2.3)
PDL((D(*err*)); –3, –15, 2)	0.06
	(2.3)
PDL($\frac{e_t kf_t}{y_t}$; –3, –11, 2)	–0.19
	(1.7)
PDL($\frac{e_t - e_{t-1}}{e_{t-1}}$; –1, –8, 1)	–0.18
	(0.2)
$accf_{-1}$	0.73
	(5.7)
Summary statistic	
Adjusted R^2	0.99
Durbin's *h*	0.02

Source: Authors' calculations.

a. Results are based on estimation of equation (6) by the ordinary least-squares method. The dependent variable is the measure of administrative controls on the capital account (*accf*). PDL(*X*; A, B, C) is a polynomial distributed lag for variable *X*, where A and B are the first and last lag, respectively, and C is the order of the polynomial. D(.) is the first-difference operator. The sample period is 1989.1 to 1999.6. Newey-West-consistent *t* statistics are reported in parentheses.

13. A more detailed discussion of the model and its dynamic properties is presented in Gallego, Hernández, and Schmidt-Hebbel (1999).

As argued, both external arbitrage and domestic market conditions affect interest rates in the short run. The general specification that nests an equation for the central bank's policy rate and another for the bank deposit rate is the following:

$$
\begin{aligned}
r_t = {} & \gamma_0 + \gamma_1 r_t^* + \gamma_2 \hat{e}_t^e + \gamma_3 \rho_t + \gamma_4 err_t + \gamma_5 accout_t + \gamma_6 \left(\frac{e_t l_{t-1}}{y_t} \right) \\
& \quad (+) \qquad (+) \qquad (+) \qquad (+) \qquad (-) \qquad (?) \\
& + \gamma_7 tot_t + \gamma_8 \left(\frac{g_t}{y_7} \right) + \gamma_9 \left(\frac{m_{t-1}}{y_t} \right) + \gamma_{10} \left(\pi_t - \pi\, t_t \right) + \gamma_{11} \left(\frac{y_t}{\bar{y}_t} \right) \qquad (7) \\
& \quad (?) \qquad (+) \qquad (-) \qquad (+) \qquad (+) \\
& + \gamma_{12} \left(\frac{cas_t}{y_t} \right) + \gamma_{13} r_{t-1} . \\
& \quad (-) \qquad (+)
\end{aligned}
$$

The first four regressors represent cost-equivalent components of international arbitrage conditions: the real international interest rate (r^*), the expected real depreciation ($\hat{e}^e$), the country risk premium (ρ), and the effective cost of the URR (*err*, or, alternatively, the simple cost measure). We also include an index of administrative controls on capital outflows (*accout*, a combined measure of *accr* and *acco*): restrictive controls on outflows, if binding, reduce interest rates. The ratio of the outstanding stock of net external liabilities (l) to output reflects a combination of the positive country risk effect and the negative effect on domestic credit demand due to lower private net financial wealth. An additional determinant of domestic private credit demand is the terms of trade (*tot*), also with an ambiguous sign because of opposite substitution and income effects. Macroeconomic policy variables include the ratios of aggregate government spending (g) and real M1 (m) to output. Finally, we include the three main potential arguments of the central bank's monetary policy reaction function: the difference between actual and target inflation, the ratio of actual to trend output, and the ratio of the current account surplus to output.

Two variants of equation (7) are implemented: one for *cbr*, the central bank policy real rate of interest, and the other for *rdep*,

the commercial banks' average real deposit rate. The central bank rate is expected to have a strong effect on the deposit rate (but not vice versa). Both rates are highly correlated, but the central bank's rate shows less variation.[14] In the spirit of a monetary policy reaction function, we estimate the equation for *cbr* controlling for interest rate arbitrage variables and monetary policy objectives. The *cbr* is specified as depending only on lagged variables or polynomials, as the central bank bases its decisions on information with a lag of one month or more.

The results in table 5 for the central bank's policy rate are supportive of equation (7). Regarding the foreign interest arbitrage components, the foreign rate, adjusted for expected real depreciation, falls just short of significance at the 10 percent level, but its coefficient is close to zero.[15] In contrast, the country risk premium is very large and statistically significant. More important are the results regarding URR policy. No significant effect is found for either of the measures of the financial cost of the URR (*urr*, *err*) alone or in combination with the determinants of the interest arbitrage condition.[16]

However, when testing separately for the two main components of the effective cost of URR (*err*), namely, the tax rate (τ) and the power of the URR (*pow*), we find that *pow* matters for setting the policy rate: the role of URR policy in raising domestic interest rates is largely due to its power rather than to the tax rate. During 1991-98, the power of the URR—kept at about 0.7 on average by increasing URR coverage and cracking down on evasion and avoidance—allowed for a rise in the central bank's policy rate of about 110 basis points.

The two traditional determinants of the policy function, the inflation and output gap, are significant in explaining the central bank's policy stance, implying that the central bank raises its policy rate whenever the economy shows signs of overheating. Finally, we tested whether the URR affected the influence of external conditions on the central bank's policy rate. For this purpose we report, in the last column of table 5, a regression with an interactive dummy (with a value of 1 in the period when the URR was operating) that multiplies external conditions (*ext* and ρ). The results show that the URR

14. For monthly observations from 1989-2001 through 2000-12, the contemporaneous correlation between both rates is 0.87. The standard deviation is 0.013 for *cbr* and 0.018 for *rdep*.

15. When r^* and $\hat{e}^e$ are included as separate regressors, the coefficient on $\hat{e}^e$ is significant at the 10 percent level, but its value remains at 0.01.

16. In the latter case the marginal significance level is close to 12 percent.

Table 5. Regression Results for the Real Central Bank Policy Rate of Interest [a]

	Regression coefficient							
	Without interactive dummy when URR is operating						*With interactive dummy when URR is operating*	
Independent variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*Base*	*Change with URR*
$D(r^*) + D(\hat{e}^e_t)$	0.01	0.01	...	...	0.01	0.02	0.01	0.01
	(1.6)	(1.6)	...	...	(1.6)	(1.9)	(0.5)	(0.5)
$D(\rho)$	1.34	1.31	1.32	1.31	1.31	1.16	1.89	–1.89
	(2.5)	(2.5)	(2.6)	(2.6)	(2.6)	(3.1)	(5.0)	(4.1)
$D(err)$	0.05	...	...	...	...	...	...	...
	(0.9)	...	...	...	...	...	...	...
$D(urr)$	...	0.01	...	...	...	...	...	...
	...	(0.1)	...	...	...	...	...	...
$D(r^*) + D(\hat{e}^e_t) + D(err)$	...	...	0.01	...	...	...	...	...
	...	...	(1.6)	...	...	...	...	...
$D(r^*) + D(\hat{e}^e_t) + D(urr)$	...	...	...	0.01	...	...	...	...
	...	...	...	(1.6)	...	...	...	...
$D(\tau)$	...	...	...	...	0.78	...	...	...
	...	...	...	...	(0.9)	...	...	...
$D(pow_{-1})$	...	...	...	...	...	1.7	...	...
	...	...	...	...	...	(2.0)	...	...
$D((\pi - \pi t)_{-4})$	0.08	0.08	0.08	0.08	0.08	0.05	0.08	
	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(1.3)	(2.6)	
$PDL(\frac{y}{\hat{y}}; -1, -2, 1)$	2.19	2.29	2.29	2.29	2.23	1.81	1.57	
	(2.0)	(2.0)	(2.2)	(2.2)	(2.1)	(2.1)	(2.3)	
$D(\frac{cas}{y}_{-1})$	–0.16	–0.14	–0.14	–0.14	–0.17	0.24	–0.44	
	(0.3)	(0.3)	(0.3)	(0.3)	(0.3)	(0.4)	(1.2)	
$D(cbr_{-1})$	0.23	0.23	0.23	0.22	0.22	0.32	0.21	
	(3.6)	(3.4)	(3.5)	(3.5)	(3.5)	(4.3)	(4.0)	
Summary statistic								
Adjusted R^2	0.37	0.37	0.37	0.37	0.37	0.48	0.51	
Durbin's h	0.23	0.22	0.21	0.22	0.28	–0.50	0.37	

Source: Authors' calculations.

a. Results are based on estimation of equation (7) by the ordinary least-squares method. The dependent variable is the first difference of the real central bank policy rate (*cbr*). PDL(*X*; A, B, C) is a polynomial distributed lag for variable *X*, where A and B are the first and last lag, respectively, and C is the order of the polynomial. D(.) is the first-difference operator. The sample period is 1989.1 to 2000.12. Newey-West-consistent *t* statistics are reported in parentheses.

contributed to isolate the central bank policy rate from external shocks, in particular from changes in country risk.

For the banking deposit rate (*rdep*) equation we include the central bank policy rate (*cbr*), the foreign interest arbitrage components, and potential credit demand determinants. The results (table 6) show that the central bank policy rate is the main determinant of the bank deposit rate, with a highly significant coefficient that is numerically very close to 1 and statistically not different from 1. Hence it is not surprising that none of the components of the foreign interest arbitrage condition exert an independent influence on *rdep* (the coefficients on the foreign interest rate plus the expected depreciation and on country risk are not significant) beyond their indirect role through the central bank policy rate. The URR—both its simple and effective cost measures—has a small and only marginally significant effect on the real bank deposit rate: the average effect of the URR on the interest rate is 90 basis points, and the variable is significant at only the 10 percent level. The two main determinants of *err* (τ and *pow*) do not attain conventional significance levels when included separately.

We found a large positive effect of the liberalization of capital outflows on the banking deposit rate; this effect is, on average, marginally significant. Among the credit demand determinants, a higher stock of net foreign liabilities and improving terms of trade both reduce the deposit rate. Deposit rates also exhibit a generally significant procyclical behavior. Finally, fiscal and monetary policies have effects with the expected signs but do not attain conventional significance levels.

The equation estimated for the RER[17] combines determinants of equilibrium in the nontraded goods market, temporary effects of asset market pressures (captured by the difference between domestic and foreign interest rates), and nominal exchange rate pressures. The estimated equation is as follows:

$$\log e_t = \delta_o + \underset{(-)}{\delta_1 rlpt_t} + \underset{(+)}{\delta_2 \left(\frac{e_t l_{t-1}}{y_t}\right)} + \underset{(-)}{\delta_3 \left(\frac{g_t}{y_t}\right)} + \underset{(?)}{\delta_4 tot_t} + \underset{(-)}{\delta_5 \left(\frac{y_t}{\bar{y}_t}\right)} \tag{8}$$

$$+ \underset{(?)}{\delta_6 r_t} + \underset{(+)}{\delta_7 r_t^*} + \underset{(+)}{\delta_8 \hat{e}^e_{t,t+1}} + \underset{(+)}{\delta_9 \rho_t} + \underset{(+)}{\delta_{10} err_t} + \underset{(+)}{\delta_{11} \log E_{t-1}},$$

17. An increase in the RER is a depreciation.

Table 6. Regression Results for the Real Deposit Interest Rate[a]

	Regression coefficient					
Independent variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
$D(r^*) + D(\hat{e}_t^e)$	0.01	0.01	...	...	0.01	0.01
	(0.8)	(0.7)	...	...	(0.7)	(0.7)
$D(\rho)$	0.74	0.67	0.61	0.60	0.61	0.61
	(1.3)	(1.2)	(1.1)	(1.1)	(1.1)	(1.1)
$D(err)$	0.19	...	...	...	...	...
	(1.6)	...	...	...	...	...
$D(urr)$	...	0.26	...	...	...	...
	...	(1.7)	...	...	...	...
$D(r^*) + D(\hat{e}_t^e) + D(err)$	...	...	0.01	...	...	...
	...	...	(0.7)	...	...	...
$D(r^*) + D(\hat{e}_t^e) + D(urr)$	...	...	...	0.01	...	...
	...	...	...	(0.6)	...	...
$D(\tau)$	...	...	...	...	0.88	...
	...	...	...	...	(0.6)	...
$D(pow_{-1})$	...	...	...	...	...	–0.32
	...	...	...	...	...	(1.0)
$D(cbr)$	0.91	0.95	0.99	0.99	0.98	0.98
	(3.5)	(3.7)	(3.5)	(3.5)	(3.6)	(3.6)
$D(accout)$	–0.78	–0.92	–0.79	–0.80	–0.96	–0.93
	(1.4)	(1.6)	(1.5)	(1.5)	(2.0)	(1.8)
$D(\frac{el_{-1}}{y})$	–15.82	–16.14	–16.61	–16.65	–15.67	–16.41
	(1.8)	(1.9)	(1.9)	(1.9)	(1.8)	(1.8)
$D(tot_{-3})$	–4.55	–4.53	–4.53	–4.52	–4.34	–4.23
	(2.1)	(2.0)	(2.0)	(2.0)	(2.1)	(2.0)
$D(\frac{g}{y})$	8.51	8.45	8.58	8.60	6.51	6.44
	(1.5)	(1.5)	(1.6)	(1.6)	(1.3)	(1.3)
$D(\frac{m_{-1}}{y})$	–11.67	–11.36	–8.59	–8.47	–24.19	–23.66
	(0.9)	(0.9)	(0.7)	(0.7)	(1.0)	(1.0)
$D(\frac{y}{\hat{y}})$	2.02	2.25	1.78	1.78	0.59	0.57
	(1.9)	(2.0)	(1.7)	(1.7)	(0.7)	(0.6)
$D(rdep_{-1})$	–0.32	–0.35	–0.39	–0.39	–0.40	–0.39
	(1.1)	(1.2)	(1.3)	(1.3)	(1.3)	(1.3)
Summary statistic						
Adjusted R^2	0.38	0.38	0.37	0.37	0.36	0.36
Durbin's h	0.73	0.64	0.56	0.56	0.56	0.57

Source: Authors' calculations.

a. Results are based on estimation of equation (7) by the ordinary least-squares method. The dependent variable is the first difference of the real deposit interest rate (*rdep*). D(.) is the first-difference operator. The sample period is 1989.1 to 2000.12. Newey-West-consistent t statistics are reported in parentheses.

where *rlpt* is relative labor productivity growth in the traded goods sector, and *E* is the nominal exchange rate. The first six regressors reflect short- and long-term influences of changes in nontraded goods. The next four regressors reflect the temporary influence of asset market pressures arising from the three components of foreign interest arbitrage. Note that the domestic real interest rate has two opposite effects on the RER, consistent with the operation of an expenditure channel and a portfolio channel.[18] The final variable reflects the temporary influence of a nominal devaluation.

We estimate an error correction model in two steps (Engle and Granger, 1987). The cointegration vector for the log of the RER consists of the following determinants of equilibrium in the nontraded goods market: the ratio of government spending to GDP, the ratio of net foreign liabilities to GDP, the relative labor productivity of traded goods, and the terms of trade. The coefficients of all but the last variable display the expected signs and are significant (table 7). In the error correction equation we include the lagged residual from the cointegration relationship and add as regressors selective lags of the business cycle, the terms of trade, the fiscal policy stance, the relative labor productivity of the traded sector, temporary effects of asset market pressures (captured by the domestic-foreign interest rate differential), and nominal exchange rate pressures (table 8).[19] The results show that neither the domestic interest rate nor the components of the foreign interest arbitrage condition (except for the expected real depreciation which has a positive and significant, albeit small, effect) affect the RER.[20] Only when the cost of the URR is subtracted from the domestic-foreign interest rate differential (*gapext*) does this composite variable have a negative and transitory effect on the RER. Hence, confirming previous research, the cost of the URR has at most a temporary influence on the RER, operating through the difference between the domestic interest rate and the foreign arbitrage rate, adjusted by the cost of the URR.

18. A higher real interest rate reduces aggregate demand (the expenditure channel), lowering demand for both nontraded goods (hence tending to cause the currency to depreciate in real terms) and for traded goods (hence raising the current account surplus). On the other hand, a higher real interest rate increases the wedge between domestic and foreign interest rates (the portfolio channel), thus inducing more capital inflows and tending to cause the currency to appreciate in real terms.

19. We also included a term for the rate of depreciation between periods 5 and 6 as expected at period t - 1, to make the actual one-month devaluation horizon consistent with the six-month interest rate parity, in a model that is estimated in first differences.

20. A change in the expected depreciation between periods 5 and 6 of 1 percent causes a spot depreciation of 0.15 percent.

Table 7. Estimation Results of the Cointegration Vector for the Real Exchange Rate[a]

	Regression coefficient	
Independent variable	*(1)*	*(2)*
$\frac{g_t}{y_t}$	–1.11	–1.04
	(0.4)	(0.3)
$\frac{e_t l_t}{y_t}$	1.08	1.07
	(0.1)	(0.2)
rlpt	–0.41	–0.45
	(0.1)	(0.1)
tot	0.09	...
	(0.1)	...
Log likelihood	194.22	193.07

Source: Authors' calculations.
a. The dependent variable is the real exchange rate (*rer*). The sample period is 1989.1 to 2000.12. Estimation is by the Johansen technique. Standard errors are reported in parentheses; constant is not reported.

As in the preceding equation, the specification for net capital inflows reflects both permanent effects of the determinants of goods market equilibrium (that is, of the current account) and temporary influences of asset market pressures (captured by the domestic-foreign interest rate differential). The estimated equation is the following:

$$\frac{e_t\, kf_t}{y_t} = \lambda_o + \lambda_1 (r_t - r_t^* - \hat{e}^e_{t,t+1} - \rho\,\dot{\rho}_t + \lambda_2 err_t + \lambda_3\, accr_t + \lambda_4 acci_t$$
$$(+) \qquad (-) \qquad (+) \qquad (-)$$

$$+ \lambda_5 \left(\frac{e_t l_{t-1}}{y_t}\right) + \lambda_6 \left(\frac{ls_{t-1}}{l_{t-1}}\right) + \lambda_7 \left(\frac{wkf_t}{wy_t}\right) + \lambda_8\, e_t + \lambda_9\, tot_t + \lambda_{10} \left(\frac{g_t}{y_t}\right)$$
$$(-) \qquad (-) \qquad (+) \qquad (-) \qquad (-) \qquad (+)$$

$$+ \lambda_{11} \left(\frac{y_t}{\bar{y}_t}\right) \quad . \qquad (9)$$
$$(+)$$

Table 8. Regression Results of Error Correction Model for the Real Exchange Rate [a]

	Regression coefficient			
Independent variable	*(1)*	*(2)*	*(3)*	*(4)*
$U_{\text{coint}}(-1)$	–0.05	–0.05	–0.06	–0.06
	(2.6)	(2.6)	(3.0)	(3.0)
$D(\frac{y_{t-1}}{\bar{y}_{t-1}})$	–0.05	–0.05	–0.07	–0.05
	(2.6)	(2.4)	(2.5)	(2.6)
$D(\frac{y_{t-2}}{\bar{y}_{t-2}})$	–0.30	–0.30	–0.27	–0.28
	(3.1)	(3.1)	(2.8)	(2.8)
$D(\frac{y_{t-3}}{\bar{y}_{t-3}})$	–0.56	–0.56	–0.53	–0.53
	(4.7)	(4.7)	(5.0)	(5.0)
$D(\frac{y_{t-4}}{\bar{y}_{t-4}})$	–0.55	–0.55	–0.53	–0.53
	(3.9)	(3.9)	(4.1)	(4.1)
$D(\frac{y_{t-6}}{\bar{y}_{t-6}})$	0.15	0.16	0.19	0.19
	(1.9)	(1.9)	(2.3)	(2.3)
$D(rlpt_{-8})$	0.01	0.01	0.01	0.01
	(0.3)	(0.4)	(0.6)	(0.6)
$D(tot_{-1})$	–0.11	–0.11	–0.11	–0.11
	(1.7)	(1.7)	(1.8)	(1.8)
$D(tot_{-3})$	0.02	0.02	0.00	0.00
	(0.4)	(0.4)	(0.0)	(0.0)
$D(tot_{-7})$	0.10	0.10	0.10	0.11
	(1.7)	(1.6)	(1.7)	(1.7)
$D(tot_{-9})$	0.08	0.08	0.07	0.07
	(1.2)	(1.3)	(1.2)	(1.2)
$D(\frac{g_{t-11}}{y_{t-11}})$	0.13	0.13	0.10	0.10
	(1.0)	(1.0)	(0.8)	(0.8)
$D(E_{t-1})$	0.18	0.19	0.18	0.18
	(2.5)	(2.5)	(2.5)	(2.5)
D(*cbr*)	–0.001	–0.001	...	...
	(0.3)	(0.3)	...	...
D(r^*)	–0.005	–0.003	...	...
	(1.0)	(1.0)	...	...
$D(\hat{e}^e_{+6})$	0.002	0.001	...	...
	(2.7)	(2.7)	...	...
D(ρ)	0.003	0.007	...	...
	(0.7)	(0.7)	...	...
D(*err*)	0.001	...	...	...
	(0.3)	...	...	...
D(*urr*)	...	0.001	...	...
	...	(0.6)	...	...
D(*gapext*) – D(*err*)	...	...	–0.001	...
	...	...	(2.0)	...
D(*gapext*) – D(*urr*)	...	...	...	–0.001
	...	...	...	(2.1)
Summary statistic				
Adjusted R^2	0.23	0.23	0.23	0.23
DW	1.70	1.70	1.70	1.70

Source: Authors' calculations.

a. Results are based on estimation of equation (8) by the ordinary least-squares method. The dependent variable is the first difference of the real exchange rate (*rer*). D(.) is the first-difference operator. The sample period is 1989.1 to 2000.12. Newey-West-consistent t statistics are reported in parentheses.

The first regressor reflects the influence of the foreign interest rate differential. The next three regressors reflect the role of capital controls (both *ERR* and administrative controls) on net capital inflows. Next the ratio of the outstanding stock of net external liabilities to output and the ratio of short-term to total net foreign liabilities are included, to take account of a negative country risk effect. In addition, we include a measure of the relative world supply of capital flows to developing countries, *wkf/wy*, to capture international push factors. The final group of regressors reflects the influence of the determinants of the current account deficit on capital inflows. They are identical to the long-term fundamentals of the RER in equation (8), except for the exclusion of the relative labor productivity of the traded sector (*rlpt*) and the inclusion of the RER (*e*). An increase in the RER is expected to reduce the current account deficit and hence net capital inflows.

The overall results in table 9 are mixed. The two measures of the cost of the URR, *urr* and *err*, have the correct sign, but only the latter is statistically significant. This implies that the URR is effective in reducing the flow of foreign capital, but only to the extent that its power is not eroded. Thus, increasing *err* by 100 basis points a year—through some combination of raising its coverage and cracking down on evasion and avoidance, holding *urr* constant—reduces total inflows by about 1 percent of GDP, short-term inflows by 2.2 percent of GDP, and affected inflows by about 2.5 percent of GDP. These results imply a substitution of long-term (unaffected) flows for short-term (affected) flows.

However, the results regarding the other regressors are less satisfactory. Only the determinants of country risk (the ratio of net foreign liabilities to GDP, and the share of short-term debt in total debt), the indexes of administrative controls, and the relative supply of foreign capital to developing countries show the expected signs and attain statistical significance at conventional levels. But all the determinants of the current account and the interest rate differential show the wrong sign (and some have statistically significant coefficients). This leads us to believe that a more serious bias problem may be present in the results reported in table 9.

To check the robustness of these results, we reestimate the previous equation using as a regressor the current account deficit itself instead of its determinants. The results, reported in table 10, show that all coefficients display the expected signs, and except for the index of administrative controls, all attain

Table 9. Regression Results for Capital Inflows[a]

	Dependent variable					
	D(total flows/GDP)		*D(short-term flows/GDP)*		*D(affected flows/GDP)*	
Independent variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
$D(cbr) - D(r^*) - D(\hat{e}^e_{t+6}) - D(\rho)$	–0.01	–0.01	0.00	0.00	–0.01	0.01
	(1.8)	(2.0)	(0.6)	(0.2)	(1.7)	(1.7)
$D(err)$	–0.009	...	–0.022	...	–0.025	...
	(1.8)	...	(3.9)	...	(2.0)	...
$D(urr)$	...	0.000	...	–0.008	...	–0.013
	...	(0.2)	...	(0.5)	...	(0.7)
$D(accr)$	0.58	0.58	...	...	0.62	0.61
	(5.9)	(6.0)	...	...	(5.1)	(4.9)
$D(acci)$	0.07	0.07	...	...	0.14	0.15
	(0.9)	(1.0)	...	...	(1.5)	(1.5)
$D(accf)$	...	...	0.57	0.72	...	...
	...	...	(1.1)	(1.5)	...	...
$D(\frac{e_t l_{t-1}}{y_t})$	–5.46	–5.37	–3.88	–3.68	–4.84	–4.66
	(4.5)	(4.5)	(3.9)	(3.6)	(4.2)	(4.0)
$D(\frac{ls_{t-1}}{l_{t-1}})$	–4.28	–4.32	–6.95	–6.96	–3.89	–3.91
	(5.1)	(5.2)	(9.1)	(8.9)	(3.8)	(3.8)
$D(\frac{wfk}{wy})$	1.93	1.96	1.27	1.25	1.92	1.89
	(2.1)	(2.1)	(1.5)	(1.5)	(1.9)	(1.9)
$D(e)$	1.62	1.62	0.37	0.63	1.37	1.30
	(1.7)	(1.8)	(0.4)	(0.6)	(1.2)	(1.2)
$D(tot)$	0.06	0.08	–0.02	0.01	0.88	0.89
	(0.1)	(0.2)	(0.0)	(0.0)	(1.5)	(1.6)
$D(\frac{g}{y})$	–1.08	–1.18	–1.41	–1.47	–0.76	–0.76
	(1.2)	(1.2)	(1.6)	(1.6)	(0.6)	(0.6)
$D(\frac{y}{\bar{y}})$	–0.88	–1.01	0.14	–0.03	–0.89	–1.01
	(1.3)	(1.5)	(0.2)	(0.0)	(1.1)	(1.3)
Summary statistic						
Adjusted R^2	0.54	0.54	0.53	0.51	0.44	0.42
DW	1.96	1.95	2.00	1.95	2.34	2.30

Source: Authors' calculations.

a. Results are based on estimation of equation (9) by the two-stage least-squares method. The instrumented variables are the real exchange rate and the ratio of actual output to potential output. The instruments are lags of each variable. D(.) is the first-difference operator. The sample period is 1989.1 to 2000.12. Newey-West-consistent t statistics are reported in parentheses; constants are not reported.

statistical significance at conventional levels. Most important, the effective cost of the URR appears to play a marginally significant, negative role in total net capital inflows. Therefore the preceding result, that increasing the *err* by 100 basis points reduces net capital inflows by about 2 to 3 percent of GDP (table 9), is upheld here. This is, again, a temporary effect, as the power of the URR (and hence *err* itself) declines over time for a given interest rate differential. The result regarding the substitution between long-term (unaffected) and short-term (affected) flows is also confirmed.

As a complement to the preceding result, we next test for the effect of capital controls on the composition of outstanding net foreign liabilities, controlling for other return and risk variables that may affect portfolio composition. We specify the following equation for the ratio of short-term to overall net foreign liabilities:

$$\frac{ls_t}{l_t} = \mu_o + \mu_1 r_t + \mu_2 r_t^* + \mu_3 \hat{e}_t^e + \mu_4 err_t + \mu_5 accr_t + \mu_6 \left(\frac{e_t l_{t-1}}{y_t} \right). \quad (10)$$

$$(+) \quad (-) \quad (-) \quad (-) \quad (-) \quad (?)$$

The rationale for the expected signs is similar to that described for equation (9). Only lagged values (PDLs) enter the specification.

The results, presented in table 11, are mixed, as some variables do not exhibit the expected signs or do not reach conventional significance levels. This result notwithstanding, both measures of the cost of the URR unambiguously reduce the share of short-term debt in net foreign liabilities. Also, as expected, lessening the administrative constraints on foreign capital remittances leads to a larger share of short-term foreign liabilities.

3.4 Conclusions

Having tested in various ways for the macroeconomic and financial effects of Chile's capital controls, we derive the following conclusions. First, capital controls themselves have been highly responsive to the domestic and international macrofinancial environment.

Table 10. Regression Results for Capital Inflows Using the Current Account Surplus as Explanatory Variable [a]

	Dependent variable					
	D(total flows/GDP)		*D(short-term flows/GDP)*		*D(affected flows/GDP)*	
Independent variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
$D(cbr) - D(r^*) - D(\hat{e}^e_{t+6}) - D(\rho)$	0.00	0.00	0.01	0.01	–0.00	–0.00
	(0.1)	(0.2)	(2.1)	(1.9)	(0.7)	(0.7)
$D(err)$	–0.017	...	–0.024	...	–0.031	...
	(2.7)	...	(4.6)	...	(2.6)	...
$D(urr)$	...	–0.008	...	–0.015	...	–0.023
	...	(0.6)	...	(1.2)	...	(1.2)
$D(accr)$	0.19	0.19	...	...	0.37	0.37
	(2.9)	(2.8)	...	...	(4.2)	(4.2)
$D(acci)$	–0.01	–0.01	...	...	0.10	0.09
	(0.2)	(0.2)	...	...	(1.4)	(1.3)
$D(accf)$	...	...	0.22	0.24	...	...
	...	...	(0.9)	(1.1)	...	...
$D(\frac{e_t l_{t-1}}{y_t})$	–3.55	–3.39	–2.25	–2.02	–3.47	–3.24
	(4.9)	(4.7)	(3.7)	(3.3)	(3.8)	(3.6)
$D(\frac{ls_{t-1}}{l_{t-1}})$	–2.84	–2.83	–5.74	–5.70	–3.08	–3.06
	(5.2)	(5.2)	(8.6)	(8.3)	(3.6)	(3.6)
$D(\frac{wfk}{wy})$	1.95	1.91	1.46	1.37	1.78	1.67
	(2.8)	(2.7)	(2.1)	(2.1)	(1.9)	(1.8)
$D(\frac{cas}{\bar{y}})$	–0.81	–0.82	–0.72	–0.71	–0.57	–0.56
	(6.4)	(6.5)	(4.6)	(4.6)	(4.1)	(4.1)
Summary statistic						
Adjusted R^2	0.69	0.68	0.61	0.60	0.50	0.49
DW	2.17	2.13	2.24	2.20	2.52	2.48

Source: Authors' calculations.

a. Results are based on estimation of equation (9) by the two-stage least-squares method. The current account surplus is instrumented using lags of itself, the terms of trade, the ratio of government expenditure to GDP, and lags of the exchange rate and the ratio of actual to potential output. D(.) is the first-difference operator. The sample period is 1989.1 to 2000.12. Newey-West-consistent t statistics are reported in parentheses; constants are not reported.

Table 11. Regression Results for the Portfolio Share of Short-Term Net Foreign Liabilities in Total Net Foreign Liabilities [a]

	Regression coefficient	
Independent variable	*(1)*	*(2)*
PDL(D(*rdep*); –1, –5, 2)	0.00	0.00
	(0.89)	(1.15)
PDL(D(r^*); –1, –5 ,2)	0.08	0.01
	(1.84)	(1.87)
PDL(D($\hat{e}^e$); –1, –5, 2)	0.00	0.00
	(1.63)	(1.69)
PDL(D(*err*); –1, –5, 2)	–0.01	...
	(2.69)	...
PDL(D(*urr*); –1, –5, 2)	...	–0.01
	...	(1.56)
PDL(D($\frac{e_t l_{t-1}}{y_t}$); –5, –10, 3)	–0.61	–0.58
	(2.91)	(2.67)
PDL(D(*accr*); –1, –12, 3)	–0.13	–0.14
	(4.10)	(4.34)
Summary statistic		
Adjusted R^2	0.15	0.14
DW	1.84	1.83

Source: Authors' calculations.
a. Results are based on estimation of equation (10) by the ordinary least-squares method. PDL (*X*; A, B, C) is a polynomial distributed lag for variable *X*, where A and B are the first and last lag, respectively, and C is the order of the polynomial. D(.) is the first-difference operator. The sample period is 1989.1 to 2000.12. Newey-West-consistent *t* statistics are reported in parentheses; constants are not reported.

The Central Bank of Chile put the URR in place in order to retain monetary control, stem overall capital inflows (and short-term and financial inflows in particular), and maintain international competitiveness. Our results confirm these policy objectives. Both the simple measure (*urr*) and the effective measure (*err*) of the cost of the URR increase with total capital inflows, the level of short-term flows, and the level of currency appreciation (*err* also responds to the difference between actual and target inflation). In addition, the central bank

responds to the decline in tax power (due to evasion and avoidance) by raising the cost and coverage of the URR through various changes in its administration. Separately, we also obtained results on the intensity of administrative controls on capital outflows: these tend to respond to similar variables as the URR and have been used as a complement to the latter.

Second, in the context of a monetary policy reaction function, complemented by imperfect foreign interest arbitrage, we found that, after controlling for the significant influence of policy objectives, the power of the URR has a significant positive effect on the central bank policy rate. Hence the URR has allowed for a certain isolation of the monetary policy interest rate from external influence. Subsequently we focused on the real bank deposit rate and found the central bank policy rate to be its main determinant. Only small direct effects were found for both *err* and *urr*. Hence *err* has mainly exerted an indirect influence on the bank deposit rate. This stands in contrast to controls on outflows: lowering the latter throughout the 1990s helped in raising the bank deposit rate.

Third, estimation of an error correction model for the RER, which reflects temporary and permanent influences of other equilibrium forces, did not find significant effects of Chile's capital controls on this variable. This may be due to offsetting short- and medium-term effects of larger capital controls on the RER, as suggested by the model sketched in Gallego, Hernández, and Schmidt-Hebbel (1999).

Fourth, a similar model, reflecting the influence of variables that affect investment-saving decisions and temporary effects due to domestic-foreign interest rate differentials, was estimated for net capital inflows. Total net inflows were reduced significantly by the *err* (but not by the alternative *urr*). Moreover, there is some weak evidence that the *err* reduced some categories of capital flows proportionately more, implying substitution between tax-exempt flows, on one hand, and short-term and URR-affected flows, on the other. An alternative portfolio composition equation for the share of short-term assets in total net foreign liabilities shows a significant negative effect of both *urr* and *err*. Hence the URR has unambiguously changed the composition of total net foreign liability flows and stocks away from short-term (affected) flows and toward medium and long-term (unaffected) flows.

4. Pros and Cons of the URR: An Overall Assessment

We have analyzed the Chilean experience with capital controls during the 1990s, extending the existing literature on the subject in three dimensions. We broadened the concept of the URR to take into account changes in its effectiveness over time. We constructed indicators for other administrative restrictions on capital flows. Finally, we extended the sample period to include those before and after the URR was in place.

From our empirical analysis we distill, in this section, several main findings and assess the overall pros and cons of capital controls. Since our results are based on a single country experience, our final remarks will refer to the potential risks of adopting Chilean-type capital controls in other countries.

4.1 Potential Benefits of the URR

Monetary Independence

Capital controls in general and the URR in particular can contribute to a greater degree of monetary autonomy. Since the controls introduce a wedge between domestic and foreign interest rates, they provide more space for the conduct of an independent monetary policy. Our results show that this benefit was partly achieved in the case of Chile. The interest rate differential supported by the URR (more precisely, by its power) was, on average, relatively small (about 100 basis points) and temporary.

External Competitiveness

The URR should lead in the short run to a more depreciated currency in real terms (and therefore to a more competitive export sector), but its long-term effect may be a real appreciation. Our results support this ambiguity by showing that the introduction of the URR did not significantly affect the RER.

External Indebtedness

The URR is expected to lead to smaller capital inflows, thereby reducing overall foreign indebtedness. Our results validate this view:

the URR led to a fall in capital inflows, although this effect is temporary in nature due to the eventual loss of power of the URR.

Composition of Inflows

The URR is expected to change the composition of capital inflows toward longer maturities, making the recipient country more resilient to shocks. Our results show indirectly that this result was attained in the case of Chile. The introduction of the URR led to a distribution of external liabilities that was skewed toward long-term liabilities.

Overall, through the last two of these channels, the URR may have contributed to a stronger external position of the Chilean economy. This may have reduced the risk of a sudden and large reversal of capital inflows—and of ensuing recession and financial crisis—when external conditions deteriorated in the aftermath of the 1997 Asian crisis.[21] This benefit should not be overlooked despite the difficulties associated with measuring it. However, when trying to draw the relevant policy lessons, it should be kept in mind that these benefits are temporary in nature and can be realized only if the central bank is very active in maintaining the effectiveness of the URR. The speed with which the URR loses its effectiveness indicates that its benefits start to diminish soon after it is introduced.

4.2 Potential Costs of the URR

Quasi-Fiscal Losses

The URR can lead to quasi-fiscal losses because it loses its effectiveness over time and, for a given interest rate differential sought by the authorities, may induce a rapid accumulation of foreign reserves. The Chilean experience shows that the net cost associated with funding the resulting excess reserves is not negligible (Gallego, Hernández, and Schmidt-Hebbel, 1999).

Misallocation of Resources

Since the URR tends to raise short-term interest rates proportionately more than longer rates, it contributes to an inefficient

21. However, Edwards (1999) shows that the URR was unable to isolate Chile from the very large financial shocks of 1997-99, as it contributed only to lower stock market instability.

allocation of resources. In particular, the URR discriminates against short-term projects and those sectors that are more dependent on bank financing. In addition, there are costs associated with the search for loopholes and with their closure. Although this cost has not been measured for Chile, it is likely that its burden has fallen proportionately more on small and medium-size firms (Edwards, 1999).

Investment and Growth

The increase in domestic interest rates caused by the URR reduces investment and long-term growth. The results presented in Gallego, Hernández, and Schmidt-Hebbel (1999) show that in the absence of the URR—and with a less restricted monetary stance—Chile could have attained somewhat more rapid growth during the 1990s.

4.3 Final Remarks

It is important to keep in mind that the effectiveness of the URR in the case of Chile was due, to a large extent, to the strong enforcement capacity of the Central Bank of Chile, to a long tradition of compliance with the law, and to relatively low levels of corruption. Chilean-type capital controls could be less effective and, in the extreme, could lead to more corruption in countries with a weaker institutional and legal environment.

The URR applied by Chile also has to be understood as a complementary and temporary tool aimed at improving the policy trade-off between the objectives of price stabilization and external competitiveness, in conjunction with exchange rate flexibility limited to a crawling exchange rate band. In other countries, capital controls could be inappropriately adopted to delay implementation of necessary reforms in the financial system or the public sector. This was not the case in Chile, which has a solid, highly capitalized, and well-regulated financial sector, complemented by a strong fiscal stance since the mid-1980s.

Despite the difficulties in assessing its net benefits and costs, Chilean-type capital controls should be understood as part of a policy mix during the country's transition to full financial integration and a truly floating exchange rate regime. The policy mix also comprises strengthening the financial system and improving public finances. In the long run, adequate regulation of banks and corporations, avoidance of government guarantees that lead to excessive foreign

indebtedness, a more developed and sophisticated financial system, and a strong fiscal stance should replace capital controls, in particular within a context of floating exchange rates.

APPENDIX A

Empirical Studies on Chile's Unremunerated Reserve Requirement: Summary of Methodologies and Main Results

Study by	*N. Eyzaguirre and K. Schmidt-Hebbel (1997)*	*Comments*
Frequency, period	Monthly, 1991-96	Only comprises the period when the URR was operating
Theoretical model	Yes; portfolio equilibrium (macro) model	
Empirical model	One equation model in all cases; URR enters the equations linearly	Treats URR as an endogenous variable (estimates an equation for this purpose)
Control for		
sterilization	Does it indirectly by putting the CB set rate as an explanatory variable in the interest rate equation	
scale flow variable	No	
capital outflow liberalization	No	
trade volume (credit)	No	
country risk rating		
domestic interest rate set by the CB	Yes (see above)	
Dependent variable	Short-term interest rate; flow composition; real exchange rate and URR (also ΔNFA)	
Hypothesis tested	URR on interest rates, flows (composition), and the real exchange rate	
Conclusion	The URR has increased interest rates (though the results are not very robust), and through this channel it has reduced the CAD (though these results are rather weak). Similarly, the URR would have a small and transitory effect on the real exchange rate (though the results are not very robust) The URR has a strong effect on the composition of inflows	The URR responded (Δ^+) to movements in the real exchange rate (appreciation) Same pitfalls as in the previous studies regarding loopholes, re-labeling, and control for other capital controls

APPENDIX A (continued)

Study by	*C. Soto (1997)*	*Comments*
Frequency, period	Monthly, 1991-96	Comprises no period before and after the URR
Theoretical model		Uses back of the envelope (simple) formula
Empirical model	Structural VAR	
Variables included	- Domestic interest rate - Capital control index - Real exchange rate - Real exchange rate volatility - Capital flows, level and composition	
Conclusion	URR affects, though in a small amount and on a transitory basis: - the domestic interest rate (increases) - the nominal (and real) exchange rate (depreciates) - and real exchange rate volatility (falls) In the long-term the URR affects flows composition (skewed toward longer term)	Same pitfalls as in previous studies regarding loopholes, re-labeling, and control for other capital controls

APPENDIX A (continued)

Study by	*S. Edwards (1998)*	*Comments*
Frequency, period	Monthly, 1988-96	
Theoretical model	No	
Empirical model	Single equation models for the interest rate differential	The existence of URR is incorporated using a dummy variable for the period 1993-98.
Control for		
sterilization	No	
scale flow variable	No	
capital outflow liberalization	No	
trade volume (credit)	No	
country risk rating	No	
domestic interest rate set by the CB	No	
Dependent variable	Interest rate differential	
Hypothesis tested	URR changed the dynamic behavior of the interest rate differential	
Conclusion	URR increased the inertia of the interest rate differential, but it did not have any significant effect on the differential itself	Same pitfalls as in previous studies regarding loopholes, re-labeling, and controlling for other capital controls This is important because the author uses a constant variable for the 1993-98 period, while the available information suggests that the economic importance of capital controls changed significantly during that period

APPENDIX A (continued)

Study by	*B. Laurens and J. Cardoso (1998)*	*Comments*
Frequency, period	Quarterly, 1989-94 and 1985-94	Comprises part of the period when inflows were not voluntary (1985-88) and no period after the URR
Theoretical model	No; partial equilibrium, single equation	URR enters in a non-linear way in the estimation
Empirical model		
Control for		
sterilization	No	
scale flow variable	No	
capital outflow liberalization	No	
trade volume (credit)	No	
country risk rating	No	
domestic interest rate set by the CB	Use interest rate differential from abroad	
Dependent variable	Total flows, short-and long-term flows separately	
Hypothesis tested	Whether flows respond to the URR	
Conclusion	No long-term effect on total capital inflows, the exchange rate, or interest rates (though no formal test is provided for the claim on the latter two variables); short-term negative impact on total flows; results are mixed regarding the composition of flows since a drop in short-term flows reverses after a few quarters (but a chart shows a decrease in the share of short-term flows in the total)	The way the model is set casts serious doubts on the validity of the authors' results. The capital control index—right hand side variable—has the dependent variable on it: it is calculated as flows times the tax rate. Same pitfalls as in Valdés and Soto regarding loopholes, re-labeling, and control for other capital controls

APPENDIX A (continued)

Study by	*S. Valdés-Prieto and M. Soto (1998 and 2000)*	*Comments*
Frequency, period	Quarterly 1987-96	Comprises part of the period when inflows were not voluntary (1987-88) and no period after the URR
Theoretical model	Yes; partial equilibrium, single equation	Uses back of the envelope (simple) formula; URR enters in a non-linear way in the estimation
Empirical model		
Control for		
sterilization	Yes	Change in CB's net foreign assets as share of GDP
scale flow variable	C.A balance for LAC countries	As a share of Chile's GDP
capital outflow liberalization	No	
trade volume (credit)	Yes	
country risk rating	Use S&P rating	Takes value of 1 when investment grade; 0 otherwise
domestic interest rate set by the CB	Yes	Endogenous variable
Dependent variable	Short-term credit flows from Balance of Payments net of URR plus Errors and Omissions	Errors and omissions captures exempt flows
Hypothesis tested	URR on ST flows (and on the Real Exchange Rate in previous paper)	
Conclusion	Effective only for taxed flows. Ineffective for total short-term flows except marginally for high URR rates; i.e., in 1995-96 Previous study finds no systematic effect on Real Exchange Rate	- Does not control for re-labeling - Does not control for loopholes closing (intensity and effectiveness of the URR) - Does not control for changes in other capital controls

APPENDIX A (continued)

Study by	*S. Edwards (1999)*	*Comments*
Frequency, period	Monthly, 1991-98; Weekly, 1994-99	
Theoretical model	No	
Empirical model	GARCH models for the nominal short-term interest rate and the stock market price index. Semi-structural VAR	URR enters linearly in all equations and is treated as endogenous in the VAR
Variables included in the VAR	- URR - Change in the real exchange rate - Rate of nominal devaluation - Domestic interest rate - Interest rate on US 3 month certificates (exogenous)	
Hypothesis tested	URR affected domestic interest rate and real exchange rate.	
Conclusion	URR increases the level of domestic interest rate but has no effect on real exchange rate. URR reduces the volatility of the stock market prices but has no effect on the volatility of interest rates	Same pitfall as in previous studies regarding loopholes, re-labeling, and controlling for other capital controls. The GARCH estimation is quite simple and it could be sensible to the imposed structure

APPENDIX A (continued)

Study by	*J. De Gregorio, S. Edwards and R. Valdés (2000)*	*Comments*
Frequency, period	Quarterly 1987-96 and Monthly 1991-98	Comprises part of the period when inflows were not voluntary (1987-88) and no period post URR
Theoretical model	Yes, for the derivation of the URR formula	In the empirical part uses a simple back of the envelope calculation; also a power index aimed at capturing the lack (or presence) of loopholes is used
Empirical model	One equation models in all cases plus VARs, linear effect	URR enters linearly in all the equations. Treats URR as an endogenous variable in the VAR
Control for		
sterilization	No	
scale flow variable	Yes, but resulted being insignificant	
capital outflow liberalization	No	
trade volume (credit)	No	
country risk rating	Yes (relative to other countries)	
domestic interest rate set by the CB	(used as a dependent variable in the interest rate equation)	Controls for the determinants of the CB policy (domestic inflation) instead
Dependent variable	Interest rates; total and short term-flows; real exchange rate	
Hypothesis tested	URR on interest rates, flows (composition), and the real exchange rate	
Conclusion	The URR does permit higher domestic interest rates and skew capital inflows toward long-term flows on a permanent basis; however, the real exchange rate is not affected	In the VAR estimations they find that the real exchange rate depreciates, on a transitory basis, with the increase in the URR; bottom line: there is no conclusive evidence on the effect on the real exchange rate. Innovation: they use a power index which is constructed according to the authors' subjective opinions

APPENDIX A (continued)

Study by	*S. Edwards (2000)*	*Comments*
Frequency, period	Weekly, 1994-99	
Theoretical model	No	
Empirical model	Semi-structural VAR	The effect of capital controls in the level of contagion is indirectly tested through a split in the sample
Variables included in the VAR	- Cyclical component of the non Latin American EMBI index - Cyclical component of the Latin American EMBI index - Rate of change in the value of the Mexican and Chilean peso vis-à-vis the US$ - A measure of the expectations of devaluation in Argentina - Argentine, Mexican, and Chilean 90-day deposit rate in domestic currency - Interest rate on US 30 years bond (exogenous)	
Hypothesis tested	URR affected the level of contagion of domestic interest from external shocks	
Conclusion	URR was not able to isolate Chilean interest rates from the external shocks of late 1997. The benchmark is the level of contagion of Argentina and Mexico.	Same pitfalls as in previous studies regarding loopholes, re-labeling, and controlling for other capital controls.

APPENDIX A (continued)

Study by	*F. Larraín, R. Labán, and R. Chumacero (2000)*	*Comments*
Frequency, period	Quarterly, 1986-97	Comprises part of the period when inflows were not voluntary (1987-88) and no period post URR
Theoretical model	Threshold model. Endogenously determined regimes	
Empirical model	Short-term taxed, short-term exempt, and long-term flows separately	URR enters trough interest rate differential or directly in the short-term equations
Control for		
sterilization	No	
scale flow variable	No	
capital outflow liberalization	No	
trade volume (credit)	No	Does it indirectly by putting the investment to GDP ratio
country risk rating	Use the ratio of debt to GDP and the GDP growth rate	
domestic interest rate set by the CB	use interest rate differential from abroad	
Dependent variable	Short-term taxed, short-term exempt, and long-term flows	
Hypothesis tested	Determinants of different types of capital flows to Chile change in different regimes	Uses threshold models to identify switching regimes
Conclusion	The URR has no effect on long-term capital, a negative effect on short term taxed flows (through the gap between internal and adjusted external rates), and a positive (but transitory) effect on exempt short-term flows. The effect of the URR operates in a non-linear way because it depends on the regime	The estimated equations are simple (probably reflecting reduced form equations) and consequently they do not control for a number of relevant variables. Same pitfalls as in previous studies regarding loopholes, re-labeling, and controlling for other capital controls

APPENDIX B

Data Sources and Definitions

Variable and abbreviation	*Description*	*Source*
Effective (*err*) and simple (*urr*) cost of the unremunerated reserve requirement (URR)	Constructed using equation (3)	Gallego, Hernández, and Schmidt-Hebbel (1999)
Actual (π) and target (πt) inflation	Monthly inflation targets calculated from linear interpolation of Central Bank of Chile December-to-December targets	Authors' calculations based on Central Bank of Chile data
Real exchange rate (*e*)		Central Bank of Chile
Policy interest rate (*cbr*)	CPI-indexed rate on 90-day Central Bank of Chile paper until June 1995; interbank lending rate thereafter	Central Bank of Chile
Deposit interest rate (*rdep*)	Rate on 91- to 365-day deposits	Central Bank of Chile
Total (*kf*), long-term (*kfl*), short-term (*kfs*), and affected (*kfa*) capital inflows to Chile		Central Bank of Chile
Aggregate capital flows to emerging market economies (*wfk/wy*)	Monthly interpolation of the ratio of aggregate capital flows to emerging market economies to world output, using the RATS routine	Authors' calculations based on International Monetary Fund, *World Economic Outlook*, various issues
URR power index (*pow*)	Constructed using equation (2)	Gallego, Hernández, and Schmidt-Hebbel (1999)
URR tax rate (τ)		Central Bank of Chile
Administrative controls on capital flows (*accf*), on capital outflows (*accout*), on capital remittances (*accr*), on capital issues (*acci*), and on other capital account transactions (*acco*)		Gallego, Hernández, and Schmidt-Hebbel (1999)

APPENDIX B (continued)

Variable and abbreviation	*Description*	*Source*
Foreign real interest rate (r^*)	Constructed as the 180-day London Interbank Offered Rate on dollars, adjusted for six-month-ahead projections of the U.S. inflation rate (inflation projected using an ARIMA model for the U.S. consumer price index)	Authors' calculations based on Central Bank of Chile data
Expected currency depreciation ($\hat{e}^{\,e}$)	Estimated as projection from rolling regressions for the six-month rate of depreciation	Authors' calculations
Country risk premium (ρ)	Premium on international bonds issued by Chilean corporations	Authors' calculations based on Central Bank of Chile and the JP Morgan Emerging Markets Bond Index (EMBI) data
GDP (y)	Monthly GDP estimated by related series using the monthly aggregate production index (IMACEC)	Authors' calculations based on Central Bank of Chile data
Terms of trade (*tot*)		Bennett and Valdés (2001)
Current account surplus (*cas*)		Central Bank of Chile
Government expenditure (g)	Monthly interpolation of public absorption using the RATS routine	Ministry of Finance and authors' calculations
Money stock (M1)		Central Bank of Chile
Relative labor productivity growth in the traded goods sector (*rlpt*)	Constructed using the methodology of Valdés and Délano (1999)	Author's calculations based on Central Bank of Chile and National Bureau of Statistics data
Nominal exchange rate (E)		Central Bank of Chile
Trend output ($\bar{y}$)	Estimated using the Hodrick-Prescott filter	Authors' calculations
Total (l) and short-term (sl) net foreign liabilities.	Calculated from monthly flows applied to the initial stock estimated by Milesi-Ferretti (1998) for December 1988.	Authors' calculations.

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The 1997-98 Liquidity Crisis: Asia versus Latin America

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Four years after its outbreak, the Asian crisis continues to confound experts: a region whose countries had long been considered paragons of successful economic development is mired in financial collapse and deep recession. By contrast, Latin America—with the important exceptions of Brazil and Ecuador—managed to avoid crisis-like situations in 1997-99, in spite of that region's checkered financial past.

It is tempting to blame the severity of the Asian crisis on the idiosyncrasies of the situation there. In the aftermath of the crisis there was no shortage of attempts to identify an unprecedented syndrome and develop a new theory to go with it. Authoritarian politics, cronyism and corruption, government guarantees to banks and moral hazard, overinvestment and inefficiency, inflated asset prices, and a number of other factors have been variously singled out as peculiar causes of Asia's economic distress. However, many of these factors were also present in other countries where crises did not erupt in the late 1990s. The new theories also fail to explain why such factors were not identified as essential in the genesis of previous crises.

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Of course, one may try to argue that policies were crazier and governments more corrupt in Asian countries than anywhere else, and that analyses of previous crises missed the role of such factors. But such a reaction would be misguided. The Asian crash is not an unprecedented event. Instead it can and should be understood as a conventional financial crisis, made possible by the illiquidity of the financial sector, the likes of which we have seen before in so-called emerging markets. Chile in 1982 and Mexico in 1994 provide the clearest, but by no means the only, precedents. These crises have five distinguishing elements:

• *International illiquidity*, which sometimes results in outright collapse of the financial system (often but not always the commercial banks), is at the center of the problem. The key issue is a mismatch of assets and liabilities: a country's financial system is internationally illiquid if its potential short-term obligations in foreign currency exceed the amount of foreign currency to which it can have access on short notice. As we discuss later (and have argued at length in Chang and Velasco, 2000a, 2001), the concept of international illiquidity is crucial, for it involves a fragile situation: it is a key condition for financial and balance of payments crises.

• The illiquidity of the financial system is almost always rooted in a previous bout of *financial liberalization*, which accentuates the maturity mismatch between international assets and liabilities. In addition, *capital flows from abroad*, caused by an opening of the capital account, falls in world interest rates, or both, magnify the problem by making available huge amounts of resources to be intermediated by domestic banks. If short in maturity, as they were in the latter stages of the Mexican 1994 and Asian episodes, additional foreign loans can sharply increase the vulnerability of domestic banks: a creditors' panic, that is, creditors' refusal to roll over these short-term loans, may render a self-fulfilling bank run possible.

• *Bad policy*, in the conventional sense of unsustainably large, money-financed deficits, need not be to blame. A striking fact shared by Chile in 1982, Mexico in 1994, and Asia in 1997 is that governments in all of them were running either surpluses or small deficits. The problem may only become fiscal ex post, in the sense that the cost of the bailout deteriorates the fiscal position.

• *The collapse of a fixed exchange rate regime* occurs because the objectives of stabilizing banks and keeping the exchange rate peg become mutually incompatible. To help the banks, the central bank

must pursue an expansionary policy, either to keep interest rates from rising (and further wreck the banks) or to provide lender-of-last-resort funds. But in either case private agents will use the additional domestic currency to buy reserves, eventually causing the collapse of the fixed exchange rate. It is in this sense that we observe "twin crises": a financial crisis and a balance of payments crisis.

• *The punishment far outweighs the crime*. Moderately weak fundamentals (especially real exchange rate overvaluation) and small changes in exogenous circumstances (the terms of trade, world interest rates) can cause large changes in asset prices and economic activity. The magnifying mechanism is the financial system, whose collapse causes costly asset liquidation and an unnecessarily large credit crunch.

In previous work (Chang and Velasco, 2000a and b, 2001) we have discussed theoretical aspects of classic financial crises in open economies and argued that, by and large, the recent Asian crises fit the pattern just described.[1] In this paper we focus more sharply on why the crises hit Asia but (for the most part) not Latin America. We argue that what saved Latin America in the recent past was not a stronger set of macroeconomic fundamentals (many Latin countries, for instance, had substantial real exchange rate appreciation and nontrivial current account deficits) but a stronger financial position. In contrast, the Asian countries were in a situation of international illiquidity evidenced by sharply rising ratios of hard-currency short-term liabilities to liquid assets. This made them extremely vulnerable to a reversal of capital inflows, which occured massively in the second half of 1997.

Financial fragility in Asia had its roots in inappropriate microeconomic policies followed during previous years. As we document below, financial liberalization measures in Asia resulted in a deterioration of the international liquidity position of the financial system. These measures, carried out at a time of large capital inflows, created the conditions for a crisis. Much of the borrowing was

1. Our view of crises has been heavily influenced by the previous work of Guillermo Calvo (in particular, see Calvo, 1995, 1996). A partial and chronological list of other papers discussing factors relevant to this view includes Díaz-Alejandro (1985), Velasco (1987), Dornbusch, Goldfajn, and Valdés (1995), Calvo and Mendoza (1996), Frankel and Rose (1996), Kaminsky and Reinhart (1996), Sachs, Tornell, and Velasco (1996a, b, and c), Sachs (1997), Goldfajn and Valdés (1997), Corsetti, Pesenti, and Roubini (1998), and Radelet and Sachs (1998).

in dollars and, especially in the period right before the crisis, short term. These two factors left domestic banks exposed to exchange rate risk and to the mood swings of lenders, who had to roll over large loan volumes at short intervals. By contrast, the Latin American countries, having gone through their cycle of financial liberalization and collapse in the 1980s and early 1990s, have followed much more cautious policies in recent years.

The paper is organized as follows. Section 1 reviews the "conventional" macroeconomic fundamentals in a group of Asian and Latin American countries in recent years and shows that they alone cannot account for the differences in performance between the two regions. Section 2 presents the key concept of international illiquidity and discusses its relation to crises. Section 3 examines evidence showing that such a condition did in fact characterize the Asian precrisis situation but did not exist in Latin America. Section 4 discusses three factors—financial liberalization, a shift in the foreign debt structure toward shorter maturities, and the currency denomination of assets and liabilities—that explain how the Asian countries but not the Latin American ones became internationally illiquid. Section 5 discusses how the potential for a crisis implied by international illiquidity translated into an actual financial crash and the collapse of fixed exchange rates in Asia. Section 6 concludes with a discussion of policy implications.

1. Macroeconomic Fundamentals in East Asia and Latin America

Can differences in traditional macroeconomic fundamentals—such as fiscal deficits, the real exchange rate, or the current account—explain the sharp differences in recent performance between Asia and Latin America? To look for the answer, table 1 presents basic macroeconomic data for the so-called Asean-5 countries (Indonesia, Korea, Malaysia, the Philippines, and Thailand) and for five of the larger Latin American economies (Argentina, Brazil, Chile, Mexico, and Peru).

We begin with fiscal policy. The classic Krugman (1979) crisis model blamed money-financed budget deficits for the erosion of reserves and the eventual collapse of an exchange rate peg. This focus corresponded well to the facts in some currency crises in emerging markets—Mexico in 1976 and Argentina, Brazil, Peru, and (again)

Table 1. Basic Macroeconomic Data for the Asean-5 and Selected Latin American Countries

Percent

Country	*Real GDP growth*		*Inflation*		*Government balance as a share of GDP*		*Saving as a share of GDP*		*Investment as a share of GDP*	
	Average 1990-96	*1996*	*Average 1990-96*	*1996*	*Average 1990-96*	*1996*	*Average 1990-96*	*1996*	*Average 1990-96*	*1996*
Asean-5										
Indonesia	7.3	8.0	8.6	6.4	−0.2	0.0	28.4	30.6	33.4	32.7
Korea	7.7	7.1	6.4	4.9	−0.5	0.2	35.4	33.9	36.5	36.8
Malaysia	8.8	8.6	4.0	3.6	−0.4	−0.5	34.6	40.6	37.0	42.2
Philippines	2.8	5.7	10.7	8.4	−2.2	−0.5	19.1	22.7	22.5	23.9
Thailand	8.5	5.5	5.1	5.9	2.6	1.5	28.6	31.5	40.3	42.5
Latin America										
Argentina	4.8	4.3	35.8	0.2	−1.3	−2.0	18.2	20.3	17.1	17.6
Brazil	1.8	2.9	1,069.8	18.2	−0.9	−3.9	20.1	17.1	19.6[a]	19.2[a]
Chile	6.8	7.2	12.8	7.3	1.8	2.0	26.7	26.2	23.5	24.5
Mexico	1.2	5.1	20.7	34.4	−0.1	0.4	19.2	22.4	18.5	17.2
Peru	3.8	2.6	96.4	11.6	−2.7	0.0	19.8	21.3	18.4	22.7

Source: International Monetary Fund, *International Financial Statistics*, various issues; JP Morgan, *Emerging Markets: Economic Indicators*, various issues; Economic Commission for Latin America and the Caribbean, *Statistical Yearbook for Latin America and the Caribbean*, various issues.
a. Data are averages for 1990-95 and 1995; 1996 data were unavailable.

Mexico in the early and mid-1980s—which could readily be attributed to fiscal irresponsibility.

A first noteworthy characteristic of the Asian economies is that their fiscal performances were rather different from this now-conventional model of fiscal indiscipline. Moderate fiscal deficits in a few countries (Korea, Malaysia, and especially the Philippines) in the early 1990s had been virtually eliminated by 1996 (top panel of table 1). In fact, these countries were so prudent that they were often lauded for their tightening of fiscal policy in response to capital inflows and incipient overheating.[2]

As the bottom panel of table 1 shows, the recent fiscal performance of the Latin American countries was quite prudent as well. In the 1990s Latin America carried out a massive fiscal adjustment. By 1996 only Brazil still displayed a sizable deficit, and three of the five countries in our group enjoyed either balanced budgets or fiscal surpluses.

As a result of their relatively strong fiscal stance, public debt figures for all of these economies were reassuring. Although available

2. See, for instance, Corbo and Hernández (1994).

statistics for total public debt do not allow for a comparison between the two groups of countries, statistics for public foreign debt do and are presented in table 2.[3] The table shows that public foreign debt during the 1990s was typically less than one-third of GDP and on a falling trend in every case. No clear cross-regional differences emerge.

Also as a result of fiscal prudence, in almost all the countries under review, monetary growth could be kept reasonably tight, resulting in low (or at least falling) inflation. Table 1 shows that, in Asia, annual inflation in the 1990s was held at 10 percent or less, with no clear tendency to increase in any of the countries. Performance was not quite as strong in Latin America—and naturally so, for only a few years earlier several of the countries had been in the throes of hyperinflation. Nonetheless, table 1 shows that by 1996

Table 2. Public and Publicly Guaranteed Foreign Debt for the Asean-5 and Selected Latin American Countries

Percent of GNP

Country	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*
Asean-5							
Indonesia	44.0	42.3	40.4	37.6	37.5	33.9	27.8
Korea[a]	8.3	11.5	11.5	10.9	10.0	9.0	8.6
Malaysia	28.3	28.1	22.7	22.6	20.3	19.8	16.6
Philippines	54.0	54.4	47.1	49.6	46.0	39.2	32.1
Thailand	14.7	13.7	12.2	12.0	11.6	10.3	9.4
Latin America							
Argentina	34.7	25.9	21.2	20.4	20.1	20.1	21.4
Brazil	20.6	22.8	24.6	21.7	17.4	14.4	12.9
Chile	36.6	30.9	23.5	20.1	17.9	11.2	6.8
Mexico	29.9	25.4	20.1	19.1	19.5	34.6	29.1
Peru	42.8	56.6	38.2	41.1	36.5	33.2	34.4

Source: World Bank, *Global Development Finance*, various issues.
a. Data are percentages of GDP as of the end of the year and are from the International Monetary Fund.

3. The difference between total public debt and foreign public debt, that is, domestic public debt, has been small or negligible in all cases but Malaysia and Brazil. In the case of Malaysia, ringgit-denominated debt was considerably larger than foreign private debt. As a consequence, Malaysia's total public debt was much larger than the foreign share shown in table 2, reaching 81.3 percent of GDP in 1990. However, it fell in the ensuing years, to 42.8 percent of GDP in 1995. For Brazil, Bevilaqua and others (1998) report that total public debt increased from 28.5 percent of GDP at the end of 1994 to 34.4 percent at the end of 1996; in 1997 it seems to have stabilized at 34.5 percent. This increase reflects the increasing importance of public debt and, in this sense, is consistent with the decrease in the foreign share of public debt shown in table 2. Note, however, that the level of the Brazilian public debt is small, in particular relative to that of some OECD countries.

inflation was moderate and decreasing in each of the Latin American countries (except Mexico).

Finally, by the end of 1996 international reserves were either stable or growing in all ten countries, as shown in table 3. In short, nowhere do we have a picture resembling the crisis syndrome described by the so-called first-generation models à la Krugman. There is little cross-regional variation in these indicators. All this suggests that conventional monetary and fiscal policies cannot explain why crises erupted in Asia and not in most of Latin America in the 1990s.

Turn now to the behavior of output. Some currency crises, especially the collapse of the European exchange rate mechanism in 1992, have been blamed on stagnation and mounting unemployment, which arguably undermined the credibility of fixed exchange rates and eventually caused a run by panicky investors trying to protect themselves from an impending devaluation. So-called second-generation crisis models stress this link.[4] It has even been argued that such models can explain the 1994 episode in Mexico, where the combination of a slow-growing economy and a contested presidential election probably kept the authorities from raising interest rates enough to defend the peg.

However, it is hard to argue that mechanisms of the second-generation type played a role in the recent crisis. Table 1 shows that

Table 3. International Reserves for the Asean-5 and Selected Latin American Countries[a]

Millions of U.S. dollars

Country	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*
Asean-5							
Indonesia	7,459	9,258	10,449	11,263	12,133	13,708	18,251
Korea	14,793	13,701	17,121	20,228	25,639	32,678	34,037
Malaysia	9,754	10,886	17,228	27,249	25,423	23,774	27,009
Philippines	924	3,246	4,403	4,676	6,017	6,372	10,030
Thailand	13,305	17,517	20,359	24,473	29,332	35,982	37,731
Latin America							
Argentina	4,592	6,005	9,990	13,791	14,327	14,288	18,104
Brazil	7,441	8,033	22,521	30,604	37,070	49,708	58,323
Chile	6,068	7,041	9,168	9,640	13,088	14,140	14,833
Mexico	9,863	17,726	18,942	25,110	6,278	16,847	19,433
Peru	1,040	2,443	2,849	3,408	6,992	8,222	10,578

Source: International Monetary Fund, *International Financial Statistics*, various issues.
a. Data are as of the end of the year.

4. See Obstfeld (1994).

Asian growth rates were very high throughout the 1990s, including 1996. In this sense they resemble those of Chile in the early 1980s, where growth averaged 7.9 percent in the five years leading to the 1982 crash. In the 1990s the Latin American countries obviously grew less rapidly than their Asian counterparts—but much more rapidly than they themselves had grown in the 1980s. And as is also evident from table 1, by 1996 output in all five of the Latin American countries was growing (and in several, such as Mexico, it was sharply accelerating). In short, lack of growth or mounting unemployment can account neither for the Asian crisis nor for the different fortunes experienced by the two regions.

The Asean-5 countries saved a lot but invested even more, as the last four columns of table 1 show. Correspondingly, their current accounts were generally in deficit, as seen in table 4. The interpretation of this performance was and remains ambiguous. Although there is no clear theoretical reason why sustained current account imbalances should lead to a crisis, in the aftermath of the Mexican 1994 collapse both private investors and the Washington multilateral institutions have regarded deficits exceeding a rule-of-thumb threshold (often 5 percent of GDP) as a source of potential trouble. But the caveats are many. Table 4 shows that the Asian economies did indeed post some large deficits in 1990-96, but the deficits are very large (systematically above 5 percent) only in Malaysia and Thailand. Paradoxically, Korea and Indonesia, arguably the countries

Table 4. Current Account Balances for the Asean-5 and Selected Latin American Countries[a]

Percent of GDP

Country	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*
Asean-5							
Indonesia	–2.8	–3.7	–2.2	–1.2	–1.4	–3.2	–3.3
Korea	–0.9	–3.0	–1.5	0.1	–1.2	–2.0	–4.8
Malaysia	–1.9	–8.5	–3.4	–4.2	–5.7	–7.7	–6.5
Philippines	–6.1	–2.3	–1.9	–5.5	–4.8	–2.6	–3.5
Thailand	–8.5	–7.7	–5.9	–5.3	–8.1	–7.6	–7.5
Latin America							
Argentina	3.7	0.2	–2.4	–2.9	–3.5	–0.9	–1.4
Brazil	–0.9	–0.4	1.7	–0.2	–0.2	–2.5	–3.3
Chile	–1.8	0.3	–1.6	–4.5	–1.3	0.3	–3.3
Mexico	–2.8	–4.7	–6.7	–5.8	–7.0	–0.6	–0.5
Peru	–3.2	–3.1	–4.5	–5.2	–5.3	–7.3	–5.8

Source: International Monetary Fund, *International Financial Statistics*, various issues; JP Morgan, *Emerging Markets: Economic Indicators*, various issues.
a. Data are as of the end of the year.

hardest hit by the crisis, had the smallest deficits of the five.[5] Moreover, formal econometric work fails to confirm the validity of the 5 percent rule of thumb. In the study by Frankel and Rose (1996) of 117 currency crises, the current account is no larger on average in crisis times than in tranquil times. Sachs, Tornell, and Velasco (1996c) also find that the current account was a poor predictor of trouble in the countries hit by the 1995 tequila effect. Indeed, and as the lower panel of table 4 shows, some Latin American countries such as Chile and Peru ran nonnegligible current account deficits in the 1990s yet have so far come out unscathed.[6]

In addition, the Asian economies were in a better position to cope with the cumulative effects of persistent current account deficits than the Latin American ones. Their economies are more export oriented and therefore can generate comparatively more foreign exchange. This is captured by the ratio of foreign debt to exports in table 5. Korea does not appear in the table because its foreign debt is too

Table 5. Ratio of Foreign Debt to Exports for the Asean-5 and Selected Latin American Countries[a]

Country	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*
Asean-5							
Indonesia	2.34	2.37	2.30	2.13	2.32	2.34	2.21
Malaysia	0.44	0.43	0.43	0.48	0.43	0.40	0.42
Philippines	2.30	2.19	1.87	1.87	1.63	1.19	0.98
Thailand	0.90	1.00	0.97	1.06	1.12	1.12	1.21
Latin America							
Argentina	3.74	4.05	4.05	3.95	3.58	2.95	2.96
Brazil	3.25	3.28	3.01	3.13	2.85	2.71	2.93
Chile	1.81	1.55	1.49	1.68	1.65	1.27	1.41
Mexico	1.91	1.98	1.83	1.95	1.79	1.72	1.36
Peru	4.52	4.46	4.11	4.87	4.16	4.00	3.52

Source: World Bank, *Global Development Finance*, various issues.
a. Data are as of the end of the year. Korea is omitted because its foreign debt is small.

5. In addition, average current account deficits in Indonesia hardly changed from the 1980s to the 1990s.

6. Table 4 understates the magnitude of the Chilean current account deficits. Until recently, the Chilean central bank excluded accrued earnings by foreign firms established in Chile from the current account computation. This was corrected in April 1998, and Chile now conforms to the IMF methodology. Revised figures raised Chile's historical current account deficits to 3.1 percent of GDP on average for 1989-96, from 2.2 percent previously. For 1997 the measured deficit grew to 5 percent of GDP, and for 1998 the projections are around 6.5 percent of GDP.

small;[7] Malaysia, the Philippines, and Thailand had very low ratios during the period considered. Only Indonesia had ratios consistently above 2, but even those are much smaller than the ratios of Argentina, Brazil, and Peru.

Several observers contend instead that the Asian current account deficits were problematic in that they signaled a loss of competitiveness. This view is consistent with the behavior of the real exchange rate: as table 6 shows, most of the Asean-5 economies experienced real appreciations from 1990 to 1996. This tendency sharpened in late 1995, as the U.S. dollar (to which these countries' currencies were pegged, either de facto or de jure) gained on the Japanese yen.[8]

Real exchange rate appreciation is, in fact, a good predictor of currency crises in the making, as found, for instance, by Sachs, Tornell, and Velasco (1996b) and Frankel and Rose (1996). Yet several caveats are in order in interpreting the Asean-5 data. The first is that there is a great deal of heterogeneity accross country experiences. Numbers for the period between 1990 and the end of 1996 range from a 10 percent real *depreciation* for Korea to a 26 percent real appreciation for the Philippines. Also, table 6 shows that the change in the real exchange rate in the Asean-5 countries is much smaller if the reference point is taken to be 1988 or 1989 instead of 1990. A second is the usual question of whether the observed appreciations reflect misalignment. For standard Balassa-Samuelson reasons, one would expect rapidly growing economies such as these to experience substantial equilibrium appreciation, and that is precisely what more careful studies show.[9]

Finally, and most important for our purposes, table 6 also shows that in the 1990s Argentina, Brazil, Chile, and Peru all experienced much greater appreciations, yet no crisis struck. All of this suggests that real overvaluation in Asia was not so large as to be a sufficient condition for a crash. And certainly the behavior of the real exchange rate cannot explain why crises occurred in Asia and not in Latin America.

7. That is, too small to be included in the World Bank's annual *Global Development Finance*, the source of the data in table 5.

8. Radelet and Sachs (1998) compute larger real appreciations.

9. In particular, Chinn (1998) estimates a structural model of real exchange rate determination and finds that, after one corrects for underlying structural change, the extent of misalignment is quite limited, and smaller than the real appreciation numbers suggested by table 6.

Table 6. Real Effective Exchange Rates in the Asean-5 and Selected Latin American Countries

1990 = 100[a]

Country	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*
Asean-5											
Indonesia	101.1	98.8	101.9	97.4	99.6	100.8	103.8	101.0	100.5	105.4	62.3
Korea	87.0	101.9	106.2	96.1	91.5	87.7	85.2	84.7	87.7	87.1	59.2
Malaysia	111.1	100.5	102.9	97.1	96.9	109.7	111.0	107.1	106.9	112.1	84.8
Philippines	99.0	101.7	108.2	92.4	103.1	107.1	97.4	111.7	109.5	116.3	90.8
Thailand	95.2	97.3	99.3	102.2	99.0	99.7	101.9	98.3	101.7	107.6	72.3
Latin America											
Argentina	95.1	110.6	101.7	100.3	103.8	111.6	120.8	97.7	77.2	95.5	106.1
Brazil	86.2	117.7	70.2	138.0	112.0	114.0	114.7	109.2	110.6	115.4	123.0
Chile	61.9	69.2	93.1	76.3	71.7	77.5	86.2	108.7	96.6	99.6	107.4
Mexico	100.2	98.5	97.8	100.9	106.2	115.7	112.7	120.1	120.8	128.5	133.4
Peru	43.3	61.2	111.1	75.7	92.3	89.6	94.6	101.4	99.7	101.6	108.8

Source: JP Morgan, *Emerging Markets: Economic Indicators*, various issues.
a. Data are as of the end of the year except for 1997, for which data are as of midyear. A rise in the index represents an appreciation of the currency in real terms.

We must conclude that differences in macroeconomic fundamentals seem too small to explain why crises hit Asia but not Latin America. A related point is that the deterioration of conventional fundamentals in Asian countries is minute compared with the magnitude of their subsequent crisis. As Calvo and Mendoza (1996) suggested regarding Mexico in 1994, it seems unlikely that the severity of the punishment was justified by the hideousness of the sins. As estimated by Radelet and Sachs (1998), the Asian economies experienced a capital outflow of $34 billion in the second half of 1997, equivalent to a negative shock of 3.6 percent of their GDP. Growth fell from highly positive to negative. The Asian currencies are trading for as little as 25 percent of their mid-1997 values with respect to the dollar; the prices of stocks and real estate have fallen just as far. It is hard to understand the magnitude of this collapse without reference to the severe turmoil in the Asian financial sector. To that subject we now turn.

2. International Illiquidity and Financial Crises

Financial collapse has clearly been the most spectacular aspect of the Asian meltdown. Bank failures and closures occurred in all of the Asean-5 nations. In Indonesia sixteen commercial banks were

closed; in Korea, operations of fourteen out of thirty merchant banks were suspended; in Thailand nonbank finance companies were the source of trouble, in an echo of the 1982 Chilean story: fifty-eight out of ninety-one such firms had their operations stopped, and almost all of these are scheduled for liquidation.

In Indonesia, Korea, and Thailand domestic financial institutions (and nonfinancial firms in Indonesia) came to the brink of default on their external short-term obligations. In Korea and Thailand default was prevented by an emergency rescheduling of liabilities. Indonesia had to declare an effective moratorium on debt service by its corporate sector in January 1998.

Financial collapse has been closely linked to the plunge in asset prices. Growing nonperforming loans and capital losses caused by currency depreciation sharply reduced bank capital. Banks were forced to sell assets and curtail lending in order to move toward the capital adequacy ratios required by regulators and the IMF.[10] In turn, the asset price plunge worsened bank capital shortages in those cases (particularly Korea) in which banks were allowed to hold some of their capital in stocks of other companies.

And financial collapse has been a prime cause of the sharp currency depreciations observed since mid-1997. Corsetti, Pesenti, and Roubini (1998) document the paradoxical fact that several of the Asean-5 nations pursued low-interest-rate policies until well into the crisis. Malaysia, for instance, waited until the ringgit had fallen by over 40 percent against the dollar before tightening its monetary stance in December 1997. In addition, in some cases such as Thailand's, monetary authorities injected large amounts of resources into failing financial institutions, creating unwanted domestic currency that private agents were quick to try to turn into hard currency. Clearly, fragile and illiquid banks prevented central banks from raising interest rates sufficiently to defend their exchange rate pegs; however, this could last only until international reserves were exhausted, at which point the pegs had to be abandoned, and exchange rates plummeted. In short, a main outcome of the Asian crisis has been a collapse of financial systems. This observation suggests that the explanation of the crisis must also be financial in nature. Consequently, several "financial" theories have been proposed to explain the Asian crash, each emphasizing a particular element of an obviously complex financial reality. In our view, both theory

10. See Radelet and Sachs (1998) for a detailed description of this process.

and evidence strongly indicate that the vulnerability of financial systems in the region resulted from their *international illiquidity*.

The concept of international illiquidity will be the key organizing principle in the remainder of our analysis. It refers to a maturity mismatch between a financial system's international assets and its liabilities. More precisely, we will say that *a country's financial system is internationally illiquid if its potential short-term obligations in foreign currency exceed the amount of foreign currency to which it can have access on short notice*. This concept is crucial since international illiquidity involves a fragile situation: it is an essential condition for financial and/or balance of payments crises. To see this, we next discuss a very stylized model that illustrates the role of international illiquidity in the genesis of financial crises. The setup here is a much simplified version of that analyzed in Chang and Velasco (2000a and 2001).

Let us focus on a small, open economy populated by ex ante identical agents. There are three periods of interest: a planning period ($t = 0$), a "short run" ($t = 1$), and a "long run" ($t = 2$). There is a composite consumption good whose price in the world market is fixed over time and normalized to one dollar. Each domestic agent has an endowment $e > 0$ of consumption in the planning period. However, that agent consumes only in the other two periods, and for simplicity we assume that he or she is indifferent between consuming in the short run and in the long run. To provide for future consumption, domestic residents have access to two kinds of assets. First, they can invest in the world market, where the net interest rate is fixed at zero. They can also borrow in the world market, but there they are subject to a debt limit $d > 0$. Second, domestic agents have access to a technology whose yield is large in the long run but small in the short run. Each dollar invested in this technology in the planning period yields $R > 1$ units of consumption in the long run, but only $r < 1$ if liquidated in the short run.

We assume that, because of indivisibilities or other reasons not explicitly modeled here, domestic agents cannot exploit the long-term technology by acting individually, but they can if they act collectively. As a consequence, domestic agents will form coalitions, or banks, which are assumed to offer demand deposits. A demand deposit is a contract by which a depositor surrenders to the bank his or her endowment e and her capacity to borrow d. In exchange, the agent gets the right to withdraw either the initial deposit (e dollars)

in the short run or a larger amount, say, y dollars in the long run.[11] In turn, each bank uses the deposits and the borrowing capacity thus obtained to invest in either the world asset or the long-run asset, in order to service withdrawals and maximize profits. We assume that any bank must hold at least $b > 0$ dollars per depositor in liquid form (that is, in the world asset). This may be due to the existence of reserve requirements; alternatively, b may represent the foreign reserves of the central bank, if we are considering the consolidated banking system.

If banks are competitive, profits will be driven to zero, and demand deposits will be designed so as to maximize the utility of the representative depositor. It is not hard to see that this implies at least three conditions:

• First, the bank's initial investment in the world asset will be as small as possible: since depositors are indifferent between short-run and long-run consumption, they are better served by investing in the long-run, higher-yield asset. So the initial investment per depositor in the world asset will be exactly b.

• Second, the typical bank will borrow all it can in the world market. The reason is that the world cost of credit is zero, whereas the bank can obtain a positive yield (equal to $R - 1$) on the long-run investment. Hence the bank will borrow d (per depositor) in the world market in the planning period. Since each domestic agent deposits his or her endowment e in the banking system, and the bank invests b dollars per depositor in the world asset, the investment in the long-run asset will be $k = e + d - b$ per depositor.

• Third, since profits are zero, the bank will distribute all of its value to depositors in the long run. Hence y will equal the bank's resources after repaying its foreign debt, which are given by $Rk + b - d$.

Given the above expressions for y and k, it follows that $y = Re + (R - 1)(d - b)$. Since $R > 1$, $y > e$ if b is not too large. An implication is that domestic residents will find it more advantageous to join a bank

11. Although the existence of demand deposits (as opposed to other kinds of contracts between depositors and banks) is simply assumed here, it can easily be derived from first principles. Diamond and Dybvig (1983) show that they emerge optimally in an environment in which depositors' liquidity needs are stochastic and in which secondary markets for illiquid assets are not present. Diamond (1997) shows that even if such secondary markets are present, banks offering demand deposits perform a useful social function as long as participation in secondary markets is limited.

than to act in isolation. More important, a banking system may emerge in this economy as a socially desirable mechanism. The typical bank will offer demand deposits, borrow in the world market, and allocate investment in order to maximize profits; in so doing, the banking system will improve social welfare.

This analysis is subject to one caveat, however. We have implicitly assumed that the holders of a bank's liabilities, domestic depositors and foreign creditors, all remain confident in the bank. This assumption ensures that depositors do not attempt to withdraw their deposits in the short run, and that (assuming that the initial external debt is only for one period) foreign creditors roll over their initial credit d in the short run. By construction, the bank will be able to honor all its commitments if confidence is maintained. But what happens if confidence is lost? In that case, a *crisis* may happen and the bank may fail.

To see this, suppose that the initial credit d contracted in the planning period is a short-term credit that needs to be renewed at $t = 1$. Suppose, further, that both domestic depositors and foreign creditors "panic" and come to believe that the bank will fail. In that case all depositors will attempt to withdraw e, and foreign creditors will demand repayment of the credit d. What resources can the bank use to meet these demands? In the planning period, the bank had allocated b to liquid assets, and $k = e + d - b$ to the illiquid asset. But if $b < e + d$, the value of the world investment will not be sufficient to meet the demands of depositors and foreign creditors. This means that the bank will have to liquidate some of the long-term asset, which is costly. In fact, even this will not prevent the bank's failure if $e + d > b + rk$, that is, if the bank's potential short-run obligations (given by the right-hand side of the expression) exceed the resources to which it can have access in the short run (given by the left-hand side). The inequality just stated is crucial and corresponds to what we have called *international illiquidity*.

Several points are worth noting:

• Banks may perform a useful social function even if liquid. In this simple model, feasible consumption by the representative depositor rises if $y > e$. It is easy to check that this requires that $b < d + e$, which is intuitive: if banks reserve too heavily, they forgo the opportunity to invest in the productive long-term asset. On the other

hand, illiquidity requires $e + d > b + rk$. Hence we can have $b < e + d < b + rk$ and enjoy banks that are both welfare enhancing and invulnerable to confidence crises. Note that this best of all possible worlds is even more readily achievable if agents are risk averse (as in the original Diamond-Dybvig model), so that banks also raise welfare by permitting risk pooling.

• If the financial system is illiquid, a crisis may occur when it could have been prevented: as we have seen, the demand deposit system would have been successful if depositors had not tried to withdraw their deposits and foreign creditors had rolled over their loans. Also, the cost of a crisis may be very high: in the event of a crisis, the economy's wealth shrinks to $b + rk = b + r(e + d - b) = (1 - r)b + r(e + d)$, which can be much smaller than the initial investment $e + d$ if b and r are small.

• In general, a crisis may be due to a loss of confidence by domestic depositors, foreign creditors, or both. If $b + rk < e$, a domestic depositors' panic is enough to cause a crisis. But it is possible that $e < b + rk < e + d$. In such case, a crisis can only occur if both depositors and foreign lenders panic. If a crisis then occurs, foreign creditors pull out of the country because they fear a domestic bank run, which then comes to pass because domestic depositors know that foreign loans will not be renewed.

• The key definition of international illiquidity depends on the maturity characteristics of assets and liabilities. So far we have implicitly assumed that loans d are short term, in the sense that they have to be rolled over in period 1. Suppose, by contrast, that the banking system has the option to borrow d in the planning period as a long-term loan. In that case, in the short run only domestic depositors can demand repayment of their claims on banks. The international illiquidity condition is now that $e > b + rk$; although this means that a crisis is still possible, this condition is less likely to be satisfied than in the previous case of only short-term foreign debt. An immediate implication is that crises may become more likely if the average maturity of foreign debt becomes shorter.

We have discussed these and other points at length in our theoretical papers (Chang and Velasco, 2000a, 2001). Next we examine whether international illiquidity did in fact play a role in the Asian crisis and how this differed from developments in Latin America.

3. Financial Liquidity in Asia and Latin America

Given the theory just outlined, an obvious question is whether the Asian and the Latin American countries were systematically different in terms of their international illiquidity at the time the crises erupted. Answering this requires making the concept of "international illiquidity" operational, which requires identifying the institutions that comprise each country's "financial system," as well as their relevant "short-term assets and liabilities in foreign currency." The appropriate definitions depend on government policy.

Our definition of a financial system will naturally include domestic banks and other domestic financial entities that perform banklike operations (such as Thailand's finance companies). In addition, because the countries under discussion had governments committed to act as lenders of last resort to private financial institutions, their central banks will be included as well. This inclusion is justified because, in the presence of such a commitment, a crisis affecting private financial institutions will force a central bank to honor it, which may pull the government itself into the crisis. Indeed, we argue later that a balance of payments crisis is best understood as a situation in which a central bank runs out of international liquidity in an attempt to fight a financial crisis.

Accordingly, an ideal definition of the liquid international assets of the financial system would include not only the short-term external assets of private financial institutions, but also the amount of foreign currency available to the central bank for last-resort lending in the event of a crisis. (Notice that the latter should, in principle, exclude the amount of reserves that has already been committed, implicitly or explicitly, to other uses in a crisis, such as the repayment of *tesobonos* in Mexico in 1994.) The definition would also include the amount of international loans to which the financial system can have access in the short run as well as the liquidation value of fixed assets. Although a measure of short-term international liquid assets embodying these desiderata can perhaps be constructed, because of data constraints we use the stock of international reserves of the monetary authorities to proxy such an ideal measure.

Similarly, an ideal definition of the short-term international liabilities of the financial system would include its short-term foreign debt as well as demandable deposits denominated in foreign currency; the only difference, from the viewpoint of international illiquidity, is that the former are obligations to foreigners whereas the

latter are obligations to domestic residents. In addition, if there is a fixed exchange rate, demandable deposits in domestic currency should also be included, since fixed rates imply that such deposits are effectively obligations in foreign currency.

The relevant data on deposits in the consolidated financial system are available from the International Monetary Fund's *International Financial Statistics* (IFS), but the situation for international debt is less satisfactory. As discussed by Corsetti, Pesenti, and Roubini (1998), the most useful source of evidence on short-term external debt is published by the Bank for International Settlements (BIS). One observation about BIS data is that they are restricted to indebtedness of a country's residents to foreign banks. More important for our purposes, available BIS tables are not broken down sufficiently to identify the short-term external debt of the financial system. However, they do contain data on the short-term external debt (against BIS-reporting banks) of a country as a whole, as well as on the amount of external debt (including debt of longer maturity) contracted by domestic banks. These aspects of the data force us to treat domestic deposits and external debt separately.

Keeping data limitations in mind, we now turn to the available evidence. The data on the Asean-5 countries do suggest that the international liquidity position of their financial systems deteriorated before the crisis. This can be seen most clearly from the BIS data on foreign bank lending. Table 7 describes the behavior of the ratio of short-term loans from international banks to reserves; obviously, an increase in the ratio implies a higher likelihood of international illiquidity. The table shows that, among the Asean-5, the ratio increased between mid-1994 and mid-1997 in every country except Indonesia, where the ratio was stable. (In Korea, Malaysia, and Thailand the ratio had also increased between 1990 and 1994. It had fallen in Indonesia but not by much. It had fallen sharply in the Philippines, but this was probably an anomaly following the Philippine Brady debt restructuring of 1991.)

It is also notable that the ratio of short-term debt to reserves in mid-1997 was substantially over 1 in Indonesia, Korea, and Thailand. This suggests a financially fragile situation, in the sense that international reserves would not have been sufficient to repay the short-term debt had foreign banks decided not to roll it over. Although this ratio was below 1 in Malaysia and the Philippines (the two countries among the Asean-5 least affected by the crisis), it more than doubled between mid-1994 and mid-1997.

Table 7. Short-Term Debt and Reserves in the Asean-5 and Selected Latin American Countries[a]

	Short-term debt (millions of dollars)			*International reserves (millions of dollars)*			*Ratio of short-term debt to reserves*		
Country	*1990*	*1994*	*1997*	*1990*	*1994*	*1997*	*1990*	*1994*	*1997*
Asean-5									
Indonesia	10,360	18,882	34,661	4,693	10,915	20,336	2.208	1.730	1.704
Korea	15,528	34,908	70,182	14,642	21,684	34,069	1.061	1.610	2.060
Malaysia	1,761	8,203	16,268	8,114	32,608	26,586	0.217	0.252	0.612
Philippines	3,019	2,646	8,293	948	6,527	9,781	3.185	0.405	0.848
Thailand	7,026	27,151	45,567	11,882	27,375	31,361	0.591	0.992	1.453
Total	37,694	91,790	174,971	40,279	99,109	122,133	0.936	0.926	1.433
Latin America									
Argentina	6,170	17,563	23,891	2,950	13,247	19,740	2.092	1.326	1.210
Brazil	20,688	28,844	44,223	7,872	41,292	55,849	2.628	0.699	0.792
Chile	3,896	5,443	7,615	4,373	10,766	17,017	0.891	0.506	0.447
Mexico	14,567	28,413	28,226	6,508	16,509	23,775	2.238	1.721	1.187
Peru	1,666	2,159	5,368	430	5,611	10,665	3.872	0.385	0.503

Source: Bank for International Settlements (1998) and International Monetary Fund, *International Financial Statistics*, various issues.
a. All data are as of midyear.

As shown in the bottom panel of table 7, the corresponding data for the Latin American countries look rather different. The ratio of short-term debt to reserves was stable and below 1 in Brazil, Chile, and Peru (and in Colombia) in mid-1997; in Argentina and Mexico it was approximately 1.2 and had been falling. Hence, the Latin American countries appear to have been in a substantially less vulnerable position than most of their Asian counterparts.

The BIS tables suggest, in addition, that the proportion of foreign bank lending intermediated by the domestic banking sector was stable in each Asian case except Thailand. In Thailand, the decline in the share of the domestic banking sector in foreign borrowing is attributable, by and large, to the increased importance of the finance companies. Finance companies seem to have emerged in response to regulatory distortions, but they performed banklike functions. In fact, they are included in the IFS as part of the group "other banking institutions;" the IFS notes that although finance companies were "not licensed to accept deposits from the public," they "issued promissory notes at terms comparable to the time deposits at commercial banks."[12] The importance of Thailand's finance companies in the

12. International Monetary Fund, *International Financial Statistics*, January 1998, p. 169.

financial system was also underscored by the fact that the Bank of Thailand was commited to support them as a lender of last resort.[13]

The evidence thus strongly indicates that the short-term external liabilities of the relevant Asian financial systems were growing faster than their liquid international assets. In our interpretation, this trend caused the international liquidity position of the Asean-5 countries to deteriorate to the point where a loss of confidence from foreign creditors could bring the financial system to a crisis. The same was not true in Latin America.

The behavior of *domestic* deposits vis-à-vis international reserves suggests a similar picture. The upper panel of table 8 shows the evolution of the ratio of the money supply (M2) to foreign reserves for the Asean-5 economies before their crises. The high level of the M2-reserves ratio seems consistent with the hypothesis of international illiquidity. At the end of 1996, this ratio was 6.5 or above in Korea and Indonesia and 4.5 in the Philippines. At the same time, as the lower panel of table 8 reveals, the same ratio was only 3.4 in Argentina, 2.75 of Brazil, and less than 2 in Chile and Peru. It was relatively higher in Mexico (4.65) but had fallen sharply since 1994; it is notable (and maybe more than a coincidence) that the M2-reserves ratio had been over 7 in Mexico in June 1994, just before its own crisis.

Table 8. Ratio of Money Supply (M2) to International Reserves in the Asean-5 and Selected Latin American Countries[a]

Country	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*
Asean-5							
Indonesia	6.16	5.51	5.61	6.09	6.55	7.09	6.50
Korea	6.48	8.33	7.20	6.91	6.45	6.11	6.51
Malaysia	2.91	2.99	2.64	2.09	2.47	3.33	3.34
Philippines	16.33	4.82	4.35	4.90	4.86	5.86	4.50
Thailand	4.49	4.10	4.10	4.05	3.84	3.69	3.90
Latin America							
Argentina	3.08	3.18	3.14	3.30	3.73	3.64	3.41
Brazil	n.a.	n.a.	n.a.	1.85	2.30	2.22	2.75
Chile	1.81	1.79	1.67	1.73	1.52	1.75	1.91
Mexico	5.67	4.53	5.12	4.44	12.63	4.37	4.65
Peru	2.43	1.85	1.76	1.91	1.27	1.31	1.24

Source: International Monetary Fund, *International Financial Statistics*, various issues.
a. Data are as of the end of the year.

13. See Corsetti, Pesenti, and Roubini (1998), section 3.2.

The M2-reserves ratio was stable or increasing in each of the Asean-5 countries, except Thailand, where it was falling. The behavior of the Thai ratio most likely indicates, as discussed above, that the relevant measure of the liabilities of Thailand's financial system to domestic residents should include the promissory notes of the finance companies, which are not included in M2 but became increasingly important.

In short, the ratio of M2 to reserves in the Asean-5 countries had been either high or increasing in every case but Thailand, where its behavior likely reflects the emergence of the finance companies. By contrast, in the five Latin American countries the M2-reserves ratio was relatively high only in Mexico, where it had been falling drastically. This evidence, which proxies the trends and levels of the short-term asset-liability positions of each financial system vis-à-vis domestic depositors, also strongly favors the view that the Asean-5 but not the Latin American countries had a problem of international illiquidity when the crisis started.

Two remarks are in order. First, it should be repeated that, because the Asean-5 countries had effectively fixed exchange rates, our accounting includes domestic-currency deposits as obligations in international currency. The relative magnitudes of deposits to international reserves implies that the latter would not have been sufficient to honor the outstanding stock of deposits at the fixed exchange rate. Given this condition, a run by domestic depositors was bound to result in either the bankruptcy of the financial system or the abandonment of the fixed exchange rate. The M2-reserves ratio, however, overstates international illiquidity in a country with a flexible exchange rate, such as Mexico and Peru, to the extent that M2 includes deposits in domestic currency. The reason is that, in a crisis, a central bank can always print enough domestic currency to honor those deposits.

Second, because comparable data are not currently available, we have so far neglected to include short-term domestic public debt in our liquidity measures. This may not be an innocuous omission. We know that the Mexican government's inability to roll over its large stock of short-term debt (in particular, the infamous *tesobonos*) was to prove key in triggering the financial crisis in December 1994. But was this factor quantitatively relevant in the 1997-98 crises? Some evidence suggests that it was not. Around the time of the collapse there does not seem to have been much short-term debt in the strongly affected countries of Indonesia, Korea, and Thailand (see table 3 in

Ito, 1998). In Latin America, Mexico managed substantially to extend the maturity of its public debt after the 1994 collapse. At the end of September 1994, short-term domestic federal debt was equivalent to $26.1 billion; by the end of June 1997 this figure was down to less than $8.5 billion.[14] Argentina, Chile, and Peru have not issued domestic short-term debt in any substantial magnitude.

The possible and key exception is Brazil. Bevilacqua and others (1998) report that by the end of 1996 the Brazilian government had approximately $150 billion in outstanding domestic securities, with an average maturity of 180 days. Although data on the precise maturity structure are not available, this number alone is cause for concern: on average, $75 billion had to be rolled over by the Brazilian government every six months. By contrast, as table 3 shows, international reserves were only slightly above $58 billion at the end of 1996. This potentially explosive situation suggests why Brazil was the Latin economy hardest hit by the reverberations of the Asian meltdown in the second half of 1997. In November of that year a speculative attack against the real forced the authorities to increase interest rates to 42 percent a year (at a time when domestic inflation was running at less than 5 percent a year) and to cut the government budget by 2 percent of GDP. After several subsequent attacks, the Brazilian peg eventually came unstuck in early 1999.

4. Factors behind Asian Financial Vulnerability

We have so far argued that the Asean-5 countries were in a state of international illiquidity, which made them vulnerable to financial crises, whereas the same was not true in Latin America. An obvious question is, What caused international liquidity positions to deteriorate in Asia but not Latin America? We believe that three factors were crucial.

4.1 Financial Liberalization prior to the Crisis

In the late 1980s and the 1990s the governments of the Asean-5 countries implemented policies designed to move away from "financial repression" and toward a freer, more market-oriented financial system. This trend included the deregulation of interest rates and

14. The figures are from the tables "Saldos de la Deuda Interna y Externa del Gobierno Federal por Plazos," on the Bank of Mexico website.

the easing of reserve requirements on banks; in Korea, for instance, lending interest rates were liberalized between 1991 and 1993, and marginal reserve requirements, which had been as high as 30 percent around 1990, were reduced to 7 percent in 1996. In addition, policies oriented toward the promotion of competition and entry of financial institutions were enacted: requirements on the opening and branching of banks were relaxed in Indonesia and Malaysia in 1988-89, and restrictions on activities of foreign banks were eased in Korea and Thailand in 1991 and 1993, respectively.[15]

By contrast, the five Latin American countries had liberalized their financial systems earlier—and in fact several of them had experienced financial crises in the 1980s or early 1990s. By 1995 an enhancement of supervision and prudential regulation, rather than further liberalization, were the policy priorities among these countries. Prompted by the 1982 financial debacle, Chile passed a stringent new banking law in 1986 and has continued to strengthen supervision since.[16] Colombia moved in the same direction at around the same time, also motivated by earlier financial difficulties. Other countries waited until the 1990s. The 1994-95 crisis provoked serious banking difficulties in Argentina, Brazil, Mexico, and Venezuela: a full-fledged crisis, involving bank closings and widespread loan reschedulings, occurred in all countries. Subsequently, all four countries moved to tighten banking supervision and actively encouraged bank mergers and acquisitions from abroad.[17]

Existing economic theory suggests that financial liberalization, although beneficial if a crisis is avoided, has a detrimental effect on the international liquidity position of the financial system. Clearly, lower reserve requirements allow the banking industry to maintain a lower degree of liquidity. But as we have argued elsewhere (Chang and Velasco, 2000a, 2001), although this may be desirable on efficiency grounds, it directly exacerbates international illiquidity and increases the possibility of a financial run. Likewise, the fostering of competition in the financial industry may deliver institutions that, although leaner and meaner, are also less liquid. In Chang and Velasco (2001) we discuss how this may happen in the banking industry. Increased competition typically forces banks to offer more

15. This information is taken from Asian Development Bank (1998), which includes a fairly detailed discussion of financial liberalization in the Asean-5 countries.

16. For details see Velasco (1991).

17. See Rojas-Suárez and Weisbrod (1996).

attractive terms (higher interest rates) to depositors. This improves social welfare in the absence of a run. But it also implies that the short-term liabilities of the banking system, in this case the face value of demand deposits, must increase, impairing international liquidity.

Evidence supporting the view that financial liberalization lowers international liquidity has been provided recently by Demirgüç-Kunt and Detragiache (1998). Their analysis of banking industry data in eight countries between 1988 and 1995 shows that financial liberalization (understood as the deregulation of interest rates) is strongly correlated with a fall in a bank's liquidity (measured by the ratio of liquid to total assets). Although more empirical work is clearly needed, our assessment of existing theory and evidence is consistent with the view that financial liberalization in Asia increased the possibility of a financial crash through its effect on international illiquidity.[18]

4.2 An Unprecedented Increase in Short-Term Foreign Liabilities

Our concept of international illiquidity focuses on the difference between short-term international assets and liabilities. It was the explosive growth of the latter, in particular of short-term international debt, that accounts for the change in the international liquidity position of the Asean-5 countries. In contrast, short-term debt grew much more slowly in Latin America.

As emphasized by Radelet and Sachs (1998), a notable feature of the Asian crisis was the extent to which foreign investors, especially foreign commercial banks, increased their loans to the Asean-5 economies up to the onset of the crisis. BIS data show that international bank lending to Asia more than doubled, from less than $150 billion at the end of 1990 to about $390 billion in mid-1997; in contrast, foreign bank lending to Latin America increased only from about

18. It must be noted that this view of how liberalization contributed to the Asian crisis differs from others that have been proposed. In particular, an alternative mechanism, suggested by Caprio and Summers (1996) and Hellman, Murdock, and Stiglitz (1994), is that financial liberalization may have reduced the "franchise value" of banks and induced them to take on more risk. Although this mechanism may have been at work, it is unclear that its effects are strong enough to explain the Asian crisis. Also, the evidence behind the franchise value story is mixed: as discussed by Demirgüç-Kunt and Detragiache (1998), the fall in the banking system's liquidity associated with financial liberalization suggests that its franchise value increases, rather than falls, with liberalization.

$180 billion to about $250 billion over the same period. The bulk of new lending to Asia was directed to the Asean-5 countries (although the Philippines received a relatively small share).

In addition, BIS data show that most of the loans by foreign banks were short-term loans. For Asia the share of loans with maturity over a year fell from about 38 percent in 1990 to less than 30 percent in mid-1997; the corresponding figure for Latin America stood at 40 percent in mid-1997. The top panel of table 9 shows that, for the Asean-5 countries, short-term debt was a larger share of total debt in mid-1997 than in mid-1990, although in most countries its importance was somewhat smaller than in mid-1994. At the time of the crisis, short-term loans as a share of total obligations to the international banking community were 68 percent in Korea, 66 percent in Thailand, 59 percent in Indonesia, 56 percent in Malaysia, and 59 percent in the Philippines. On average, the numbers were lower in Latin America (bottom panel of table 9).

Hence the data show not only an unprecedented increase in capital flows toward the Asean-5 countries after 1990, but also that a growing proportion of those flows were short term. As shown by the behavior of the ratio of short-term debt to international reserves, these short-term capital inflows were not matched by a comparable increase in international liquid assets, implying that international

Table 9. Short-Term Debt and Total Debt in the Asean-5 and Selected Latin American Countries[a]

	Total debt (millions of dollars)			*Short-term debt (millions of dollars)*			*Ratio of short-term debt to reserves*		
Country	*1990*	*1994*	*1997*	*1990*	*1994*	*1997*	*1990*	*1994*	*1997*
Asean-5									
Indonesia	20,076	30,902	58,726	10,360	18,882	34,661	51.60	61.10	59.02
Korea	23,369	48,132	103,432	15,528	34,908	70,182	66.45	72.53	67.85
Malaysia	6,864	13,874	28,820	1,761	8,203	16,268	25.66	59.12	56.45
Philippines	9,055	5,990	14,115	3,019	2,646	8,293	33.34	44.17	58.75
Thailand	11,675	36,545	69,382	7,026	27,151	45,567	60.18	74.29	65.68
Total	71,039	135,443	274,475	37,694	91,790	174,971	53.06	67.77	63.75
Latin America									
Argentina	25,106	31,001	44,445	6,170	17,557	23,891	24.58	56.63	53.75
Brazil	54,984	52,291	71,118	20,688	28,976	44,223	37.63	55.41	62.18
Chile	8,577	10,504	17,573	3,896	5,447	7,615	45.42	51.86	43.33
Mexico	46,854	58,260	62,072	14,567	28,404	28,226	31.09	48.75	45.47
Peru	2,957	2,994	8,013	1,666	2,157	5,368	56.34	72.04	66.99

Source: Bank for International Settlements (1998).
a. All data are as of midyear.

illiquidity became a more serious problem. Short-term flows to Latin America were, in contrast, more modest.

A key question naturally suggests itself: How did the financial system in the Asean-5 countries end up with so much short-term debt? Although a definitive answer remains to be found, we believe that the following hypotheses are plausible:

• Financial liberalization may once again carry part of the blame. As part of the deregulation and capital account liberalization that took place in the Asean-5 countries, obstacles to capital inflows were reduced—a change that clearly encouraged total inflows. The remaining question, then, is why short-term debt became relatively more important. One possibility is that, if before the liberalization governments wanted to encourage foreign direct investment, the barriers that were reduced basically affected short-term flows. In that case, financial liberalization clearly would have led to a rising share of short-term debt. In contrast to Asia, many Latin American countries followed policies that actively discouraged short-term flows. Brazil, Colombia, and Chile applied taxes (actually non-interest-bearing reserve requirements) on capital inflows, where the tax rate was inversely proportion to the maturity of the inflow, and where long-term flows such as FDI went untaxed at the border. Empirical studies by Valdés-Prieto and Soto (1996) and Cárdenas and Barrera (1997) find that such taxes in Colombia and Chile lengthen average maturity while leaving loan volumes unaffected. If so, they may also be effective in reducing vulnerability.

• Economic fundamentals may imply that increases in total capital inflows must be associated with a rising share of short-term debt. In our theoretical work (Chang and Velasco, 2000a, 2001) we have shown that this may be the case in an economy that needs to obtain short-term loans to provide for today's consumption, and long-term loans to finance investment projects that mature later. In such a case, an increase in total capital inflows will then be distributed between short- and long-term debt, in proportions that depend on specific properties of preferences and technology.

• Miscalculation and wishful thinking on the part of Asian borrowers may also be to blame. As the effects of external shocks (dollar appreciation, Chinese devaluation, stagnation in Japan) made themselves felt and macroeconomic fundamentals deteriorated, firms and banks may have conjectured that the shocks were temporary, and that relatively inexpensive short-term borrowing was called for to

get over the hump. The Mexican government did something similar in the course of 1994, attempting to get through a period of domestic political instability and higher world interest rates by playing the yield curve and borrowing short to minimize interest expense. In both cases the period of turbulence was deeper and longer than had been anticipated, and ex post the decision to borrow short seems unsound.

• Finally, supply-side factors may have been at work. A larger share of short-term debt among the Asean-5 countries reflects a *worldwide* trend toward shorter debt maturities. The data from the BIS show that medium- and long-term loans as a share of total international bank loans fell from almost 40 percent in mid-1994 to less than 35 percent in mid-1997. This fall reflects similar trends in both developed and developing countries (although, as discussed earlier, the share of short-term debt of the Asean-5 countries has consistently been well above the world average). As table 9 makes clear, in the 1990s the share of short-term debt sharply increased in Latin America as well. It is conceivable, then, that the shortening of international debt maturities reflects the relative world supply of short- versus long-term funds.

4.3 An Increase in Foreign-Currency Debt

In the 1990s not only the maturity but also the currency composition of the financial system liabilities of of the Asean-5 countries was conducive to financial fragility. As we saw above, there was a sharp increase in borrowing abroad, which, table 10 reveals, was overwhelmingly in foreign currency. Since the currency composition of the financial system's domestic liabilities did not change much (dollarization of deposits has been limited in Asia, in contrast to Latin America), the increase in foreign loans implied also a sharp rise in the volume of total obligations denominated in foreign currency.

Why would domestic financial institutions choose dollar or yen debt over debt in domestic-currency? Two explanations stand out. The first is a bias toward foreign borrowing implicit in the regulatory environment. In the Philippines, for instance, banks are subject to a 10 percent tax rate on income from foreign-currency loans, whereas other income is taxed at the regular corporate income rate of 35 percent. Also, Philippine banks face reserve requirements of 13 percent for peso deposits (down from 16 percent in 1996), versus zero

Table 10. External Debt Denominated in Local Currency in the Asean-5 and Selected Latin American Countries[a]

	Total debt (millions of dollars)			*Currency positions[b] (millions of dollars)*			*Ratio of local-currency debt to total debt (percent)*		
Country	*1990*	*1994*	*1997*	*1990*	*1994*	*1997*	*1990*	*1994*	*1997*
Asean-5									
Indonesia	20,076	30,902	58,726	468	843	1,262	2.33	2.73	2.15
Korea[a]	23,369	48,132	103,432	2,685	3,182	6,152	11.49	6.61	5.95
Malaysia	6,864	13,874	28,820	212	1,513	2,977	3.09	10.91	10.33
Philippines	9,055	5,990	14,115	430	323	2,239	4.75	5.39	15.86
Thailand	11,675	36,545	69,382	679	2,145	3,906	5.82	5.87	5.63
Total	71,039	135,443	274,475	4,474	8,006	16,536	6.30	5.91	6.02
Latin America									
Argentina	25,106	31,001	44,445	181	443	2,061	0.72	1.43	4.64
Brazil	54,984	52,291	71,118	2,318	–1,018	7,558	4.22	–1.95	10.63
Chile	8,577	10,504	17,573	47	942	2,863	0.55	8.97	16.29
Mexico	46,854	58,260	62,072	171	1,266	1,911	0.36	2.17	3.08
Peru	2,957	2,994	8,013	0	0	156	0	0	1.95

Source: Bank for International Settlements (1998).
a. All data are as of midyear.
b. Claims minus liabilities.

for foreign-currency deposits.[19] Offshore or special financial centers, which dealt exclusively in foreign currency, also distorted the incentives faced by borrowers. Banks operating in the Bangkok International Banking Facility were eligible for special tax breaks. The phenomenon was also present elsewhere.[20]

A second commonly mentioned culprit is the combination of high domestic interest rates (often caused by sterilization of capital inflows) and commitment to a fixed exchange rate. The Asian Development Bank (1998) documents the large spreads between domestic and foreign borrowing costs that prompted banks and firms to seek financing abroad. The next question is why such liabilities were mostly unhedged. Radelet and Sachs (1998) write, "Nominal exchange rates were effectively pegged to the U.S. dollar, with either limited variation (Thailand, Malaysia, Korea, and the Philippines) or very predictable change (Indonesia). Predictable exchange rates

19. IMF, "Philippines—Recent Economic Developments," April 1997, cited by Radelet and Sachs (1998).

20. "Malaysia promoted Labuan as a financial center, the Philippines developed an off-shore Euro-peso market, and Singapore and Hong-Kong further developed their roles as regional financial centers. These markets were often given regulatory and tax advantages . . . and much external financing was channeled through these offshore markets" (Asian Development Bank, 1998).

reduced perceived risks for investors, further encouraging capital inflows." In other words, there was, as we know ex post, a nontrivial risk of nominal and real devaluations, but government words and deeds led investors to underestimate that risk. Economists often fret about exchange rate pegs that lack credibility; by contrast, Asian pegs seem to have enjoyed too much credibility.

In contrast to Asia, most Latin American countries moved toward greater exchange rate flexibility in the 1990s. By 1996 the Mexican peso and the Peruvian sol were floating, while the Chilean peso was allowed to fluctuate within a wide band of plus or minus 12.5 percent around the central parity. The Brazilian real also moved within a (narrower) band whose center crawled at a rate that was sometimes altered by the authorities unannounced. Hence all these regimes exposed investors to substantial foreign exchange risk. Moreover, sometimes exchange arrangements were designed with the explicit goal of increasing the degree of market-driven volatility. That is how in July 1992 Chilean authorities justified the move from a dollar peg (for the band's central parity) to a peg to a basket of currencies that also included the deutsche mark and the yen.

Since the run on Mexico's dollar-denominated *tesobonos* in December 1994, it has become fashionable to blame foreign currency-denominated debt for a host of ills—sometimes with less than full justification. As we stressed above, the ratio of foreign currency-denominated liquid liabilities to foreign currency-denominated liquid assets is not the proper measure of a financial system's international illiquidity. Under a fixed exchange rate, domestic-currency deposits are no different from dollar or yen liabilities: a depositor withdrawing pesos or baht or won from a bank should be able to convert them into dollars at the announced parity, and a liquid system (that is, one in which the fixed parity can be maintained) must have enough dollars or yen to meet that demand.

But there are differences between foreign- and domestic-currency liquid obligations. The first is that, if the exchange rate is not fixed but flexible, the central bank is able to serve as a lender of last resort in the domestic currency, and this added degree of freedom may help forestall panic by depositors or creditors. In our theoretical work (Chang and Velasco, 2000a) we study this point at length. There we show that self-fulfilling bank runs can be ruled out if three factors—domestic-currency liabilities, a central bank willing to serve as lender of last resort in domestic currency, and a flexible exchange rate—are present simultaneously. Conversely, the combination of

foreign-currency liabilities, a fixed exchange rate, and insufficient international reserves—precisely the situation that prevailed in most Asian countries—leaves financial systems illiquid and vulnerable to shifts in investor sentiment.

The other channel through which foreign currency liabilities can be destabilizing comes into being comes after a crisis erupts (if one erupts) and the domestic currency is devalued. If banks have borrowed in foreign currency and lent in domestic currency, the devaluation imposes a capital levy. But harmful effects can be felt even if domestic banks were not directly exposed to exchange risk: if they lent domestically in foreign currency, exchange risk was simply transferred to the borrowing firms. To the extent that these firms' revenue is not in foreign currency, a devaluation sharply reduces their profitability and cuts their debt service capacity. According to many accounts, this mechanism has been at work in the Asian episode, affecting in turn the health of domestic banks.[21]

5. From Illiquidity to Financial Panic

So far we have shown that, when the Asian crisis erupted, the Asean-5 countries were internationally illiquid whereas the Latin countries were not. As such, the Asean-5 economies were vulnerable to a change in mood on the part of depositors and creditors. As we show in Chang and Velasco (2000a, 2001), if initial liquid liabilities are large relative to liquid assets, an exogenous shock (such as an increase in the world interest rate) or a sudden loss of confidence may prompt holders of the system's liabilities to attempt to liquidate them. But they cannot all be successful, since international illiquidity means precisely that the foreign-currency value of their holdings cannot be covered by the amount of international liquidity available to the system. Hence a financial crisis may occur even if things would have been normal had confidence stayed high. If a crisis does take place, financial institutions may be forced to call in loans, interrupting productive projects, and sell fixed assets such as land, causing real estate and stock prices to plunge. The government may try to help, but the crisis is one of excess demand for foreign currency, and hence the government may see its own international reserves plunge in the struggle.

21. See Corsetti, Pesenti, and Roubini (1998), Radelet and Sachs (1998), and Asian Development Bank (1998).

Acute illiquidity left Asia vulnerable to a sharp reversal in the direction of capital flows, and that is exactly what happened in the second half of 1997. Data from the Institute of International Finance show, in particular, that net international inflows of capital to the Asean-5 countries fell dramatically to a negative $12 billion in 1997, from $93 billion in 1996. This fall in inflows is accounted for largely by the behavior of foreign banks, whose positions in the Asean-5 countries dropped by $21.3 billion in 1997 after increasing by $55.5 billion in 1996. Combining this information with BIS data, which shows that foreign banks increased their lending to the Asean-5 countries by $13 billion in the first half of 1997, Radelet and Sachs (1998) conclude that there must have been a capital outflow of about $34 billion in the second half of 1997, equivalent to a negative shock of 3.6 percent of GDP.

This suggests that when the potatoes became hot in mid-1997, international bankers panicked and decided to close their exposure to the more troubled Asian countries. They were able to pull out simply by refusing to roll over their loans, given the prevalence of short-term borrowing. The run by international creditors may, in addition, have been self-fulfilling. As discussed by Calvo (1995) and Chang and Velasco (2001), when domestic financial entities contract short-term debt abroad to finance less liquid investments, coordination failure becomes possible. No individual creditor will find it profitable to roll over its loan if he or she believes that the others will not either and that, as a consequence, domestic borrowers will be forced into bankruptcy. In turn, the sudden increase in the need for liquidity may crush the financial system, confirming creditors' expectations.

The magnitude of the crisis may reflect an interaction between the foreign creditors' run and a domestic run on deposits. As discussed in Chang and Velasco (2001), foreign lenders may panic and refuse to roll over short-term loans if they believe that there will be a run on domestic deposits. In turn, domestic depositors may run because they believe that financial institutions will be forced into bankruptcy, given that they cannot service their short-term obligations. But the latter could have been prevented if the financial system had had access to the necessary financing. In other words, in economies as open as the Asean-5, the distinction between a foreign lenders' panic and a domestic financial run is blurred: both may happen at the same time and reinforce each other. Such a self-fulfilling panic seems to have been present in several countries in the Asian

episode. It was panic dumping of Korean assets, for instance, that brought Korea to the verge of default in December 1997.[22]

In contrast, the relatively strong position of the Latin American countries in terms of their international liquidity meant that a financial run was bound not to succeed in bankrupting the financial system. Consequently, there were no incentives for individuals to participate in a run, which may explain why the crisis left Latin America in relatively good shape.

Note that our argument is not that the Asian crisis was merely a jump to a bad equilibrium, unrelated to fundamentals. We stress that self-fulfilling crashes can be successful if and only if a country suffers from international illiquidity. We have shown that, although the behavior of real macroeconomic fundamentals was quite varied across the Asean-5 countries, illiquidity was one of their common features. And in this regard the Asean-5 countries differed from the Latin American countries of the 1990s, which also suffered from large real appreciation and current account deficits, but whose financial systems were a great deal more liquid and whose banking sectors were more solid. Ironically, this incipient solidity was the result of the cleanup following earlier debt and/or banking crises in Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela.

Our interpretation also helps account for some noteworthy features of the Asian episode. One, stressed by Radelet and Sachs (1998), is that the crash seems to have been largely unanticipated. They base their claim on several observations. First, interest rate spreads did not rise in the runup to the crisis. Second, capital inflows were large even in the first half of 1997. Third, neither the major credit rating agencies nor the IMF reports managed to predict what was to happen. Of these three observations, the first two are the most striking (credit agencies have a notoriously bad forecasting record, and the IMF is understandably very tight-lipped in its public pronouncements). This also matches the experience of such troubled countries as Chile in 1982 and Mexico in 1994. In both cases capital inflows continued even after the real fundamentals had deteriorated. In Mexico interest rate spreads remained practically constant between the assassination of presidential candidate Donaldo Colosio in March and the abandonment of the peg in December 1994.[23]

22. Even Corsetti, Pesenti, and Roubini (1998), who are notoriously skeptical of this line of explanation, recognize as much. See p. 44 of their paper.

23. Both spreads between peso and dollar Mexican assets and between U.S. and Mexican dollar assets were stable. See Sachs, Tornell, and Velasco (1996b) for details.

Finally, our emphasis on financial collapse also helps explain the apparent lack of proportionality between the gravity of the sin (deteriorating fundamentals caused in part by external shocks such as dollar appreciation and Japanese stagnation) and the severity of the punishment (plunging asset prices and a sharp fall in growth rates relative to trend). In our theoretical work (Chang and Velasco, 2001) we show how, if financial systems are relatively illiquid initially, a "small" real shock can push the economy into a region where a financial crisis is either possible (contingent on expectations) or outright inevitable. If a financial crash does occur, bankruptcies and early liquidation of investments have real consequences that multiply the harmful effect of the initial shock. The process is likely to be costly and disruptive.

6. Policy Lessons

Our analysis yields a number of policy implications, some of which are summarized below. The first three have to do with the prevention of crises, and the rest with the solution of crises once they occur.

6.1 Financial Liberalization May Be Beneficial but Has to be Engineered Cautiously

In their 1996 paper on the "twin crises," Kaminsky and Reinhart found that, of the twenty-six banking crises they studied, eighteen were preceded by financial sector liberalization within five years. They also found that financial liberalizations accurately signal 71 percent of all balance of payments crises and 67 percent of all banking crises. The experiences of Chile in 1982, in Mexico in 1994, and contemporary East Asia and Latin America strongly confirm this general tendency. Freeing interest rates, lowering reserve requirements, and enhancing competition in the banking sector are sound policies on many grounds—indeed, countries in which they are applied often experience an expansion in financial intermediation. But they can also sharply reduce the liquidity of the financial sector and hence set the stage for a crisis.

Although we have focused on the effects of liberalization on liquidity, a host of other potential ills have been mentioned in the literature. In particular, deregulation coupled with explicit or implicit guarantees on banks and inadequate oversight can generate a serious moral hazard problem. Overlending and excessive risk taking

are likely results, as argued by Velasco (1991) for the case of Chile, and by Krugman (1998) for the recent Asian episode. A lending boom and a growing share of risky or bad loans often result. As Gavin and Hausmann (1995) persuasively argue, the empirical link between lending booms and financial crises is very strong. Rapid growth in the ratio of bank credit to GDP preceded financial troubles not just in Chile and Mexico, but also in Argentina (1981), Colombia (1982-83), Uruguay (1982), Norway (1987), Finland (1991-92), Japan (1992-93), and Sweden (1991).[24]

The moral of the story is the same in both cases. Financial liberalization should be undertaken cautiously. Reserve requirements can be a useful tool in stabilizing a banking system, as the experience of Argentina in 1995 showed. Lowering them to zero, as Mexico did in the runup to the 1994 crash, smacks of imprudence.

6.2 Short-Term Capital Inflows Do Have a Dark Side

Short-term government debt proved to be dangerous in the case of Mexico in 1994; short-term external debt proved risky in the case of Asia. What can be done about it?

Restraining short-term borrowing involves no free lunch, for both governments and banks have perfectly sound reasons for wanting to make at least some of their liabilities short term. At the same time, it is not clear that decentralized decisionmaking delivers the optimal debt maturity structure: governments may rely too much on short-term debt if they suffer from time inconsistency or high discounting; foreign creditors may only be willing to lend short because of imperfect information or monitoring, or because of coordination failure with other creditors (if each creditor expects the others will only lend short, thus making a crisis possible, his or her best response is also to lend short in order to have a chance to get out if the crisis comes). These conjectures suggest that there may be a case for a policy discouraging short-term debt.

What policy, exactly, is a tricky matter. High required reserves on liquid bank liabilities (whether in domestic or foreign currency, and whether owed to locals or foreigners) is an obvious option.

24. In Mexico and Chile, as in some Asian countries more recently, the perception of government guarantees may have created a moral hazard problem and led banks to take on excessive risk. Velasco (1991) discusses evidence for this in the case of Chile. Krugman (1998) stresses the role of moral hazard and overinvestment in Asia.

It may be sound policy even if it has some efficiency costs or if it causes some disintermediation. An obvious caveat is that if banks are constrained, firms will do their own short-term borrowing, as happened massively in Indonesia.

The taxes on short-term inflows used by Brazil, Chile, and Colombia in the 1990s may have had a beneficial impact. They can be justified in terms of findings such as those of Sachs, Tornell, and Velasco (1996c), who found that a shorter maturity of capital inflows was a helpful predictor of vulnerability to the tequila effect in 1995, whereas the size of those inflows was not.

6.3 There Is a New Case for Flexible Exchange Rates

The combination of an illiquid financial system and fixed exchange rates can be lethal. If the central bank makes a commitment not to serve as a lender of last resort, bank runs can occur; if it acts as a lender of last resort in domestic currency, bank runs are eliminated at the cost of causing currency runs. Hence, under fixed exchange rates plus insufficient reserves (that is, illiquidity), a crisis is unavoidable if investor sentiment turns negative; the only choice authorities face is what kind of crisis to have.

A regime in which bank deposits are denominated in domestic currency, the central bank stands ready to act as a lender of last resort, and exchange rates are flexible may help forestall some types of self-fulfilling bank crises. The intuition for this is simple. An equilibrium bank run occurs if each bank depositor expects others will run and exhaust the available resources. Under a fixed exchange rate regime, those who run to the bank withdraw domestic currency, which in turn they use to buy hard currency at the central bank. If a depositor expects this sequence of actions to cause the central bank to run out of dollars or yen, that depositor's best response is to run as well, and the pessimistic expectations become self-fulfilling. On the other hand, under a flexible exchange rate regime with a lender of last resort, there is always enough domestic currency at the commercial bank to satisfy those who run. But since the central bank is no longer compelled to sell all the available reserves, those who run face a depreciation, whereas those who do not run know that there will still be dollars available when they desire to withdraw them at a later date. Hence running to the bank is no longer the best response, pessimistic expectations are not self-fulfilling, and a depreciation need not happen in equilibrium.

In our view this represents a strong case in favor of flexible exchange rates. But there are caveats. One is that such a mechanism can protect banks against self-fulfilling pessimism on the part of domestic depositors (whose claims are in local currency), but not against panic by external creditors who hold short-term debt denominated in dollars. To the extent that this was the case in Asia, a flexible exchange rate system would have provided only limited protection.[25]

Proper implementation is subtle. If they are to be stabilizing, flexible rates must be part of a regime whose operation agents take into account when forming expectations. Suddenly adopting a float because reserves are dwindling, as Mexico did in 1994 and as several Asian countries have done recently, may have the opposite effect by further frightening concerned investors. In fact, the case has been made that it was precisely the sudden (but late) abandonment of the peg that pushed Mexico to a "bad equilibrium" at the end of 1994.[26]

6.4 The Paramount Concern in Time of Crisis Should Be the Provision of Liquidity

The Asian troubles have ignited a lively debate on the wisdom of closing wobbly banks. The IMF has pursued that policy vigorously, making bank interventions and closures part of its conditionality in the affected countries. Fierce critics of this policy, such as Jeffrey Sachs, have charged that it invites runs on healthy banks and induces an unnecessarily sharp credit crunch.

The proper policy prescription clearly depends on one's assessment of the crisis. If the problem is primarily one of moral hazard and overlending (as Krugman, 1998, has claimed for Asia) or of outright fraud (as Akerlof and Romer, 1993, argue for the U.S. savings and loan crisis), banks are insolvent and should be either closed or forced to recapitalize. But if the problem is one of illiquidity, made acute by panicked behavior by depositors and creditors, as we have argued, liquidity should be injected into banks, not withdrawn from them, in order to avoid a costly asset liquidation.

25. Floating is not totally useless in this case, for panic by foreign creditors could perfectly well be triggered by a run by domestic depositors, with the outcome being self-fulfilling. For details on this line of argument, see Chang and Velasco (2001).

26. See Calvo (1994) and Sachs, Tornell, and Velasco (1996a).

Nonperforming loans typically shoot up in time of trouble, often reaching up to a quarter of bank assets. This would seem to confirm the insolvency-cum-closure view. The problem is that it is not clear whether bad loans are causing the crisis or being caused by it. Clearly, the combination of less bank credit, high real interest rates, and sharp real devaluations can render many loans bad that would have performed adequately had no liquidity crisis occured. In Chile in 1982 and Mexico in 1994, many investment projects were left for dead. But as anyone who bought a half-built shopping center in Santiago at that time knows, those investments turned out to be perfectly sound once the economy returned to normalcy, and their value in dollars has risen several times in the intervening fifteen years. This suggests that the liquidity problem may well be the more serious one, and that the authorities should think twice before they engage in policies of wholesale bank closure.

6.5 There Is a Case for an International Lender of Last Resort

If financial crises such as those in East Asia are at least partially caused by self-fulfilling liquidity squeezes on banks, there is a role for an international lender of last resort that can help overcome a financial system's international illiquidity. Funds from above to prevent unnecessary credit crunches and avoid costly liquidation of investment can increase welfare.

The usual (and valid) objection is moral hazard. But this need not be a rationale for policy paralysis. Fire insurance and bank deposit guarantees also risk inducing moral hazard, but the risk can be minimized by proper contract design and appropriate monitoring. No one advocates banning fire insurance simply because it leads some homeowners to be careless with their fireplaces. The same is true of an international lender of last resort.

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