

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 inter-state 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:

$$U = \int_0^1 e^{-\delta s} u(F_s) G_s. \quad (1)$$

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:

$$\delta = r. \quad (2)$$

For the sake of simplicity, we assume that this is an endowment economy.⁷ Every agent has an endowment that is temporarily lower:

$$y_t = \begin{cases} y(1 - \alpha), & t < T \ (\alpha > 0) \\ y, & t \geq T. \end{cases} \quad (3)$$

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

$$\int_0^1 E_t^g G_t = B_t \leq L . \quad (4)$$

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

$$\dot{E}_t = \mathcal{U}E_t + F_t - y_t , \quad \text{given } E_0 . \quad (5)$$

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):

$$c^* = y(1 - \alpha) + y\alpha e^{-rT} - rb_0. \quad (6)$$

Under a credit ceiling, the central planner's problem becomes¹⁴

$$MDx_{\{c_t\}_0^\infty} \int_0^\infty e^{-\delta s} u(F_s) ds$$

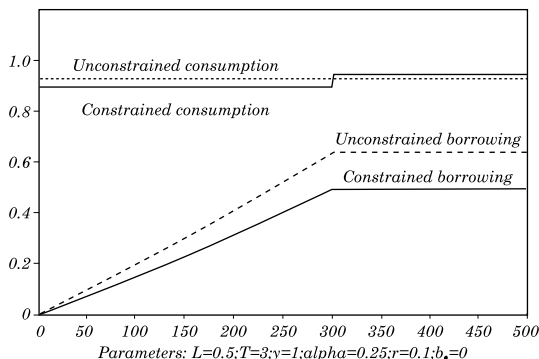
$$\text{subject to } \dot{E}_t = UE_t + F_t - y_t, \text{ given } E_0, \quad E_t \leq L \quad \forall t. \quad (7)$$

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 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 $b_\tau = L$.

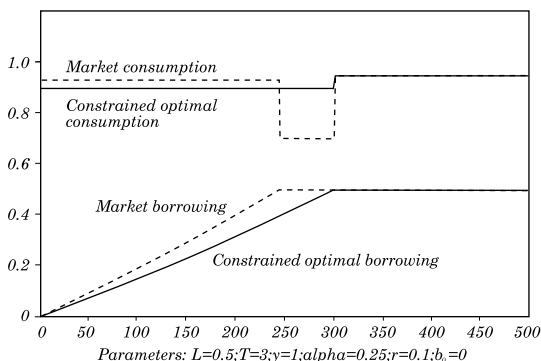
The representative agent maximizes the following equation:¹⁶

$$MDx_{\{c_t\}_0^\infty} \int_0^\infty e^{-\delta s} u(F_s) ds$$

subject to $\dot{E}_t = UE_t + F_t - y_t$, given E_0 , $E_t \leq E_t \Pi$ $t \geq \tau$. (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_τ^M until T (phase 2), and then jumps to a level c_τ^M from T onward (phase 3), in such a way that

$$b_t^M > b_t^P \quad \text{for } t < T$$

$$b_t^M = b_t^P = L \quad \text{for } t \geq T ,$$

$$y(1-\alpha)-rL=c_\tau^M < c_0^M < c_0^M < c_T^M = c_T^P = y-rL .$$

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: $c_r^M < c_0^P$. 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

$$y = y(\cdot), \quad wKH y_W \leq 0 \quad \text{and} \quad y_{WW} \leq 0.$$

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:

$$y(0) = Y(0) \geq sR_1(S, s) + (1-s)R_2(S, s). \quad (9)$$

A self-validating panic (that is, a panic crisis) occurs when the creditors' withdrawal leads to insolvency *ex post*:

$$y(W) = Y(W) < sR_1(S, s) + (1-s)R_2(S, s). \quad (10)$$

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

$$Y(\underline{S}) - \underline{S} = (1 - \underline{S}) / (1 - \rho) . \quad (11)$$

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 $\bar{S}$ as

$$Y(\bar{S}) = \bar{S} . \quad (12)$$

From equation (12) we see that $\bar{S}$ is the maximum level of risk-free short-term debt, in the sense that, up to $\bar{S}$, a run by the short-term creditors will always allow them to recover the promised payment by the firm. We assume $\bar{S} < 1$.

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

$$T(S) = \begin{cases} 1 & \text{if } \underline{S} < S \leq 1 \\ 0 & \text{otherwise.} \end{cases}$$

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

$$\begin{aligned} ST(S)\pi_1^R(S, s) + (1 - ST(S))R_1(S, s) &= 1 , \\ ST(S)\pi_2^R(S, s) + (1 - ST(S))R_2(S, s) &= 1 / (1 - \rho) , \end{aligned} \quad (13)$$

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

$$\begin{aligned}\pi_1^R(S, s) &= R_1(S, s) \text{ if } y(\cdot) \geq R_1(S, s), \\ \pi_1^R(S, s) &= y(\cdot) \text{ if } y(\cdot) \leq s.\end{aligned}$$

The long-term debt payment $\pi_2^R(S, s)$ is²⁶

$$(1 - s) \pi_2^R(S, s) = \max(y(W) - \pi_1^R(S, s), 0).$$

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 different than that of the whole economy.²⁷

If $0 \leq S \leq \underline{S}$, then $q(S) = 0$, and

$$R_1(S, s) = 1, \quad (14)$$

$$R_2(S, s) = 1/(1 - \rho). \quad (15)$$

If $\underline{S} < S \leq \bar{S}$, then $q(S) = 1$, and

$$psR_1(S, s) + (1 - p)sR_1(S, s) = s \Rightarrow R_1(S, s) = 1 \quad (16)$$

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 over-borrow 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.

$$S[y(S)-s] + (1-S)(1-s)R_2(S,s) = \frac{1-s}{1-\rho} \quad (17)$$

$$\Rightarrow R_2(S,s) = \frac{1-s-p(y(S)-s)(1-\rho)}{(1-p)(1-s)(1-\rho)} . \quad (18)$$

If $S > \bar{S}$, then $q(S) = 1$ and

$$py(S) + (1-p)sR_1(S,s) = s \Rightarrow R_1(S,s) = \frac{s-py(S)}{(1-p)s} \quad (19)$$

$$S0 + (1-S)(1-s)R_2(S,s)(1-\rho) = 1-s \quad (20)$$

$$\Rightarrow R_2(S,s) = \frac{1}{(1-p)(1-\rho)} . \quad (21)$$

For brevity, we define $F(S,s)$ as the financial cost of borrowing, that is, the function

$$F(S,s) = sR_1(S,s) + (1-s)R_2(S,s) . \quad (22)$$

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:

$$V(S) = \max_S (1 - ST(S)) [Y(0) - (SR_1(S,S)) + (1-S)R_2(S,S)] \quad (23)$$

Define S^* as the value that minimizes $F(S,s)$ over the range $S \in [\underline{S}, 1]$, provided that the parameterers are such that $\underline{S} \leq S^*$:

$$Y'(S^*) = -\frac{\rho}{p(1-\rho)} . \quad (24)$$

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 :

$$\underset{s \in [0,1]}{\text{Max}} U(s) = (1 - pq(S)) [y(0) - F(S, s)] . \quad (25)$$

As an equilibrium condition under symmetry, it is required that the choice of the representative firm be equal to the average:

$$s^M(S) = S = S^M . \quad (26)$$

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 $S \in [0, 1]$ 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):

$$\begin{aligned}
 F(S, s) &= \frac{1 - \rho s}{(1 - \rho)} \quad \text{if } 0 \leq s \leq \underline{S} \\
 &= \frac{1 - \rho s - p y(S)(1 - \rho)}{(1 - \rho)(1 - p)} \quad \text{if } \underline{S} < s.
 \end{aligned}
 \tag{27}$$

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 :

$$\begin{aligned}
 F_s(S, s) &= -\frac{\rho}{(1 - \rho)} < 0 \quad \text{if } 0 \leq s \leq \underline{S} \\
 &= -\frac{\rho}{(1 - \rho)(1 - p)} < 0 \quad \text{if } \underline{S} \leq s
 \end{aligned}$$

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 $\rho = 0$, 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 $\rho > 0$, 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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