BALANCE-OF-PAYMENTS RESCUE PACKAGES:

CAN THEY WORK?

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Abstract. This paper generates a typology of balance-of-payments crises under rational expectations, namely liquidity crises and solvency crises. The ex-post application of official financial rescue packages of sufficient size is a perfect cure for liquidity crises but amounts to an ineffective and costly bailout of private investors in the case of solvency crises. The anticipation of the rescue program encourages borrowing offsetting any solvency improvement. Due to likely imperfections in implementation, actual rescue programs entail official financial losses and may be easily counterproductive due to moral hazard. In particular, if liquidity and solvency crises cannot be distinguished, rescue programs heighten the risk of crisis.

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INTRODUCTION

The financial difficulties experienced in Mexico in 1994, characterized by abrupt Central Bank reserve losses and the unwillingness of investors to roll over public bonds despite good fiscal indicators, have provoked a reexamination of balance-of-payments crises. The unprecedented and ad-hoc gigantic rescue package put together by the international community (especially the United States Treasury, IMF and BIS) at the beginning of 1995 has spurred intense controversy, as well as deep concern on the part of those who see this kind of emergency as a natural feature of emerging markets. It has been agreed among G-10 countries that a new emergency financing mechanism, based on the IMF's General Agreement to Borrow, will be established to halt similar crises in the future. This paper analyzes the root causes that may give rise to external capital market crises of the kind observed in Mexico, as well as the efficacy of official financing packages in preventing or overcoming such crises.

Most of the debate concerning the Mexican crisis focused on exchange rate policy: whether the Mexican peso should have been devalued before the crisis and, if so, when and by how much. Such a policy focus is based on the implicit assumption that the crisis would have been avoided had Mexico followed a different exchange rate policy, certainly the one that, in hindsight, appears to be the best. We make the observation that the elimination of the real exchange rate disequilibrium through deep devaluation and free floating following the crisis did nothing to calm foreign investors or to diminish the need for a massive rescue package in order to avoid default, which casts doubts on the validity of this exchange rate-based interpretation of the crisis. We argue that an alternative way to interpret the evidence is to focus on the underlying factors adversely affecting foreign investors' perception of risks and returns in all financial instruments, whether or not they were subject to devaluation risk, over the course of 1994.[1] Under this interpretation, the pressure on the Mexican peso due to capital outflows and the financial crisis that made the rescue package necessary are both consequences of the underlying shift in investors' perceptions. A devaluation would relieve the first disequilibrium without necessarily affecting the second one.

Consequently, this paper focuses on the risk that a country might fail to honor its external obligations, which is the contingency whose anticipation triggers the rationing of foreign capital and is the natural premise for a balance-of-payments rescue package such as the one provided to Mexico. The focus on payments crises, as opposed to currency crises, deviates

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[1] This is in contrast with a recent paper by Sachs, Tornell and Velasco (1996), who interpret the crises in Mexico and other emerging markets with a model whose key feature is devaluation risk. Devaluation risk is certainly more important in the recent capital inflows episode than it was in the 1970s, a point that was stressed before the crisis by Dooley, Fernandez-Arias, and Kletzer (1995) to show the vulnerability of emerging markets, but it does not fully explain why Mexico could not roll over dollar-linked *Tesobonos* after the peso was let to float. We conjecture that the static model in Sachs et al. would produce a reversion of capital outflows after the devaluation takes place if a second period is considered.

from the traditional balance-of-payments crisis literature that began with the seminal paper by Krugman (1979). That literature has been concerned mainly with exchange rate crises (i.e., the collapse of a nonflexible exchange rate) and with the sudden loss of international reserves that precedes

them.[2] The next section elaborates on the importance of focusing on the payment crisis aspect of balance-of-payments crises in developing countries. While this paper was written with the Mexican crisis in mind, the modeling approach is quite general and its implications apply to all payment crises regardless of their causes.

In this paper, by definition, an external financial crisis occurs when a country does not honor a significant portion of its international financial contracts (e.g., the redemption of Mexican *Tesobonos*). The crisis emerges when the burden of external obligations is too large relative to the cost of default, in which case the country chooses not to pay.[3] Despite this element of "willingness to pay,@ however, it has been customary in the recent sovereign debt literature to recast this sovereign choice in terms of the traditional corporate bankruptcy model by defining the cost of default as the country's "capacity to pay."

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[2] An important exception is Calvo (1995), who develops separate models to illuminate various aspects of capital market crises without necessarily linking them to collapsing exchange rates. That piece inspired the generic analysis of the mechanics of balance-of-payments crises developed in this paper. Recent work by Atkeson and Rios-Rull (1995), which came to our attention after this paper was prepared, also focuses on payment crises.

[3] Costly default is required to sustain investment, although the nature and size of the costs of default are unclear because, unlike the corporate case, international collateral pledges are difficult to enforce. See Eaton, Gersovitz, and Stiglitz (1986) for an analysis of the costs of default. If the costs of default do not accrue to investors, e.g., through seizures, then the effective costs of default would result from bargaining between creditor and debtor, as discussed in Bulow and Rogoff (1989).

Following this convention, external financial crises are due to the country's "insolvency," or at least to a generalized perception of Ainsolvency@ that precludes new borrowing and leads to default.

That financial crises are due to widespread perceived insolvency is completely in line with Krugman's (1989) seminal insight that "there is no such a thing as a pure liquidity problem; it must arise because of doubts about solvency." Otherwise some loans would be available and the Aliquidity problem@ would cease to exist. Nevertheless, the Mexican balance-of-payments rescue package and the increased funding of the IMF so that it will be able to finance similar packages in the future are predicated on the belief that such packages are needed to provide the liquidity a country requires to dig itself out of a crisis. This strategy presumes that the country is solvent enough as to be able to repay all investors, including official rescuers, at the end of the rescue process. The contrast between the "liquidity" and "solvency" diagnosis is not new in the analysis of balance-of-payments crises. For example, it is very reminiscent of the debate between the Brady and the Baker strategies for solving the debt crisis of the 1980s, the first strategy calling for debt reduction in order to eliminate insolvency and the second strategy calling for debt increase in order to provide the liquidity needed for growth and the resolution of the crisis.

The first question that arises, then, is whether these two views of crises, solvency and liquidity, can be reconciled without simply assuming that the market is wrong in its doubts about solvency. In this paper we investigate this question by focusing on the effect that liquidity may have on solvency, following Calvo (1995). For example, lack of liquidity available to the public sector may require increased taxation or public prices, with the effect of reducing private and aggregate investment and, hence, solvency. Alternatively, lack of liquidity may lead to a reduction in public investment, whose aggregate effect on investment and growth may be drastically magnified by inefficiencies in the reduction program, such as the interruption of maintenance, and the negative effect on complementary private investment, as in fact happened in countries during the debt crisis of the 1980s. Lack of foreign exchange liquidity may also have a dramatic negative effect on aggregate investment and solvency if the tradeable sector is price inelastic and investment is import intensive, as observed in many countries during the imports contraction caused by the debt crisis.

The recognition of how liquidity affects solvency leads to a generalization of Krugman=s (1989) insight and enables us to meaningfully define liquidity and solvency crises, as well as the related concepts of panic and fundamentals-based crises, in the context of a unified framework. We do find circumstances under which crises can be appropriately termed liquidity crises and rescue packages make perfect sense, which bear some similarity to the seminal analysis by Diamond and Dybvig (1983) on bank runs and the role of deposit insurance. However, liquidity crises are possible only if the liquidity effects on solvency are sufficiently strong, as measured by a simple marginal net solvency condition. These liquidity crises correspond to multiple equilibrium situations, which in the context of this paper can be interpreted as sunspot equilibria of the kind recently characterized by Cole and Kehoe (1995).[4] The additional analytical structure in this paper enables us to explicitly identify these outcomes in order to evaluate the performance of rescue packages.

This general analysis of types of balance-of-payments crises is the foundation for our assessment of a balance-of-payments rescue program of the kind that is being envisaged after the Mexican crisis, the main ingredients of which can be summarized as follows. The relevance of liquidity crises as defined in our typology of balance-of-payments crises, which is key to justifying the application of financial rescue packages, requires strong liquidity effects on solvency, low Afundamental@ solvency, and investors who are prone to Apanic.@ Even if these conditions are met, the success of a balance-of-payments rescue program crucially depends on the degree of accuracy with which solvency and liquidity crises can be distinguished from each other when rescue packages are implemented, because in solvency crises, official rescue packages amount to ineffective costly bailouts of private investors. In contrast to the unanticipated emergency rescue package for Mexico, future packages of the type currently being envisaged will be anticipated by the market, which implies that their bailout component will be an implicit unpaid guarantee to foreign investors. This guarantee is a source of moral hazard that induces risky borrowing and turn the rescue program counterproductive..

The paper is structured as follows. Section 1 elaborates on the relevance and scope of the definition of external financial crisis used in this paper. Section 2 captures the essential elements of the problem in a simple model that formally defines concepts frequently used in policy discussions on the subject, and Section 3 analyzes the ex-post economic impact (i.e., the cost and effectiveness of resolving crises) of an emergency financing mechanism.

Sections 4 and 5 look at the ex-ante problem by building a formal model where foreign investors and country authorities rationally anticipate the availability of international rescue packages. Section 4 is the benchmark market case, with no official intervention, and Section 5 examines the effect of rescue packages (i.e., their cost and effectiveness in preventing crises) in a variety of scenarios. Section 6 summarizes the findings and concludes.

1. BALANCE-OF-PAYMENTS CRISES

Our definition of external financial crisis centers on the political risk of the country=s international obligations not being honored when they exceed the country=s capacity to pay. Since in international financial contracts massive default generally involves a purposeful government decision, as opposed to technical insolvency or actual inability to pay, we restrict our attention to politically based default. The anticipation of this failure to effect the payment of contractual obligations leads to capital rationing.

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[4]The paper by Cole and Kehoe came to our attention after this paper was prepared. We conjecture that the set of sunspot equilibria they identify in their model is empty unless a condition similar to the one we present in this paper for the existence of liquidity crises holds. This is important because without sunspot equilibria rescue packages do not work.

The definition is purposely agnostic about the underlying shock or disequilibrium prompting the external financial crisis in order to facilitate analysis of the common features of such crises and their remedies. This is important because the relevance of different types of shocks in crises is varied, or at least usually controversial. For example, as shown in Fernandez-Arias (1996), international interest rates are important for the debt-carrying capacity of debtor countries, i.e., for their credit ceilings and creditworthiness, and may provoke a regime switch between access to capital markets and rationing. Consequently, one leading cause of crisis in developing countries is the increase in international interest rates, which has been identified as a key factor leading to the debt crisis at the beginning of the 1980s and has also played an important role in the deterioration of Mexico=s capital account after February 1994. However, domestic factors have also deteriorated in the case Mexico and contributed to its recent crisis, although their extent and nature in terms of fundamentals is controversial. The definitions and models in this paper do not assume any particular underlying shock, and therefore their implications have general validity.

They are also flexible enough to accommodate a variety of factors underlying government unwillingness to honor the country=s financial obligations. For example, public sector Acapacity to pay@ depends on a combination of balance-of-payments factors (the external transfer problem) and fiscal factors (the internal transfer problem) that are relevant for both the burden of complying and the cost of default, as analyzed by, among others, Fernández-Arias (1991) and Montiel (1993), and empirically estimated by Bevilaqua (1995). Rigidities in the domestic financial system may also prompt government intervention in private markets which can also result in an external financial crisis.

This definition of financial crisis is broad. It includes the debt crisis of the 1980s, in which there was a generalized failure in a number of countries to honor public sector external debt obligations as well as in the private sector as a result of deliberate government interference, as opposed to commercial reasons, where substantial external private debt obligations were nationalized or controlled by the public sector. It also includes the current episode of private capital inflows attracted by the private sector, rather than by public sector borrowing, as in most cases leading to the 1980s debt crisis.[5]

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[5] Chile is an important exception to this public-private pattern. Chile fell into the debt crisis not because of high external public debt but through the nationalization of high external private debt, in what may be a preview of crises to come

Under this definition, external financial crises may originate in current account deficits of the private sector rather than in fiscal imbalances, either current or post-crisis. Such situations may come about as a result of either public or private foreign liabilities, since they impose a similar strain on the balance of payments (e.g., private sector capital outflows in Mexico during 1994 set the stage for the difficulties of redeeming public bonds once international reserves had been depleted).[6]

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now that Chile=s pattern is more common.

[6] Furthermore, the Mexican crisis was not confined to the public domain. Lustig (1996) reports that Mexican banks were also unable to renew certificates of deposit.

Loss of reserves and exchange rate crises are neither necessary nor sufficient for external financial crisis. First and foremost, exchange rate crises need not be accompanied by external financial crises. In the context of this paper, a financial crisis is caused by the adverse evolution of the underlying determinants of capital inflows and country risk, which creates the conditions for capital outflows and for the country not to honor international obligations. If capital outflows result from an unsustainable fixed exchange rate that is expected to be devalued, an exchange rate crisis leading to a float would eliminate the disequilibrium and, therefore, should not lead to a financial crisis of the kind analyzed in this paper.[7] Conversely, currency crises are not necessary for payment crises: flexible exchange rate regimes may precede default. Furthermore, many countries ran arrears during the 1980s while accumulating substantial reserves. While a large fall in international reserves usually occurs before default materializes, it sometimes does not, depending on economic circumstances and strategic considerations. Therefore, in this paper the factors determining capital flows and country default risk are essential, while international reserves and the exchange rate are peripheral.

2. SOLVENCY AND LIQUIDITY CRISES

[7] Presumably, this would have also been the case in Mexico after the currency was allowed to float in December 1994, had there not been other problems. The case can be made that the remaining problems, as well as the loss of reserves suffered throughout 1994, had to do with fundamental doubts about Mexico's future capacity to pay. If so, then the analyses of the Mexican crisis that emphasize exchange rate policy as well as the timing and size of the devaluation may be misleading.

In this section, solvency and liquidity crises are defined and characterized in the context of a model where all agents possess the same information and are fully rational, including rational expectations. For simplicity, the model in this section features an economy where all liabilities take the form of debt denominated in foreign currency.[8] This assumption leaves

[8] This simplification is justified not only because of the relative importance of this class of financial instruments in actual portfolios, but also because most classes of foreign investment are likely to be affected by an external financial crisis (see Fernández-Arias, 1996, technical appendix).

out devaluation risk and enables us to focus on default risk, which is the key ingredient of payments crises.[9]

A Simple Model

The dynamic elements of the problem can be captured in a simple two-period model. Foreign liabilities take the form of bonds D maturing at the end of period 1 and carrying a debt service obligation C (encompassing both principal and interest). In this section we take both contractual variables D and C as given parameters.[10] At the end of period 1, new bonds N maturing at the end of period 2 are issued, including maturing bonds that are rolled over (not redeemed) either voluntarily or through arrears. Therefore, the net flow of resources received by the country in period 1 is F=N-C.

As it is customary in sovereign debt models, we assume that there is a maximum net amount that a country would pay toward its foreign liabilities in any given period, which relates to some measure of Acapacity to pay.@ We denote by x_1 and x_2 the maximum resources available for the net debt service in periods 1 and 2, respectively. The country=s solvency is defined as the expected present value of this stream of resources, discounted at the investor=s alternative rate of return. This sovereign case differs from the corporate case in that assets cannot be legally seized, and as a result the debtors= wealth and the country=s wealth far exceed this measure of solvency. This customary economic definition of country solvency is appropriate for this purpose.

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[9] This case is complementary to the case analyzed by Sachs, Tornell, and Velasco (1996), where the opposite assumption is made, i.e., foreign debt is in the form of bonds denominated in domestic currency, in order to focus on currency crises.

[10] The endogenous determination of volume and terms of external finance will be addressed in the ex-ante analysis in sections 4 and 5.

To simplify, we assume that as of the end of period 1 there is no uncertainty about period 2, so that capacity to pay x_2 is known with certainty. (The relaxation of this assumption would introduce algebraic complications without adding new insights.) To simplify notation, but without loss of generality, second-period capacity to pay x_2 is expressed in present value form, discounted at the risk-free rate, and is therefore the credit ceiling in period 1. New lending N, not exceeding that ceiling ($N \leq x_2$), is voluntarily lent, and assuming competitive lending, the riskless rate is charged. Alternatively (if $N > x_2$), partial default results and lending is involuntary.

Based on the previous analysis and following Calvo (1995), in this model liquidity matters for solvency. The lower the net flow of resources received by the country in period 1, that is, the higher the net redemptions paid out in period 1, the lower the level of repayment resources available in period 2. A financial crunch in period 1 leads to lower investment and capacity to pay, which may be extremely damaging if unit adjustment costs increase with the severity of the crunch. Specifically, the repayment capacity in period 2, x_2, is linked to the net flow of resources made available in period 1, F, such that $x_2 = x_2[F]$, $x_2' \geq 0$, $x_2'' \leq 0$.

Definition: A crisis occurs when legally binding contracts are not honored. In this two-period formulation, four types of outcomes can be characterized based on this definition:

Outcome	**Period 1**	**Period 2**
(No crisis)	No crisis	No crisis
(Crisis Type I)	Crisis	Crisis
(Crisis Type II)	No Crisis	Crisis
(Crisis Type III)	Crisis	No crisis

Characterization of Market Equilibrium

In this section, we analyze the market equilibrium resulting from the interaction of competitive bondholders, without the interference of international financial institutions, and characterize the equilibrium outcomes and types of crises that emerge.

By definition, a crisis occurs in period 2 when contractual debt service associated with the outstanding bonds N is not fully serviced. Under the certainty assumption of this model, this occurs when $N > x_2[N-C]$. In this case, lending in period 1 is involuntary (profits over the second period are negative), and therefore the repayment is constrained at its maximum feasible level. In principle, repayments in period 1 may be constrained by either the country's capacity to pay x_1 (Type I crisis) or the level of debt obligations coming due C; that is, the creditors' contractual legal claims (Type II crisis).

A Type I crisis obtains when obligations exceed capacity to pay ($C > x_1$). In this case, net flows and second-period capacity to pay are minimized: $F = -x_1$ and $x_2 = x_2[-x_1]$. In that case, there is involuntary lending ($N = C - x_1 > 0$) and the second-period crisis condition takes the form $C - x_1 > x_2[-x_1]$. Therefore, if $C > x_1$, in this model a crisis in the second period is a sufficient condition for crisis in the first period. A Type II crisis, however, can be ruled out in this model because it is inconsistent with second-period crisis, since all debt is repaid (N=0).

Conversely, a crisis occurs in period 1 when the net debt service obligations that creditors demand exceed maximum capacity to pay, in which case actual lending N reaches its minimum level $N = C - x_1$ (necessarily positive in this case). The previous condition for second-period crisis evaluated at this critical point ($C - x_1 > x_2[-x_1]$) is now a necessary condition for crisis in period 1: If outstanding debt does not exceed capacity to pay, then competitive lending yields zero profits over the second period and there is no reason for bondholders to insist upon redeeming bonds beyond the country's capacity to pay (or for new lenders not to voluntarily replace excess redemptions). Therefore, in this model crisis in the second period is a necessary condition for crisis in the first period.

This discussion rules out the possibility of Type II and Type III crises as a market equilibrium outcome.[11] Only two outcomes are possible in market equilibrium: I) there is no crisis at all ("No Crisis"); or ii) there is a crisis in both

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[11] In a model with second-period debt, Type II crises are possible. In a model with uncertainty in the second period, the necessary condition $C_1 + C_2 - x_1 > E[x_2]$ is not equivalent to crisis in the second period (since it only refers to expected values), and therefore, Type III crises are possible (i.e., the country may be sufficiently lucky in the second period and the crisis may resolve).

periods (ACrisis Type I@). The most interesting case for the issue at hand--rescue packages to resolve crises--is the one where a crisis in period 1 is possible; that is, $C > x_1$. In this case, crisis in period 2 is a necessary and sufficient condition for crisis in period 1.

These types of equilibrium outcomes can be characterized as follows:

No Crisis: $F \geq -x_1$ and $F+C \leq x_2[F]$

(The above inequalities determine a supply range in terms of the amount of new lending N=F+C. The actual equilibrium depends on demand, to be modeled in subsequent sections.)

Crisis: $F = -x_1$ and $F+C < x_2[F]$

What Is a Liquidity Crisis?

Crisis (of Type I) obtains when maximum enforceable payments x_1 are made in period 1 and the resulting second-period contractual obligations exceed capacity to pay. This is the case when $C > x_1 + x_2[-x_1]$. The implication is that if $C \leq x_1 + x_2[-x_1]$, then crisis does not occur. The interpretation of this standard condition is that crises occur when outstanding obligations exceed solvency.

However, this model differs from the standard model in that solvency is not predetermined but depends on liquidity. In this model, the non crisis condition $C \leq x_1 + x_2[-x_1]$ is sufficient but may fail to be necessary for crisis avoidance: The non crisis outcome can be attained for $C \leq x_2[F] - F$, with $F \geq -x_1$, of which the previous sufficient condition corresponds to the particular case $F=-x_1$. Increased liquidity $F > -x_1$ may avoid the crisis.

This generalized non crisis condition can be interpreted as debt obligations not exceeding solvency under a feasible financial arrangement. If additional new financing is allowed (subject to the constraints that second-period solvency is not violated), then the set of debt obligations C consistent with non crisis outcomes could expand, in which case it would overlap with the set defined by the crisis condition already identified. This area of intersection corresponds to market crises that can be avoided by appropriate debt service rescheduling, in contrast to unavoidable crises for which rescheduling is no cure.

Ultimately, ex-post, all crises among rational agents are due to expected insolvency. However, in order to explore the nature of crises, it is necessary to go beyond the previous typology of how crises manifest and analyze the underlying conditions that give rise to them. The previous concept of crisis avoidability provides a basis for such analysis:

Definition: A liquidity crisis is a crisis that can be avoided through the provision of liquidity at market terms (appropriate rescheduling in the context of this model).

Definition: A solvency crisis is a crisis that cannot be avoided through the provision of liquidity at market terms.

Based on these definitions, we consider the liquidity provision that supports maximum debt obligations:

$$F_{\max} = argmax\,(x_2[F] - F), \text{ subject to } F \geq -x_1 \qquad (1)$$

Under the assumption that second-period capacity to pay is increasing and concave in liquidity,

$F_{max} > -x_1$ if and only if $x_2'[-x_1] > 1$. In other words, optimal liquidity deviates from the crisis outcome $-x_1$ if and only if the marginal solvency impact of additional liquidity under crisis conditions is large enough to increase the resources available for payment net of the new lending; that is, for payment of the rest of the debt. Otherwise, $F_{max} = -x_1$ and there is no liquidity infusion on market terms that could avoid the crisis.

Therefore, there is a (non empty) set of liquidity crises if and only the liquidity effect on solvency is strong enough:

$$x_{2'}[-x_1] > 1$$

The fact that liquidity matters for solvency is not enough to produce liquidity crises. This is analogous to the perverse effect of debt overhang studied in the sovereign debt literature. In that case, the fact that the debt stock matters for solvency is not enough to produce a Laffer curve and justify unilateral debt forgiveness.

If liquidity effects are strong enough, then there is an overlapping interval between the crisis and the non crisis regions that corresponds by definition to liquidity crises:

$$x_1 + x_2[-x_1] < C \leq -F_{\max} + x_2[F_{\max}]$$

(1)

Consequently, the three relevant intervals determining the likelihood of crises are: I) the solvency interval, where no crisis can occur; ii) the illiquidity interval, where a (liquidity) crisis may or may not occur depending on available liquidity; and iii) the insolvency interval, where a (solvency) crisis necessarily occurs. In terms of the model, they are:

Solvency: $C \leq x_1 + x_2[-x_1]$

Illiquidity: $x_1 + x_2[-x_1] < C \leq -F_{max} + x_2[F_{max}]$

Insolvency: $C > -F_{max} + x_2[F_{max}]$

Notice that it remains true that any crisis, even if of liquidity, signals weak solvency. The illiquidity interval lies between the solvency and insolvency intervals, which implies that a liquidity crisis cannot occur if solvency is strong.

In the illiquidity interval there are two market equilibria: one where a crisis results, and another one where the crisis is avoided. By definition, liquidity crises require the existence of multiple equilibria. It is important to note that within the illiquidity interval, the provision of the liquidity required to avoid the crisis is an equilibrium fully consistent with individual investors= profit maximization; i.e., no participating investor has an incentive to withdraw and Afree ride@ on the rest. Therefore, which equilibrium is realized is purely a matter of coordination. Precisely because the failure of such a happy equilibrium requires the shared expectation of a massive defection, it is natural to define the so-called panic crises as liquidity crises.[12]

It is interesting to note that when liquidity effects are strong and condition (2) is met, it is always in the creditors= collective interest to provide adequate liquidity when facing a crisis. If solvency is not too weak, such action prevents a liquidity crisis, as noted above. If solvency is weaker, the (solvency) crisis is unavoidable but, nevertheless, losses can be minimized by providing liquidity F_{max}, which entails a defensive lending of $F_{max} + x_1 > 0$. But the analogy between liquidity and solvency crises stops there. In the case of a solvency crisis, such provision of liquidity is not an equilibrium, and therefore participating investors would have an incentive

to withdraw and free ride on the liquidity provided by the rest. A non market enforcement mechanism, beyond pure coordination, would be required in this case.

Some of the debates concerning debt crisis strategies can be interpreted along these lines. For example, the Baker strategy, where commercial banks were indicated the amount of resources they should provide in the aggregate on a voluntary basis, could be suitable for a liquidity crisis as defined above. Conversely, in a solvency crisis commercial banks would cooperate with an efficient solution only if additional compensation or pressure is provided, as in the Brady strategy. The failure of the Baker strategy in bringing liquidity would indicate that the debt crisis was a solvency, rather than a liquidity, crisis, at least by the mid-1980s.

3. THE ROLE OF INTERNATIONAL RESCUE PACKAGES

[12] Whether or not a potential liquidity or panic crisis would materialize, i.e., which one of the two equilibria is selected, is not addressed in this paper. These panic crises correspond to the self-fulfilling crises in Cole and Kehoe (1995).

We now analyze a situation where a credit line is made available to the country by a third party in order to avoid crisis in period 1, from which a loan L (an international rescue package) is drawn. We consider the optimistic case in which the credit line is unlimited, and leave out the case in which an otherwise successful rescue package may fail because of lack of resources. Consequently, since a crisis in the first period can always be avoided if this loan is sufficiently large (e.g., L=C), we assume this objective is achieved. We also assume for concreteness that this third party is an official senior creditor (say IMF), but the conclusions also hold if the third party has (de facto) equal seniority vis-á-vis private bondholders.

Crises can now be private or official depending on whose claims are not honored. Furthermore, this third party intervention leads to the following changes in the model. First, the net flow of resources received by the country is augmented by the official loan: F*= N-C+L. Second, first-period capacity to pay to bondholders is increased by the official loan to $x_1^* = x_1 + L$.[13] Third, second-period capacity to pay to bondholders is reduced by the senior official loan to $x_2^* = Max(0, x_2[F^*]-L)$.[14] Now the relevant private credit ceiling is x_2^*, and private default occurs when $N > x_2^*$.

A rescue package that avoids a crisis in the first period (i.e., no contract is breached) implies that there is no involuntary new private lending: either private bondholders have profitable investment opportunities available and voluntarily lend (N > 0), or they do not have profitable opportunities and fully exit (N=0). We analyze both cases in turn.

If there is positive lending, then it does not exceed second-period solvency available to private investors: $0 < N \leq x_2^*$. Therefore, official lending does not absorb all of the country=s second-period solvency: $x_2^* = x_2 [N-C+L] -L>0$. This ensures that official creditors will be repaid, and therefore no crisis, private or official, occurs in either period. This non crisis condition is:

$$N \leq x_2 [N - C + L] - L \quad with \ C - N \geq x_1 + L \quad and \quad N > 0$$

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[13] The precise level of the first-period maximum enforceable payment to bondholders depends on how third party intervention is structured (see Fernández-Arias, 1991 for a game-theoretic analysis). The assumption in the text is an upper bound that maximizes the package=s chance of success.

[14] This reflects the customary Asingle pool@ assumption, in which creditors share a given overall country=s capacity to pay x_2. In particular, it implicitly assumes no scope for conditionality associated with official lending, at least in terms of expected repayment capacity. This assumption appears largely justified in the context of an emergency rescue package, in which a credible government=s commitment (e.g. through tranching) is difficult to establish.

(4)

Substituting F=N-C+L and rearranging, it can be easily checked that equation (1) again determines the net flow of resources that support maximum debt obligations, and therefore a crisis cannot be avoided unless $C \leq - F_{max} + x_2 [F_{max}]$ (the lower bound of the insolvency interval). Within this interval, there is a range of feasible overall lending (N + L)>0, but the private and official components are perfect substitutes and are not determined. It can be easily checked that the converse also holds: if indebtedness is outside the insolvency interval, then a rescue package can lead to voluntary private lending. In particular, a loan $L = F_{max} + C$ leads to strictly positive profits at N = 0 $(0 < x_2 [F_{max}]-(F_{max}+C))$.

Therefore, adequately implemented international rescue packages solve liquidity crises. They do so at no cost, because the country retains enough solvency to pay them back in full. In practice, once a liquidity crisis begins to manifest, the use of a rescue package would restore confidence and allow the country to regain access to markets. If adequately engineered, private voluntary lending would perfectly substitute official lending and fully roll back the rescue loan. Even more, in theory, the availability of a sufficiently large line of credit should prevent liquidity crises from occurring at all: the liquidity crisis outcome would cease to be an equilibrium as the expectation of a liquidity crunch becomes unjustified, and the unique, fundamentals-based equilibrium would prevail. The line of credit would be totally effective, cost free, and would never need to be actually used!

However, rescue packages largely fail with solvency crises. As noted above, in the insolvency interval private voluntary lending is not maintained. In that case, N = 0 and private solvency is null: $0 = N = x_2 *$. This implies that the rescue loan L absorbs all of the country=s second-period capacity to pay. Since liquidity is F*=N-C+L=L-C, then $L \geq x_2 [L-C]$. Therefore, official creditors are not paid in full. It is easy to check that the financial loss is minimized at $L_{max} = C+F_{max}$, in which case the cost of the rescue package is $(C+F_{max})-x_2 [F_{max}] > 0$.

If liquidity effects are weak in the sense of equation, (2), that is $x_2' [-x_1] \leq 1$, the official loss is at least as large as the implicit subsidy to private bondholders (it is identical if the official loss is minimized) and the country would benefit from the rescue package only if the official sector does not minimize its losses. If liquidity effects are strong, then $F_{max} > -x_1$ and optimal liquidity leads to an efficiency gain resulting from the alleviation of the liquidity crunch, which is shared between the country and the official sector in the form of smaller losses (relative to the private gains).

But in all cases, the **A**successful@ application of international rescue packages in the case of solvency crises amounts to a costly bailout of private bondholders. The market solvency crisis is avoided at the cost of an official solvency crisis in the second period.

This analysis suggests the rule of using international rescue packages in the case of liquidity crises but not in the case of solvency crises. Unfortunately, it appears difficult to distinguish between the two types of crises in a way that makes this rule operational. Consequently, if rescue packages are used, they can be expected to be used in insolvency situations with some frequency, even if there is no intention of a costly bailout. We make the observation that the fact that the Brady strategy and its implicit shift to an insolvency diagnosis came only after several years of debt crisis points to a significant risk of failing to recognize solvency crises in a timely fashion, specially in the emergency situations being analyzed.

The expected cost of a rescue package is determined by the probability that it will be applied in a solvency crisis, in which case it is a bailout. This probability of misapplication depends positively on the risk of detection failure (i.e. the probability that a solvency crisis is misdiagnosed as a liquidity crisis, q) and negatively on the relevance of liquidity crises (i.e. the probability that a crisis is a liquidity crisis, l), according to the expression $p=q(1-l)/(l+q(1-l))$. Ex-post, the application of emergency rescue packages is worthwhile when the probability of missaplication p is low enough. The previous analysis suggests sizable detection errors (large q) and a narrow range supporting liquidity crises (small l), and therefore a significant probability p that rescue packages are bailouts.

What can be said about the Mexican crisis and rescue package based on the previous analysis? In theory, the very application of a rescue package would reveal ex-post whether the crisis was one of liquidity or solvency, depending on whether or not the country regains access to private markets and the official loan is quickly repaid in full. Shortly after the Mexican currency adjustment, not even the announcement of an $18 billion rescue package, roughly equivalent to Mexico=s entire stock of short-term public bonds in the hands of foreigners, was enough to stop the run. The payment crisis was finally avoided by the pledging of an unprecedented rescue package of almost $50 billion, roughly equivalent to all of Mexico=s external obligations for 1995, about half of which were disbursed and remained outstanding (see Lustig, 1996, for details). On these grounds, the evidence indicates that the crisis was one of solvency and that, therefore, the rescue package was a costly bailout.[15] However, in 1996 Mexico has started repaying its US loan ahead of schedule replacing it with bonds purchased by private investors. True that this successful bond offering is far from full access to market as it required the collateralization with Pemex oil revenues in what amounts to an erosion of the privileged status of senior creditors, but it is an improvement in the private perception of Mexico's solvency relative to the time of the crisis.[16] Whether this development indicates that the initial perception of insolvency was unfounded or that events unfolded better than could be initially expected is unclear.

4. MARKET EQUILIBRIUM

The previous sections took the terms of the debt contracts (amount D and repayment terms C) as given parameters. However, the availability of rescue packages should reduce the ex-ante private perception of country risk. This opens the interesting possibility of optimal packages being effective policy instruments for dealing with solvency crises, despite being

[15] The argument can be made that by the time the package was approved and put together the damage had already been done. But the Mexican package was put together in record time. If the success of these packages is so dependent on their quick approval and application, then this is one more reason to be concerned about the effectiveness of these programs.

[16] Nevertheless, it should be kept in mind that the US loan repayments came under considerable pressures resulting from the US political circumstances. In contrast, as of August 1996, the IMF loan is not being repaid and the standby agreement is being extended.

ineffective ex-post, by inducing less expensive repayment terms, thereby making insolvency less likely. In any event, a full analysis of the effect of international rescue packages requires taking into consideration that debt contracts are often altered in anticipation of the possible application of these packages. This section builds a full model to analyze this ex-ante problem and describes the market solution that emerges in the absence of rescue programs. The next section introduces rescue programs into the model.

The following simple model builds on the previous one and captures the essential elements of the ex-ante problem. (As before, all variables are expressed in present value terms.) There are three periods: 0, 1, and 2 (which may be considered the condensation of the infinite future). As before, debt D is acquired in period 0 and due in period 1 in the amount C. In period 1 there is new lending which translates into a net flow of resources F. Finally, in period 2 there are final repayments.

Production in periods 0 and 1 is known and exogenous (and equal to one for simplicity). External resources, both the initial inflow D and the subsequent net inflow F, are invested and yield returns in period 2. Production in period 2 increases with the initial long-term investment D and also with the subsequent liquidity F, required to obtain a high yield from the original investment. In summary, production at time 2 is s+g[D]+v[F], g[0]=v [0]=0, with both g[.] and v[.] increasing and concave, where g(D) is the basic return of the investment and v(F) is the liquidity effect on production.

Apart from the use of external resources, production (and overall solvency) in period 2 is uncertain at time 0 when the debt contracts are closed. Specifically, at time 0, s is random and, as before, uncertainty is fully resolved at time 1 when debt is due. As customary in the sovereign debt literature, capacity to pay is endogenously modeled as a fraction ? of production. Therefore, capacity to pay is ? in period 1, which implies that F$\geq$-?. Capacity to pay in period 2 is ?(s+g[D]+v[F]), where s is assumed to be at least -v[-?] to ensure that production is non-negative. Therefore, the marginal solvency effect of liquidity highlighted in this model equals ?v'[F].

It greatly simplifies the algebra to consider the increasing and concave liquidity function v[.] as: v[F]=cF, with c>0, for F<0, and v[F]=0 for F$\geq$0. Let k=?c be the liquidity effects as measured in condition (2). Strong liquidity effects obtain when k>1, which will be generally assumed to allow for an illiquidity interval and make the problem interesting. As to optimal

liquidity in equation (1), F_{max}=0 (any positive net flow F is equivalent). Then, the period -1 problem simplifies to F=-? if there is crisis and to F=0 otherwise.

Consequently, the solvency, illiquidity, and insolvency intervals expressed in solvency space are:

Solvency: s $\geq$ C[D]/? - (g[D]-(k-1))
Illiquidity: C[D]/? - (g[D]-(k-1)) < s $\leq$ C[D]/? - g[D]
Insolvency: s < C[D]/? - g[D]

Default occurs in the insolvency interval (solvency crisis) and may also occur in the illiquidity region (liquidity crisis). For strong liquidity effects (k>1), we assume that liquidity crisis is realized in the relatively more insolvent states of the illiquidity interval, when investors may be more prone to panic:
Liquidity Crisis: C[D]/? - (g[D]-p(k-1)) < s $\leq$ C[D]/?- g[D]
Solvency Crisis: s < C[D]/? - g[D]

The parameter p represents the proportion of the illiquid states that result in actual liquidity crisis, that is the probability that the nonfundamental, sunspot equilibrium is selected when there are multiple equilibria. If p = 1, all illiquid states result in liquidity crises (investors always panic); if p=0, none does (investors never panic). The case of weak liquidity effects (k $\leq$ 1) can be obtained by setting p = 0, in which case the illiquidity interval vanishes and default occurs only in the insolvency interval.

Therefore, default occurs when s<s[D], with the threshold state s[D] such that ?(s[D]+g[D]-p(k-1))=C[D]. P=P(s<s[D]) denotes the probability of default evaluated at time 0. To simplify, it is assumed that s follows a uniform distribution, so that p is the probability of a liquidity crisis given than an illiquid state is realized. Consequently, the probability that a crisis is of liquidity, l, equals p(k-1)/P. Without loss of generality, it is assumed that the range of s is [m,m+1]. Then for an interior s[D], P=s[D]- m.

The country's welfare function is assumed to be the expected present discounted value of income. Since creditors lend at a expected zero profit, this welfare function at time 0 collapses to W[D]=2+E[s]+g[D]+E[v[F]], where E is the expectation operator. Therefore, ex-ante welfare maximization amounts to maximizing g[D]+[v[F]]; that is, the efficiency gains due to external borrowing, which under the assumptions equals g[D]+kP. Therefore, for an interior solution where

0<P<1, the objective function can be written as U[D]=g[D]-ks[D].

The sequence of decisions is as follows. At time 0, debt D is acquired and carries a contractual debt service C[D] due at time 1. At time 1, s is realized. If s<s[D], there is default: F=-? and overall repayments amount to ?(s+g[D]-(k-1))<C[D]. If s≥s[D], there is full compliance: overall repayments amount to the contractual amount C[D] and, without loss of generality, F=0. Lenders set the schedule C[D] such that these expected payments recover the initial investment D (zero profit condition). All agents have the same information and have rational expectations.

Note that in this model it is always efficient to increase external borrowing. If liquidity were not a factor, initial debt D would be equal to the credit ceiling. (We assume that the marginal effect of borrowing on capacity to pay is less than unitary (?g<1) to ensure that a credit ceiling exists and borrowing is finite.)[17] However, since the liquidity crunch that would result from default is a factor, initial borrowing is moderated in order to leave room for additional liquidity in non default states. This tradeoff results in risky initial borrowing when incentives to borrow, as opposed to waiting, are sufficiently high. A sufficient condition for risky borrowing is ?g>k/(1+k), which we assume in order to make the problem interesting.

The country concentrates its choice on initial borrowing D. For an interior solution, it maximizes the objective

[17] It is further assumed that k<2 to ensure the credit ceiling is risky. It will be shown that the exact condition is: $k < (2 - p) / (1 - p)$. If the conditional probability of panic p is small, stronger liquidity effects make lenders unwilling to lend in the face of any risk of default.

function (4), where the threshold default state function s[D] (and the contractual terms function C[D]) results from the zero-profit condition (5) and the default condition (6):

MARKET EQUILIBRIUM

Objective

(0)

Zero profit

$$\text{Max}_D U[D] = g[D] - ks[D]$$

$$\int_{m}^{s[D]} l(s + g[D] - (k - 1))ds + \int_{s[D]}^{m+1} (C[D])ds = D$$

(2)

$$l(s[D] + g[D] - p(k - 1)) = C[D]$$

Default

(2)

Differentiating (5) and (6), it is established that the default state function (s[D]) and the terms functions (C[D]) are increasing and convex functions of debt D (see appendix). For low levels of debt, no spread is charged (C[D]=D) and the probability of default is zero (s[D]<m and P=0, consistent with (6).) When borrowing is risky (P>0), positive and increasing spreads C[D]-D are charged until the credit ceiling is reached at P=1-(1-p)(k-1). Notice that credit rationing does not necessarily signal default unless the illiquid region always leads to investor panic and default. [18]

The convexity of these functions implies that the objective function U[D] is concave and that as long as there is a liquidity effect (k<0), optimal borrowing D* is determined by the first-order condition:

$$g'[D^*] = k's[D^*]$$

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[18] If liquidity effects are weak ($k \leq 1$), it is easy to check that the credit ceiling obtains at P = 1 (certain default).

(2)

It is shown in the appendix that the optimal borrowing condition (8) entails risky borrowing short of the credit ceiling (0<P*<1- (1 - p) (k -1).) To make the problem interesting for the next section, we will assume that this optimal choice of P* entails some risk of solvency crisis; that is, P*>p(k-1). Therefore, the probability of a liquidity crisis is p(k-1) and the probability of a solvency crisis is P*-p(k-1).

5. EFFECTIVENESS OF INTERNATIONAL RESCUE PROGRAMS

By definition, a perfect rescue package is one applied in the event of a liquidity crisis, in which case it is cost free and totally effective, and not applied in the case of a solvency crisis, in which case it is costly and ineffective for avoiding a crisis. A perfect package does more than perfectly prevent liquidity crises: since it improves country risk ex-ante, it also leads to lower risk premia. Through this channel, even though a perfect package is not applied to insolvency situations ex-post, it has an indirect effect on reducing the risk of solvency crises by making repayment terms more affordable. However, before concluding that (perfect) packages would be, after all, effective policy for dealing with the problem of solvency crises, we need to consider their positive effect on the incentives to borrow to take advantage of better terms.

The effects of a perfect international rescue package can be studied in the unified framework of conditions (5), (6), and (7) as follows. Consider the default condition ?(s[D]+g[D] +?)=C[D], where insolvency risk is P+?. The market benchmark case developed in the previous section obtains for ?=-p(k-1)≤0. A perfect rescue package guarantees full payment in the event of liquidity crises, and can therefore be seen as, ceteris paribus, reducing the crisis threshold s[D] by setting ?=0, in which the case default occurs only in the insolvency intervals s<C[D]/? - g[D]. The generalized default condition that obtains is:

$$l(s[D] + g[D] + r\ ) = C[D]$$

(2)

The zero-profit condition (6) remains unchanged because s[D] refers in all cases to private default risk, in this case after the package is applied. Since in the case of a perfect package there is no bailout cost, the objective function (5) is also unchanged. Therefore the generalized optimal borrowing problem amounts to maximizing the same objective functions (5), given conditions (6) and (8). The problem retains the same general characteristics (see appendix) and, therefore, optimal borrowing is obtained by the same first-order condition, where the parameter ? is now emphasized:

$$g'[D^*] = ks_2[\ r\ , D^*]$$

(2)

The availability of (rationally anticipated) packages increases country creditworthiness and, therefore, would lead to correspondingly lower risk premia for any given borrowing amount, which reduces insolvency risk. However, as shown in the appendix, optimal private borrowing D* also increases with the rescue program as a reaction to these better terms, which increases insolvency risk. Therefore, the question of the net result of the package program on insolvency risk is in principle ambiguous.

Under the simplifying linear assumption that g@=0, optimal borrowing implies that the introduction of a perfect rescue program does not alter the probability of insolvency prevailing in the market benchmark case (see appendix). Therefore, a perfect package reduces the probability of crisis by p(k-1), that is, the probability of liquidity crisis, leaving the probability of solvency crisis unchanged. In this model, the effects of more affordable terms and increased borrowing exactly cancel each other. This result assumes that the official rescue package is not tied to conditionality: Effective conditionality would alter the constraints in the country=s maximization problem and could lead to lower borrowing and insolvency risk. However, such conditionality would not be credible, and therefore effective, because the incentives to enforce it are not time-consistent. The failure to meet the conditions would call for the nonapplication of rescue packages in the event of liquidity crises, while it is ex-post optimal to apply them.[19] The result remains that rescue packages are ineffective for dealing with solvency crises.

The modest achievements of even a perfect rescue package should be interpreted as a warning, since its implementation is not feasible in reality. The rule of applying official rescue packages if and only if the crisis is one of liquidity implies a solvency assessment riddled with verifiability and commitment problems, let alone purely technical difficulties. The application of such a rule is subject to significant errors, which justifies the study of imperfect packages. The most interesting and realistic case is one where rescue packages are (unintendedly) applied to solvency crises with probability q > 0. This over-application in solvency crises is accompanied by under-application in liquidity crises unless liquidity crises are perfectly detected. In particular, if liquidity crises cannot be distinguished from solvency crises, rescue packages are applied to all crises, liquidity and solvency, with probability q.

The default condition (8) is also applicable to these imperfect packages, where ?=-p (k-1) corresponds to the case in which liquidity and solvency crises are not distinguished (as in the market solution) and where ?=0 corresponds to the case of perfect detection of liquidity crises (as in perfect packages). However, the zero-profit condition changes to reflect that with imperfect packages there is a range of crises in which private creditors are fully compensated with probability q. This range includes solvency crises, where the compensation amounts to a bailout, and liquidity crises when they are imperfectly detected. If the bailout resources are unlimited, so is the fraction q to be captured in default, in which case private creditors would supply unlimited capital at ever-increasing zero-profit premia, forcing default and collecting the expected bailout. We will discard this kind of opportunistic equilibrium by implicitly assuming that it is credible to refuse to extend rescue packages in those abusive situations.

$$\int_{m}^{s[D]} (qC[D] + (1-q)\, l(s + g[D] - (k-1))ds + \int_{s[D]}^{m+1} (C[D])ds = D$$

[19] Furthermore, it is not clear in the context of this model why such conditionality would be beneficial ex-ante.

(1)

The bailout amounts to the additional payment that bondholders receive in the insolvency states s < s[D] + ?. The bailout is the difference between full payment C[D] and default payment ?(s+g[D]-(k-1)). The cost of the bailout (B) is minimized when optimal liquidity $F_{max} = 0$ is provided. Given that P + ? = s[D] + ? -m, the probability of overall insolvency risk, of which only a fraction (1-q) is private under this imperfect package, the integral yields a bailout cost (see appendix) of:

$$B = q\, l(s[D] + r - m)^2/2 = q\, l(P + r)^2/2$$

(1)

The country=s welfare function changes in the case of imperfect packages because of the official financial loss B involved in the bailout, which, ex-ante, accrues to the country. Furthermore, now the efficiency loss due to the liquidity crunch is realized only a fraction (1-q) of the times a crisis state occurs. Pulling together the various pieces, the generalized version of the optimal borrowing problem that replaces the market benchmark problem (5), (6), and (7) is:

GENERALIZED EQUILIBRIUM

Objective

$$\mathrm{Max}_D\, U[D] = g[D] - ((1-q)k + q\, l(m - r))s[D] + (q\, l/2)s[D]^2$$

(1)

$$\int_m^{s[D]} (qC[D] + (1-q)\, l(s + g[D] - (k-1)))ds + \int_{s[D]}^{m+1} (C[D])ds = D$$

Zero profit

(13)

Default

$$l(s[D] + g[D] + r) = C[D]$$ (1)

- **Market Benchmark: ? = -p (k-1) ≤ 0 and q = 0**
- **Perfect Rescue Package: ? = 0 and q = 0**

- **Imperfect Rescue Package (Liquidity crisis detected): ? = 0 and q > 0**
- **Imperfect Rescue Package (Liquidity crisis not detected): ? = -p (k-1) and q > 0.**

The analysis of imperfect packages builds on the previous analyses by considering the effect of variations in the parameter q. It is shown in the appendix that the element of bailout in rescue packages introduces moral hazard that leads to overborrowing. As a result, private default risk (1-q)P[?,q], that is, the portion of risk absorbed by private creditors, increases with q under both scenarios of liquidity crisis detection. It is shown in the appendix that the implicit partial guarantee given by the rescue program leads to the country engaging in riskier borrowing regardless of whether or not liquidity crises are successfully detected:

$$d((1-q)P)/dq > 0 \qquad (1)$$

The previous result assumes no conditionality attached to the rescue program. In theory, the conditions associated with the program could lead to less demand for borrowing and, consequently, lower default risk. However, this conditionality would be credible only if its enforcement is time consistent, i.e., it is optimal for the official sector to follow the rules ex-post, once the crisis emerges. It is clear that the emergency nature of crisis situations makes the implementation of future conditions impossible and restricts conditionality to preconditions. If the imperfections in the implementation of the package are small (liquidity crises are detected and the error parameter q is small), then the package would be almost always applied to liquidity crises, which is ex-post optimal, and preconditions indicating the contrary are not credible. If the imperfections in the implementation of the package are large (e.g., liquidity and solvency crises are not distinguished), then, given this large degree of ignorance, it is likely that the degree of compliance with the preconditions will add little information to the assessment of the probability that a given crisis is of solvency or liquidity. In this case, any rescue program perceived as beneficial will remain so even if conditions are not met, that is, the ex-post probability of failure p will not be substantially reassessed, and packages will be applied ex-post in all cases, thus rendering the conditionality ineffective. Credibility severely limits the application of conditionality to rescue programs and suggests that the assumption in the paper is a good approximation under a broad range of circumstances.[20]

Riskier lending in (16) implies that the probability of insolvency, P[?,q]+?, also keeps increasing with q. Therefore, insolvency risk is larger than under a perfect package or under the market benchmark. Riskier lending also implies that the probability of default, or crisis risk, also increases with q. This crisis risk is equal to P[?,q]+q?, the sum of the insolvency risk, P+?, and the probability of liquidity crises left undetected, -?(1-q). As long as there is insolvency risk (P>-?), equation (15) implies that crisis risk increases for any positive q. The resulting crisis risk is depicted in Figure 1 under two scenarios: 1) liquidity and solvency crises are not distinguished (?=-p(k-1)), so that at q=0 the market benchmark crisis risk P*=P[-p(k-1),0] obtains; and 2) perfect detection of liquidity crises (?=0), so that at q=0 the perfect package crisis risk P[0,0] obtains. As shown above, under the simplifying linear assumption g@=0, a perfect package reduces crisis risk by the probability of liquidity crises: P*-P[0,0]=p(k-1).

(Insert Figure 1 here)

[20] Additional arguments justifying the assumption of no conditionality can be found in Rodrik (1989).

If liquidity and solvency crises are not distinguished (upper curve in figure 1), rescue programs of any size are counterproductive. As long as the rule used to decide whether or not to provide financial rescue with frequency q does not discriminate between liquidity and solvency crises, what can be interpreted as an arbitrary mixed strategy, rescue programs lead to a higher risk of crisis. The market alone, without any program, would lead to less default. Even if liquidity crises are perfectly detected (lower curve in figure 1), rescue packages can also be counterproductive. Since the risk of liquidity crises p(k-1) may be small or null, either because of weak liquidity effects (k=1) or because investors never panic and the bad equilibrium is never selected (p=0), the negative effect of moral hazard (the increasing slope of the curve) may quickly dominate the benefit of the elimination of liquidity crises (the discrete gain at the origin estimated at p(k-1)) and lead to the overall heightening of the risk of financial crises.

As the implicit guarantee rate q increases, moral hazard is more intense. It is clear that if the rescue package is applied in all crises, that is, q = 1, there is full insurance against default, private creditors face no risk, debt jumps to the credit ceiling induced by the implicit bailout limit, and the probability of (official) default increases to one. However, a full guarantee is not needed for certain insolvency: a moderately imperfect package can lead to the same collapse. It is shown in the appendix that there is a lower value for the error q, q* < 1, at which insolvency always obtains (P=1).

6. CONCLUDING REMARKS

All financial crises are necessarily associated with rational doubts about solvency; i.e., about the country's willingness to sacrifice to avoid default. Based on that rationality constraint, in this paper we have built a crisis typology that distinguishes between crises that can be avoided by adequate debt rescheduling (liquidity crises) and those that cannot (solvency crises). Liquidity crises occur if and only if there are multiple equilibria (and the crisis equilibrium is selected). Liquidity crises can be interpreted as panic driven and insolvency crises as fundamentals driven.

Liquidity crises are not possible unless the following three conditions hold. First, lack of liquidity has a strong negative effect on solvency; weak liquidity effects do not generate liquidity crises. Second, solvency is relatively weak; a liquidity crisis reflects a near-insolvency situation. And third, investors are prone to panic, in the sense that with significant probability they may fail to coordinate beliefs around fundamentals when sunspot equilibria exist.

The distinction between liquidity and solvency crises is useful not only conceptually but also operationally. In particular, the performance of official financial rescue packages crucially depends on this distinction. When applied to liquidity crises, rescue packages are cost free and completely effective in diffusing (or preventing) them. When applied to solvency crises, rescue packages result in a costly bailout of private creditors that only postpones default.

The rational anticipation of the possible application of rescue packages in the context of an established program improves perceived country creditworthiness and, therefore, lowers risk premia. On the one hand, this effect leads to more affordable contractual obligations, which reduces the risk of default. On the other hand, this effect also leads to higher borrowing, which increases the risk of default. The net effect of a rescue program depends on the relative importance of each.

It is likely that the implementation of an official rescue program will result in official financial losses and may easily turn counterproductive regarding risk of default. The supporting reasons are:

1. The benefits of a perfect rescue program (i.e., rescue packages are applied if and only if there is liquidity crisis) are limited by two main factors. First, the direct benefits on solvency of avoiding liquidity crises are null or small unless liquidity effects on solvency are very strong and investors are highly prone to panic. Second, the indirect benefits on insolvency risk through the improvement in country creditworthiness are null because the positive impact on more affordable terms is fully offset by higher borrowing.
2. Perfect packages are not feasible. Theoretical speculation, as well debate about the Mexican evidence, strongly suggest that rescue packages are substantially imperfect (i.e., they are applied to solvency crises with some sizable probability). While perfect packages certainly cause no harm, the costs of imperfect implementation may easily outweigh their small benefits.
3. Imperfect rescue packages are onerous. They lead to official financial losses in the form of costly bailouts of private creditors.
4. Imperfect rescue programs may fail in delivering a reduction in the risk of crisis and may easily turn counterproductive. They encourage risky borrowing because their application in solvency crises is equivalent to an implicit unpaid partial guarantee, which introduces moral hazard into the optimal borrowing decision. As a result, the insolvency risk is larger than it would be with no rescue program at all, and increases with the degree

of imperfection. If liquidity and solvency crises are not distinguished, any rescue program is counterproductive regarding the overall risk of default. Even if liquidity crises are detected, as the degree of imperfection increases the direct benefits on liquidity crises are progressively offset, first eliminating any reduction in default risk and then turning counterproductive.

Financial rescue programs designed on the basis of the emergency package provided to Mexico appear to be unsatisfactory as international mechanisms for dealing with external financial crises, and alternative approaches are needed. In the transition, it is important to eliminate the expectation that rescue programs will be applied in the case of payment crises, because otherwise overborrowing will continue to be fueled. This overborrowing not only deepens the fundamental problem of crisis risk but also complicates the credibility of the commitment not to use rescue packages, since they may be more attractive ex-post once part of their moral hazard cost is sunk.

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Appendix

Section 4

Differentiating (6) and (7) with respect to D yields:

$$P\, lg' + (1 - P)C' - s'\, l(1 - p\,)(k - 1) = 1 \tag{A1}$$

$$l(s' + g') = C' \tag{A2}$$

Substituting (A2) into (A1):

$$Q\, lg' + (1 - Q)\, C' = 1 \tag{A3}$$

where Q = P + (1 - p) (k - 1)

When P=0, lending is riskless and C[D] = D. For risky lending (P > 0), (A3) is applicable. Since Q > 0 and ? g′ < 1, C′ > 1 (risk premium). The credit ceiling obtains at Q = 1 (P = 1- (1 - p) (k -1)), where C′= + 4.

Differentiating (A3) and (A2):

$$Q\, lg'' + (1 - Q)C'' - s'(c' - lg') = 0$$

$$l(s'' + g''\,) = C'' \tag{A4}$$

(A5)

Since c′ > ?g′, s′> 0, and g@ ≤ 0, then from (A4) C@> 0 (increasing risk premium). Then from (A5), s@ > 0.

Then the FOC U′= g′-ks′= 0 determines the unique maximum given that under the assumptions U′> 0 at P = 0 (s′ < g′/k) from (A2) and assumption ? g′ > k / (1 + k)) and U′< 0 at Q = 1 (s′= + 4 as Q approaches 1). Then 0 < P* < 1 - (1 - p) (k-1)

Section 5

Perfect Package

Similar results are established following the same steps as in section 4. Now the functions s and C are s[?, D] and C[?, D]$_1$ with -p (k-1) ≤ ? ≤ 0. In particular,

$$P\, lg' + (1 - P)\, c_2 - s_2\, l(k - 1 + r\,) = 1$$

(A6)

$$Q\, lg' + (1 - Q)\, c_2 = 1$$

(A7)

where Q = P + ? + k - 1.
Second order conditions are unchanged.
Now the credit ceiling is reached at P = 2 - k - ?.
The FOC is now: g:[D*] = ks_2[?, D*], which defines an implicit function D* [?] characterized by:

$$dD^* / dr = (ks_{12}) / (g'' - ks_{22}) > 0$$ (A8)

where the denominator is negative (SOC) and s_{12} can also be shown to be negative by computing the corresponding differentiations:
Differentiating with respect to ?:

$$(1 - P)\, c_1 - s_1\, l\, (k - 1 + r\,) = 0$$

(A9)

$$l(\, s_1 + 1) = c_1$$

(A10)

Substituting, $-s_1$ (1 - Q) = 1 - P, and therefore 1 + s_1 = (1-k-?) / (1 - Q) < 0.
Differentiating again:

$$s_{12}\, (1 - Q) = s_2\, (1 + s_1\,)$$

(A11)

which implies that $s_{12} < 0$.
If g@= 0, g: is constant and the FOC implies that s_2 [?, D* [?]] is constant for all ?. From (A6), this implies that c_2 constant. Then from (A7), Q is constant, and therefore

(A12)

$$P + (k - 1) + r \text{ constant}$$

Therefore the probability of insolvency, P + ?, is constant.

Imperfect Package
Using the default condition, the cost of the bailout is:

$$B = \int_{m}^{s[D]+r} (q\, l(s[D] + r - s))ds = q\, l(s[D] + r - m\,)^2 /2$$

(A13)

For small q, the problem is concave by continuity.
Differentiating the zero-profit condition (14) and using the default condition (15):

$$s'(-(1-q)\, l(k-1)) + C'(qP + (1-P)) + (1-q)\, lPg' = 1 \qquad \text{(A14)}$$

Substituting C' = ? s' + ? g':

$$s'(-(1-q)\, l(k-1) + \; l(qP + (1-P))) = 1 - \; lg' \qquad \text{(A15)}$$

The FOC is U' = g' -s' ((1-q)k + q?(m-?)) + q?ss'= 0. Substituting P = s-m:

$$s'((1-q)k - q\, l(P + r\,)) = g' \qquad \text{(A16)}$$

If g@ = 0, eliminating s' from (A15) and (A16) yields an implicit function P[q]:

$$((1-q)k - q\, l(P + r\,))/(-(1-q)(k-1) + (qP + (1-P))) = \; lg'/(1 - \; lg') = k^* \qquad \text{(A17)}$$

Under the assumption that ? g' > k / (1 + k) , k* > k
Implicit differentiation of (A17) leads to dP/dq. It is easy to check that dP^2/dPd?>0. Private insolvency risk:

$$d((1-q)P)/dq = (1-q)dP/dq - P = \qquad \text{(A18)}$$

$$((1-q)(k + k^*(k-1)) + l(P + r\,)) + Pq\, l\,)/(k^* - q(\; l + k^*))$$

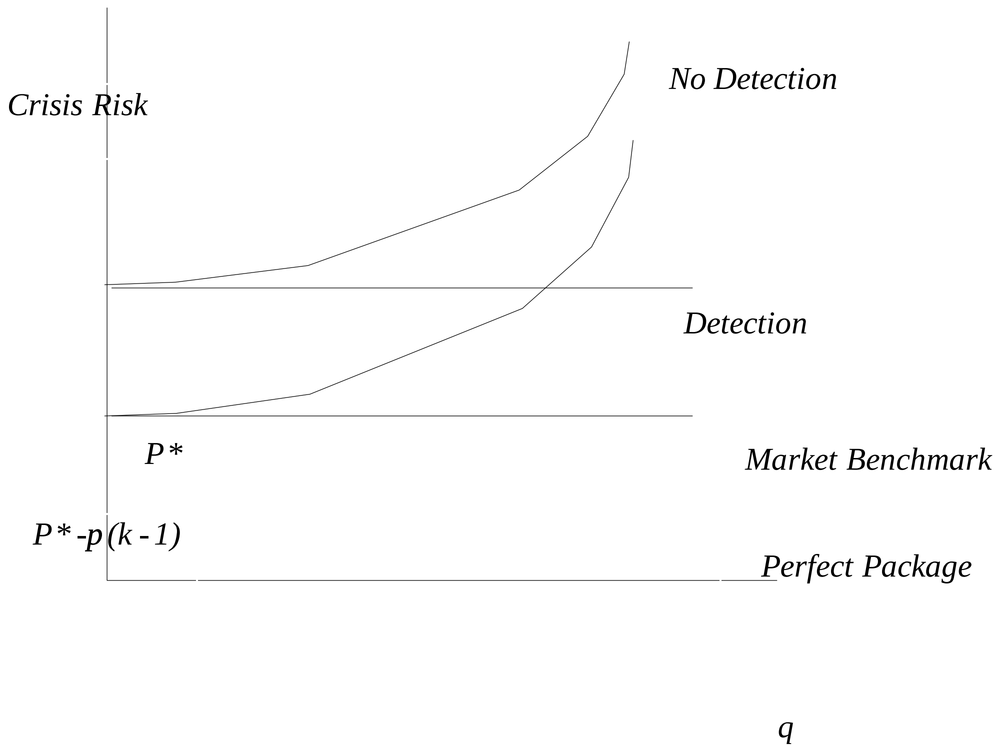
Therefore private insolvency risk and insolvency risk in general increases with q for where the denominator is positive.
The extreme case of P = 1 is obtained in (A17) as: $q < \dfrac{k^*}{l + k^*}$

$$q^* = (k(1+k^*) - k^*)/(k(1+k^*) + l(1+r))$$

Since k < 2, it is easy to check that q* < k* / (? + k*).

This limit q* is an upper bound. Borrowing and risk may increase even more steeply if the FOC fails to be a global maximum. Therefore insolvency risk monotonically increases with q until it reaches sure insolvency at q* < 1.

Figure 1


Crisis Risk
No Detection
Detection
P*
Market Benchmark
P*-p(k-1)
Perfect Package
q