

DISCUSSION PAPER SERIES

No. 2520

DEBT MATURITY AND THE GLOBAL FINANCIAL ARCHITECTURE

Olivier Jeanne

INTERNATIONAL MACROECONOMICS



Centre for **E**conomic **P**olicy **R**esearch

www.cepr.org

DEBT MATURITY AND THE GLOBAL FINANCIAL ARCHITECTURE

Olivier Jeanne, International Monetary Fund and CEPR

Discussion Paper No. 2520
August 2000

Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

This Discussion Paper is issued under the auspices of the Centre's research programme in **International Macroeconomics**. Any opinions expressed here are those of the author(s) and not those of the Centre for Economic Policy Research. Research disseminated by CEPR may include views on policy, but the Centre itself takes no institutional policy positions.

The Centre for Economic Policy Research was established in 1983 as a private educational charity, to promote independent analysis and public discussion of open economies and the relations among them. It is pluralist and non-partisan, bringing economic research to bear on the analysis of medium- and long-run policy questions. Institutional (core) finance for the Centre has been provided through major grants from the Economic and Social Research Council, under which an ESRC Resource Centre operates within CEPR; the Esmée Fairbairn Charitable Trust; and the Bank of England. These organizations do not give prior review to the Centre's publications, nor do they necessarily endorse the views expressed therein.

These Discussion Papers often represent preliminary or incomplete work, circulated to encourage discussion and comment. Citation and use of such a paper should take account of its provisional character.

Copyright: Olivier Jeanne

CEPR Discussion Paper No. 2520

August 2000

ABSTRACT

Debt Maturity and the Global Financial Architecture*

The Paper starts from the premise that the debate on the 'new architecture' of the international financial system should be based on a theory that endogenizes the structure of countries' external liabilities. I present a model in which the maturity of a country's external sovereign debt is the solution to an incentives problem, which may lead to reliance on short-term debt and vulnerability to runs. I study, in the context of this model, the welfare effects of an international lender of last resort, measures aimed at coordinating creditors in crises and a tax on short-term capital flows. These measures may increase or decrease global welfare and always leave it strictly below the first-best level.

JEL Classification: F32, F33 and F34

Keywords: capital controls, debt maturity, international debt, lending in last resort and liquidity crises

Olivier Jeanne
Research Department
Room 10-548L
International Monetary Fund
700 19th Street NW
Washington DC 20431
USA
Tel: (1 202) 623 4272
Fax: (1 202) 623 6334
Email: ojeanne@imf.org

* This Paper benefited from comments by IMF colleagues and participants in a number of seminars, especially at the University of California at Berkeley, the University of Pennsylvania, Princeton University, Stanford University, the Federal Reserve Bank of New York, the 1999 European Summer Symposium in Macroeconomics and the 2000 annual meetings of the American Economic Association. I thank Charles Bean, Andy Berg and Patrick Bolton for detailed comments, and Franklin Allen, Ben Bernanke, Guillermo Calvo, Enrica Detragiache, Allan Drazen, Marc Flandreau, Ilan Goldfajn, Marcus Miller, Michael Mussa, Maury Obstfeld, Richard Portes, Gérard Roland, Garry Schinasi and Jeromin Zettelmeyer for useful comments and discussions. I also thank Catherine Fleck for her help in editing the Paper. This Paper reflects the views of its author, not necessarily those of the IMF.

Submitted 26 June 2000

NON-TECHNICAL SUMMARY

The recurrence of international financial crises in the 1990s has generated an intense policy debate on the 'architecture' of the global financial system. A number of proposals of reform have been put forward, such as the institution of an international lender of last resort, controls on short-term capital inflows, or changes in debt contracts that would be conducive to a more orderly resolution of crises. While the debate has recently lost steam in the policy community – as the Southeast Asian economies were recovering from the 1997–8 crisis – too little has changed in the actual structure of international finance to believe that the underlying fragilities will disappear in the near future. This Paper takes a step back and explores some theoretical issues in reforming the global financial architecture. Its purpose is not to advocate particular reforms, but rather to structure a number of arguments that have been made in the recent debate with the help of a model.

It is often noted that the emerging economies that were hit the hardest in the recent wave of crises had to roll over large amounts of short-term external debt, often denominated in US dollars and in the hands of a large number of uncoordinated creditors. The exposure to this liquidity risk took different forms in different countries – involving mostly private debt in the case of Southeast Asia and sovereign debt in the cases of Mexico 1994 and Russia 1998 – but in all cases was dangerously high in the period leading up to the crisis.

Whether the ensuing crises were the result of self-fulfilling runs has been debated. There is little doubt, however, that liquidity and currency mismatches in the balance sheet of emerging economies contributed to the depth, persistence and international propagation of the crisis.

One question that is generally overlooked in policy debates – but is more difficult to eschew from a theoretical point of view – is the following: if short-term debt denominated in foreign currency is so dangerous, why does it arise so often? There must be some reasons why international investors and borrowers in emerging economies prefer to engage in short-term contracts that turn out to be costly for both sides in case of crisis as opposed to safer forms of finance. And it seems important to understand these reasons in order to predict how changes in the institutional and regulatory framework of international finance will affect the lending structure that arises in equilibrium as well as the welfare of lenders and borrowers. The theoretical side of the debate on the 'new architecture', in other words, should be based on a theory of the structure (the share of debt versus equity or FDI, its maturity and currency composition) of emerging countries' external liabilities.

This Paper endogenizes the *maturity structure* of an emerging country's external sovereign debt, and then looks at the welfare effects of an international lender of last resort, new provisions for involving private creditors

in the resolution of crises and different forms of taxation of short-term capital flows. The maturity of debt is endogenized as the solution to an incentives problem. When the government's solvency deteriorates, short-term debt becomes less expensive or more accessible than long-term debt, for reasons related to the incentive effects of the debt structure on fiscal policy. The government is under more pressure to restore the fiscal situation if its debt has a shorter maturity, because it is more vulnerable to a run by creditors. Short-term debt, however, has one inconvenience: it makes possible self-fulfilling debt runs in which creditors stop rolling over their loans for an extraneous reason unrelated to the fundamentals. There is a tension, thus, between the disciplinary benefits of short-term debt and the risk of self-fulfilling liquidity crises.

The importance of endogenizing the maturity of debt becomes clear when assessing the optimality of public intervention. Although *laissez-faire* is inefficient in our model for the reason that many 'new architects' have in mind – the possibility of self-fulfilling liquidity crises – many of the measures that have been advocated yield ambiguous welfare results and can easily be welfare-decreasing. The reason is that short-term debt is not just a source of risk; it also brings benefits to lenders and borrowers. The challenge of the new architecture is to design mechanisms that remove the risks of short-term finance without sacrificing its benefits. This requires careful crafting and the present Paper attempts to clarify some of the difficulties and pitfalls involved in such a task.

For example, we find that the optimality of coordinating private creditors in the resolution of crises is generally ambiguous. Coordination reduces the cost of crises *ex post*, but softens the discipline of short-term debt and thus makes external finance more difficult to obtain *ex ante*. Such schemes can improve global welfare relative to *laissez-faire*, but can also decrease it and generally leave the economy in a second-best position.

We also find that discouraging short-term debt flows by a tax is unambiguously welfare-decreasing. The reason is that in our model the function of short-term debt is to save the government from a default in situations where long-term debt is not an option. There is no substitutability between short-term and long-term debt and taxing the former makes the fiscal problem more difficult to solve.

We finally discuss some factors that could reverse our conclusions, most notably financial contagion. Financial contagion can be viewed as a negative externality of short-term debt for which taxation could be the adequate response. The case for taxing short-term debt must rest on the idea that its social cost and its substitutability to long-term debt are sufficiently large. This is ultimately an empirical question.

1 Introduction

The international financial crises of the 1990s have generated a sense that the global financial system, left to itself, tends to give rise to dangerous forms of finance. Mexico in 1994, Indonesia, Korea, Malaysia and Thailand in 1997, and Russia in 1998; all these countries had to roll over large amounts of short-term external debt, often denominated in U.S. dollars and in the hands of a large number of uncoordinated creditors.¹ Whether the ensuing crises were the result of self-fulfilling runs is debatable, but there is little doubt that liquidity and currency mismatches in the balance sheet of emerging economies contributed to the depth, persistence and international propagation of the crisis.

Explaining why emerging economies tend to develop dangerous balance sheet structures is important for the debates on the “new architecture” of the international financial system. A number of proposals of reform have been put forward following the Asian crisis, such as the institution of an international lender of last resort, controls on short-term capital inflows, or changes in debt contracts that would be conducive to a more orderly resolution of crises.² These proposals are often inspired by different views on the causes of the recent crises, and their implementation may involve very different sets of institutions, but they all attempt, in one way or another, to deal with the risk posed by the liquidity and currency mismatches in the balance sheets of developing economies.

It is difficult to assess the relative merits of these reforms, however, without understanding the underlying reasons why mismatches arise in the balance sheet of emerging countries. While it is often taken for granted that international capital is “hot”, there must be some reasons why international investors and borrowers in emerging economies prefer to engage in short-term contracts that turn out to be costly for both sides in case of crisis as opposed to safer forms of finance. And it seems important to understand these reasons in order to predict how changes in the institutional and regulatory framework of international finance will affect the lending structure that

¹The exposure to this liquidity risk took different forms in different countries—involving mostly private debt in the case of Southeast Asia and sovereign debt in the cases of Mexico and Russia—but in all cases was dangerously high in the period leading up to the crisis.

²See Eichengreen (1999) for an excellent review of the different options of reform.

arises in equilibrium as well as the welfare of lenders and borrowers.

This paper attempts to make some progress in the normative analysis of the global financial architecture. It presents a model in which the maturity structure of a government's external debt is endogenous, and then looks at the welfare effects of an international lender of last resort, new provisions for involving private creditors in the resolution of crises, and different forms of taxation of short-term capital flows. When the government's solvency deteriorates, short-term debt becomes less expensive or more accessible than long-term debt, for reasons related to the incentive effects of the debt structure on fiscal policy. The government is under more pressure to restore the fiscal situation if its debt has a shorter maturity, because it is more vulnerable to a run by creditors. Short-term debt, however, has one inconvenience: it makes possible self-fulfilling debt runs in which creditors stop rolling over their loans for an extraneous reason unrelated to the fundamentals. There is a tension, thus, between the disciplinary benefits of short-term debt and the risk of self-fulfilling liquidity crises.

The model is completely real: there are no currencies and no exchange rates. One way to interpret this simplifying assumption is that debt is denominated in foreign currency. Thus we assume away one part of the problem (the currency composition of debt) to better focus on the other part (its maturity structure). The focus on sovereign debt also implies that the analysis is more directly applicable to crises that primarily involved sovereign debt, such as the 1994 Mexican or 1998 Russian crises, than to the Asian crisis, where fragility arose primarily in the corporate and banking sectors. Private debt crises are intrinsically more complicated to analyse, because they are never purely private: they always involve governments in different ways, through financial safety nets and bailouts. These complications, and how they affect our results, are discussed at the end of the paper.

The importance of endogenizing the maturity of debt becomes clear when assessing the optimality of public intervention. Although *laissez-faire* is inefficient in our model for the reason that many "new architects" have in mind—the possibility of self-fulfilling liquidity crises—I find that many of the measures that have been advocated yield ambiguous welfare results, and can easily be welfare-decreasing. The reason is that in my model, short-term debt is not just a source of risk; it also brings benefits to lenders and bor-

rowers. The challenge of the new architecture is to design mechanisms that remove the risks of short-term finance without sacrificing its benefits. This requires careful crafting, and the present paper attempts to clarify some of the difficulties and pitfalls involved in such a task.

We find that an international lender of last resort enhances global welfare, but that its efficiency is hampered by a “large lender curse”. The lender of last resort is called upon to intervene when an incentives problem induces—or forces—the government to roll over short-term debt with a large number of uncoordinated creditors. However, because it is a large strategic agent, the lender of last resort is unable to provide the government with the same incentives as a large group of uncoordinated creditors. Instead it rolls over its loans in a defensive way and finances the government’s fiscal “gamble for redemption”.

We find that the optimality of coordinating private creditors in the resolution of crises is generally ambiguous. Coordination reduces the cost of crises ex post, but softens the discipline of short-term debt and thus makes external finance more difficult to obtain ex ante. Such schemes can improve global welfare relative to laissez-faire, but can also decrease it, and generally leave the economy in a second best. Furthermore it is optimal to increase the bargaining power of lenders in a crisis.

We find that discouraging short-term debt flows by a tax is unambiguously welfare-decreasing. The reason is that in our model the function of short-term debt is to save the government from a default in situations where long-term debt is not an option. Thus, making short-term debt more costly encourages substitution not from short-term finance to long-term finance but from short-term finance to no finance at all. In other words, it has the effect of replacing the *risk* of a default due to a self-fulfilling debt run by the *certainty* of a default due to the absence of external finance.

Although commentators often emphasize the novelty of the international financial crises of the 1990s, recent discussions are to a large extent a sequel of the debates that followed the debt crisis of the 1980s. That the emergence of short-term debt might be the symptom of more fundamental problems did not escape analysts at the time. Sachs (1984), for example, notes that commitment problems may shorten the maturity of sovereign debt, possi-

bly leading to debt runs and multiple equilibria.³ Krugman (1985) makes the point that the distinction between liquidity and solvency crises is made ambiguous by the fact that short-term debt is often the reflection of solvency problems—an idea which plays an important role in this paper. Both Krugman and Sachs take this as *prima facie* evidence that there is scope for Pareto-improving intervention by official lenders. From this perspective, the present paper may be viewed as an attempt at pushing further the exploration of a research agenda left opened since the 1980s.

The more recent theoretical literature on international financial crises has been influenced by the concomitance, in Asia, of banking and currency crises (the so-called “twin crises”). Some recent papers have endogenized the structure of countries’ external liabilities as bank deposits a la Diamond-Dybvig (1983) (Chang and Velasco, 1998; Chui, Gai and Haldane, 2000; Goldfajn and Valdes, 1999). An important question is whether the insights gained in frameworks derived from the Diamond-Dybvig model are robust to the consideration of other approaches to endogenizing the structure of emerging economies’ external liabilities. The model in this paper suggests that the answer is no: my normative results are strongly driven by the fact that short-term debt provides incentives to the borrower, and not the sort of liquidity that is provided to depositors in the Diamond-Dybvig model. Note that the differences between my results and those derived from open economy versions of the Diamond-Dybvig model do not obviously come from the fact that I consider sovereign (instead of bank) liabilities. Although the question remains to be explored, it is plausible that models where the short maturity of bank liabilities stems from the need to discipline bankers (such as Calomiris and Kahn, 1991 and Diamond and Rajan, 2000) would yield normative implications that are very similar in spirit to the ones in this paper.

The idea that the maturity of external debt is a crucial variable to endo-

³The idea that the threat of termination in a sequence of short-term debt contracts can act as a disciplining device is well-known in the literature on the maturity of corporate debt (Stiglitz and Weiss, 1983). Moreover, the idea that the disciplining power of short-term debt depends on the easiness with which it can be restructured ex post (and in particular the number of creditors) has also been studied—although more recently—in the corporate finance literature (Berglöf and von Thadden, 1994; Bolton and Scharfstein, 1996).

genize in order to understand recent international financial crises can also be found in two recent papers by Rodrik and Velasco (1999) and Kumar, Masson and Miller (2000). Rodrik and Velasco (1999) find, in a sample of thirty-two emerging-market economies, that the external short-term debt to reserves ratio is a robust predictor of financial crises, and that greater short-term exposure is associated with more severe crises when capital flows reverse. As an introduction to their empirical analysis they present a stylised model which, like the one in this paper, endogenizes the maturity structure of an emerging economy's external debt as the solution to a commitment problem on the side of the government. Kumar, Masson and Miller (2000) present an analysis of IMF policies in the context of a model that builds on the present paper and Rodrik and Velasco (1999).

The paper is structured as follows. Section 2 presents the model; section 3 analyses the welfare effects of different reforms, and section 4 concludes.

2 The model

The model focuses on the problem of a government having to roll over its external debt in a context of uncertainty about its solvency. The government has a window of opportunity to implement a fiscal reform which is costly but reduces the probability of default. The government can roll over its debt on a short-term or a long-term basis. This section characterizes the maturity of debt arising in equilibrium, depending on the model parameters. The following section proceeds with the normative analysis.

2.1 Assumptions

The model is in finite continuous time $t \in [0, 1]$. The agents are a domestic government and risk-neutral foreign investors. Investors can invest their wealth at the world safe interest rate, which is normalized to zero, or by lending to the government.

There is a mismatch between the maturity structure of the government's debt and its fiscal receipts. At time $t = 0$ the government has a borrowing requirement, normalized to 1, coming from the need to repay existing

debt. No fiscal receipt, however, becomes available before the end of the time interval $t = 1$. Thus the government has to bridge its financing gap by borrowing from lenders between time 0 and time 1. This can be done by issuing long-term debt or by rolling over short-term debt.

Ultimately, the government's debt will be repaid using uncommitted fiscal resources, R , that become available at the end of the time interval ($t = 1$). The resources are stochastic: they can be high $R = R_H > 1$, or low $R = 0$. The probability of a good fiscal outcome depends on whether or not the government implements a fiscal reform. Fiscal resources are high with probability 1 if the reform is implemented, and with probability $p < 1$ if it is not. (Note that fiscal receipts may be high even if the reform is not implemented, because of fiscal "good luck".) The government is assumed to be insolvent in the absence of reform, i.e., the expected value of fiscal receipts is lower than initial debt:

$$pR_H < 1 \tag{1}$$

The fiscal reform is the result of a continuous sequential process. At each point in time the government may or not take steps towards the completion of the reform (such as pushing the fiscal reform in parliament, or negotiating the reform with unions). For the sake of analytical simplicity I assume that the reform is indivisible, and that it is completed at the end of the time interval only if the government has taken all the necessary steps. More formally, denoting by ϕ the dummy variable for the completion of the reform and by s_t the dummy variable for the government's reforming effort at time t , one has:

$$\begin{aligned} \phi = 1 & \iff \forall t \in [0, 1], s_t = 1 \\ \phi = 0 & \iff \exists t \in [0, 1], s_t = 0 \end{aligned}$$

Whether or not the government is pressing ahead with the reform (variable s) is observed by market participants at all times. The completion of the reform cannot be ascertained until the end of the time interval, however, because the government retains the option to drop the reform at any time. The government cannot commit ex ante to complete the reform.

I assume that the government maximizes the utility of the representative

domestic resident (abstracting from agency problems arising from political representation). The government's objective function is given by:

$$U_1^g = R - \rho - \delta C - \phi\gamma \quad (2)$$

Variable ρ is the amount repaid to investors at the end of the time interval; δ is the dummy variable for default; C is the default cost, and γ is the cost of the fiscal reform. At times $t \leq 1$ the government maximizes the expected undiscounted final utility of the representative domestic resident:

$$U_t^g = E_t(U_1^g) \quad (3)$$

The first two terms in (2) represent the pecuniary component of domestic residents' utility. Domestic residents derive some utility from having fiscal resources in excess of the amount repaid to foreign lenders, because these resources can be used, *inter alia*, to reduce taxes or increase the supply of public goods. On the other hand, domestic residents derive some disutility from implementing the fiscal reform (which requires efforts and costly resources) or from a default on the government's external debt. The nature of the default cost may be interpreted in different ways, which have been discussed extensively in the debt crisis literature of the 1980s: as a reputational cost, a loss of access to external finance, direct seizure of the country's external assets or a diminished ability to engage in international trade (Eaton and Fernandez, 1995). The default cost is assumed to be strictly larger than initial debt and the probability of a self-fulfilling debt run is assumed to be positive but not too large:

$$1 < C \quad (4)$$

$$0 < \mu < \log(1 + p(C - 1)) \quad (5)$$

There is a continuum of identical atomistic foreign investors of mass 1, each one endowed with W_0 at time 0, plus an equal share of government debt. The utility of the representative investor is equal to its expected end-of-life wealth:

$$U_t^i = E_t(W_1) \quad (6)$$

The government must roll over its debt between time 0 and time 1. There are two possible rollover strategies: a short-term one and a long-term one.⁴ In a long-term rollover the government refinances its debt at time 0 by issuing new debt maturing at the end of the time interval, when fiscal receipts become available. Investors are offered to roll over their claims at interest rate $r_{01} \geq 0$ until time 1. If they accept, the government must repay $\rho = 1 + r_{01}$ at time 1, or default.

In a short-term rollover, the government's debt is entirely repayable on demand at any point in time—like bank deposits. In order to avoid default, thus, the government must induce investors to continuously roll over their claims. The game between the government and its creditors involves continuous decision variables on each side: at each point in time the government offers investors to roll over their loan at the *instantaneous* interest rate $r_t \geq 0$, and investors decide whether or not to roll over. The dynamics of debt are governed by:

$$\dot{D}_t = r_t D_t \tag{7}$$

and the government has to repay $\rho = \exp\left(\int_0^1 r_t dt\right)$ at the end of the time interval, or default.

Investors accept whether or not to roll over so as to maximize their utility. I assume that individual payoffs are structured in a such a way that each investor is better off *not* rolling over when other investors do not, implying the possibility of self-fulfilling debt runs. The literature offers different ways to rationalize this assumption, the most popular one being Diamond and Dybvig's (1983) sequential service constraint.⁵ If the government serves investors sequentially by drawing on a small "fiscal reserve", it is rational for each individual creditor to join a run, since by doing so it secures a chance to be at the beginning of the queue.⁶ More formally, I assume that the government defaults at a given point in time $t < 1$ if and only if the set of investors who do not roll over at this time have claims that exceed the fiscal

⁴The intermediate case in which the government simultaneously issues long-term and short-term debt is discussed at the end of subsection 2.3.

⁵See Cole and Kehoe (1996) for another approach to modelling self-fulfilling sovereign debt crises. The results in this paper do not hinge on the differences between Cole-Kehoe's and Diamond-Dybvig's models.

⁶The question of why the government adopts a sequential service constraint is left outside the scope of the paper.

reserve in aggregate; in this case the reserve is randomly allocated among the investors who do not roll over while the other investors receive nothing. The fiscal reserve can be arbitrarily small, and is taken to be infinitesimal in the following.

This model, like all models with multiple equilibria, has to address the delicate question of equilibrium selection. I adopt here the convention that investors coordinate on one equilibrium or the other depending on the realization of a sunspot variable—a publicly observed variable that may or not have a link with the fundamental determinants of the government’s solvency.⁷ For the sake of the analysis the sunspot variable is assumed to follow a Poisson process of parameter μ . Under a short-term rollover, thus, there is a probability μdt that a run will occur in the time interval $[t, t + dt]$ if it has not occurred at t . It would be easy to extend the analysis to other specifications of the sunspot’s stochastic process.

I consider sequential Nash equilibria of the game between the government and investors. The government announces the conditions under which it refinances its debt (whether it borrows on a short-term or a long-term basis, and at which interest rate), and investors take or leave the government’s offer. The remainder of this section characterizes the equilibria in two steps, looking first at the refinancing options available to the government in equilibrium, and then deriving the government’s optimal rollover policy.

2.2 Long-term debt versus short-term debt

Two assumptions make the analysis of the equilibrium especially simple. First, investors are atomistic. As a result they will stop rolling over and “rush for the exits” as soon as the government stops (or is expected to stop) implementing the reform—even though this results in a default in which they lose everything. The reason is that each investor, being very small, rationally takes the default of the government as exogenous to its individual

⁷As Morris and Shin (1999) show, removing the assumption of common knowledge of fundamentals makes it possible to select the equilibrium in a model that would otherwise exhibit multiple equilibria. More generally, the selection of the equilibrium in the real world is likely to involve quite complex learning dynamics, for which the sunspot model may be viewed as a convenient “black box” (Jeanne, 2000).

action.⁸ Second, the fiscal reform takes a *continuous* effort by the government over a finite time. This assumption implies that a failure to press ahead with the reform makes the government unambiguously insolvent. In particular, it rules out equilibria in which the government drops the reform while promising to complete it later.⁹

The following proposition states the condition under which the government can roll over its debt on a long-term basis.

Proposition 1 . *The government can roll over its debt on a long-term basis if and only if the cost of the fiscal reform is lower than a threshold:*

$$\gamma \leq \underline{\gamma} \equiv (1 - p)(R_H + C - 1) \quad (8)$$

If this condition is satisfied the government can borrow long at the riskless interest rate.

Proof. The government is able to roll over its debt only if investors expect the fiscal reform to be implemented. To see why, assume for the sake of argument that investors do *not* expect the reform to be implemented. Then it is common knowledge that at the end of the time interval the government will repay with probability p an amount that cannot be larger than the maximum pledgeable income:

$$\bar{p} \equiv \min(R_H, C)$$

i.e., the largest amount that the government is able *and* willing to repay in the event of a good fiscal outcome. The best offer that the government can make on a long-term loan at time 0 yields an expected gross return of $p\bar{p} \leq pR_H < 1$ per investor. There is no equilibrium in which investors accept this offer since in such an equilibrium, each individual investor would be strictly better off getting repaid and investing all its portfolio in the riskless asset. It is indeed

⁸The case of large lenders is discussed in subsection 3.2.

⁹The only way in which finite time restricts the analysis is by implying that the government must implement the reform before a deadline. Otherwise time could be infinite: variable R could be interpreted as the present value at the end of the time interval of fiscal receipts over the infinite horizon.

possible for an individual investor to get repaid without provoking a default (if all other investors lend) because of the atomistic nature of individual claims.

Investors, if they expect the government to complete the reform, are ready to lend at a zero interest rate ($r_{01} = 0$). They know that the government will be able and willing to repay, since R_H and C are larger than 1. The question, hence, is whether the expectation that the government will implement the fiscal reform is rational. The government implements the reform once the long-term loan is secured if and only if this increases its utility, i.e.:¹⁰

$$\begin{aligned} E_0(U_1^g | \phi = 1) &> E_0(U_1^g | \phi = 0) \\ R_H - 1 - \gamma &> p(R_H - 1) - (1 - p)C \end{aligned}$$

which, after rearranging terms, gives condition (8). If this incentive condition is satisfied the government can roll over its debt at time 0 with a zero-interest rate long-term loan. **Q.E.D.**

Equation (8) is an incentives condition. It ensures that the government does not “gamble for redemption”—count on fiscal good luck instead of reform to escape default—once the long-term loan is secured. If this condition is not satisfied investors do not lend on a long-term basis at any interest rate because of the assumption $pR_H < 1$, which makes it impossible for the government to offer a positive expected return on its debt in the absence of reform. Because investors are atomistic and uncoordinated there is no way, in equilibrium, they can accept to roll over their loans in exchange for a negative return.

If condition (8) is not satisfied, the only way the government can escape default is by rolling over short-term debt. The following result states the condition under which this is possible.

Proposition 2 . *The government can roll over its debt on a short-term basis only if the cost of reforming is lower than a threshold*

$$\gamma \leq \bar{\gamma} \equiv (1 - p)R_H + C - e^\mu \tag{9}$$

¹⁰The government’s decision at time 0 is time consistent.

which is strictly lower than the threshold for long-term debt ($\underline{\gamma} < \bar{\gamma}$).

If condition (9) is satisfied, the government can roll over its debt at interest rate $r = \mu$ as long as it pursues the reform and there is no run. If the condition for long-term debt, (8), is not satisfied, the government drops the reform following a run.

Proof. Like before, a necessary condition for a successful short-term roll over is that investors expect the reform to be completed. There is no equilibrium in which investors go on rolling over the government's debt after they have ceased to believe in the completion of the reform. In such an equilibrium each individual investor would be strictly better off switching to the safe asset strictly before the end of the time interval. Rational backward induction implies that all investors stop rolling over at the time the completion of the fiscal reform ceases to be credible.

Pursuing the reform is a necessary condition for a successful short-term rollover but it is not sufficient: the government can default following a debt run. In order to compensate investors for the risk of a debt run short-term debt has to bear an interest rate at least equal to μ . If $r = \mu$ the dynamics of short-term debt are given by:

$$D_t = e^{\mu t} \tag{10}$$

Conversely, investors are ready to lend at rate $r = \mu$ if they expect the government to implement the fiscal reform conditional on no debt run. Under which condition is this expectation rational? At time 0 the government has to choose between two strategies: pressing ahead with the reform in the hope that no debt run will occur, and not reforming (and a certain default). The probability that a debt run occurs at some point in the time interval is equal to $1 - e^{-\mu}$. Hence the government's expected utility under the first strategy is given by:

$$E_0(U_1^g) = e^{-\mu}(R_H - e^\mu - \gamma) + (1 - e^{-\mu})(pR_H - C)$$

This is larger than the utility under no reform, $pR_H - C$, if condition (9) is satisfied. To conclude the proof, note that the inequality $\underline{\gamma} < \bar{\gamma}$ results equation (5). The reform is dropped following a run, since after a default

the residual benefit of the reform, $(1 - p)R_H$, is lower than its cost, γ (if (8) is not satisfied). **Q.E.D.**

There is a range of γ for which the government cannot borrow long but can escape default by rolling over short-term debt. The comparative advantage of short-term debt, in such a situation, is that it removes the temptation of a gamble for redemption. Failing to press ahead with the reform triggers an immediate default, as private investors rush for the exits. Short-term debt, in other terms, is a vehicle of macroeconomic discipline: it is better than long-term debt at goading the government into implementing the reform, and as a result it is made available to the government under a wider set of circumstances.

Short-term debt, however, involves the risk of self-fulfilling runs. Although it is tempting to call them “liquidity crises”, it is important to note that debt runs are not, in this model, “pure” liquidity crises striking a solvent but illiquid government. If the government were obviously solvent it could borrow long. The government is constrained to roll over short-term debt by investors’ doubts about its solvency. Moreover, after a debt run the government does not implement the fiscal adjustment and becomes effectively insolvent, which might seem to vindicate ex post investors’ decision to stop lending.

2.3 Equilibrium

The government’s optimal refinancing strategies are summarized in Figure 1 (with a metaphore that expands the theological connotations implicit in the “gamble for redemption”). One may think of the government trying to refinance its debt as being in paradise, hell or purgatory. In paradise, the government can roll over its debt on a long-term or a short-term basis. It actually chooses to borrow long in equilibrium (and escape default with probability 1) since the alternative involves the risk of a self-fulfilling debt run. In hell, the government is unable to refinance its debt and defaults with probability 1. Purgatory is an intermediate “grey zone”, in which the government attempts to escape default by borrowing short, and ends up ex post with the same utility as in paradise or hell, depending on the occurrence of a debt run. Purgatory, while obviously more desirable than hell, is also more risky, in the sense that it puts the government at the mercy of self-fulfilling shifts

in market sentiment. In paradise or hell, by contrast, the government’s fate is sealed from the beginning by the state of the fundamentals.

[Insert Figure 1]

Remark. I have ruled out mixed debt structures by assuming that the government issues *either* short-term debt *or* long-term debt—but does not issue debt of different maturities at the same time.¹¹ This assumption has been made for the sake of simplicity, in order to eliminate the discussion of equilibria where the maturity structure of debt is undeterminate. Allowing the government to issue short-term and long-term debt simultaneously would not affect the essence of our results. What matters in equilibrium is whether the quantity of short-term debt is larger or smaller than the fiscal reserve. As long as it bears more short-term debt than it can repay with its reserves, the government is subject to the same incentives to reform as in the short-term rollover equilibria we have described above.

3 “New Architecture” issues

Laissez-faire is inefficient in two different ways in our model. First it is always optimal for the government and its creditors to reschedule debt repayment until the end of the time interval when the alternative is a default. An early default constrains the government to pay the default cost, while this cost could be spared (and investors could be repaid) with probability p if debt was rescheduled. Second, self-fulfilling debt runs are inefficient, to the extent that they result in the fiscal reform not being implemented when it is in the joint interest of the borrower and the creditors to see it completed. *A priori*, hence, there seems to be no shortage of justification for public intervention.

We consider below three measures that have been advocated to strengthen the architecture of the international financial system: (i) an international lender of last resort, (ii) measures that facilitate the coordination of creditors in crises, and (iii) various forms of taxes on short-term capital inflows. Would they be effective in the context of our model? And would they increase global

¹¹Note that this assumption applies to the *flow* of new debt issued in the time interval under consideration, not to the stock of government debt, which could be heterogeneous if the government has long-term debt—inherited from the past—at time 0.

welfare? In order to address the latter question, we need first to define a welfare criterion.

3.1 Global welfare

The definition of an aggregate welfare measure for a group of heterogeneous agents raises well-known difficulties. For the sake of the analysis I adopt, as the welfare criterion, the sum of the government's and foreign investors utilities—a natural choice given that utility is linear.¹² Global welfare at time t is defined as:

$$GW_t = U_t^g + U_t^i \quad (11)$$

Global welfare at time 0 is given by $GW_0 = R_H - \gamma + W_0$ when the government rolls over its debt on a long-term basis and by $GW_0 = pR_H - C + W_0$ when the government is unable to roll over its debt and defaults. Under short-term debt global welfare is the average of global welfare when there is no default and when there is a default, weighted by the probability of a debt run:

$$GW_0 = e^{-\mu}(R_H - \gamma) + (1 - e^{-\mu})(pR_H - C) + W_0 \quad (12)$$

The first best is defined as a situation in which the government and investors follow the orders of a benevolent global planner. The global planner always asks investors to roll over (so that there is no debt run, and in the absence of reform the default cost is paid with probability p), and sets global welfare to:

$$GW_0^* = \max_{\phi \in \{0,1\}} \phi(R_H - \gamma) + (1 - \phi)(pR_H - (1 - p)C) + W_0, \quad (13)$$

the maximum of the level achieved if the government implements the reform ($\phi = 1$) and the level achieved if it does not ($\phi = 0$). The fiscal reform is implemented, under the first best, if and only if:

$$\gamma \leq \hat{\gamma} \equiv (1 - p)(R_H + C) \quad (14)$$

¹²Recall that the government's utility is the same as that of the representative domestic citizen.

If this condition is satisfied we say that the reform is *globally efficient*.

It is easy to see that $\underline{\gamma} < \hat{\gamma}$, i.e., if the government can issue long-term debt then reforming is globally efficient. On the other hand the ability to borrow short does not generally coincide with the efficiency of the reform. The threshold $\hat{\gamma}$ maybe larger or smaller than $\bar{\gamma}$, depending on the values of the parameters of the model.¹³

Figure 2 shows how laissez-faire compares with the first-best for different values of the reform cost. There are two reasons why global welfare is strictly below the first-best level in the purgatory and hell regions. First, laissez-faire implies that the government defaults with certainty when it does not reform, which is inefficient. Waiting until the end of the time interval to declare default would increase global welfare by pC , the probability of fiscal “good luck” times the default cost. Second, the government might not implement the reform although this would be globally efficient, or conversely, might implement a reform that is inefficient from the global point of view. Under laissez-faire the government’s “private” incentives to reform do not generally coincide with the maximization of global welfare.

In the purgatory region, self-fulfilling debt runs involve both types of inefficiency. Runs constrain to a costly default governments that could otherwise turn out to be solvent ex post (following fiscal good luck), and may prevent the implementation of a globally efficient reform. If the government rolls over short-term debt and the reform is globally efficient ($\gamma \in [\underline{\gamma}, \hat{\gamma}]$), the gap between laissez-faire and the first best, in figure 2, is entirely due to the possibility of self-fulfilling runs—and would vanish if the probability of debt runs, μ , could be set to zero. In the purgatory region, moreover, global welfare is strictly decreasing with the probability of debt run whether or not the reform is globally efficient:

$$\forall \gamma \in [\underline{\gamma}, \bar{\gamma}], \quad \frac{\partial GW_0}{\partial \mu} = -1 - e^{-\mu}(\bar{\gamma} - \gamma) < 0$$

The question scrutinized in this section is whether, and how, public intervention can increase global welfare. In order to capture the idea that the financial architecture is reformed behind a “veil of ignorance”—before the cost of fiscal reform and the value of the other parameters are known—I define “ex ante” global welfare as:

¹³ $\bar{\gamma}$ is larger than $\hat{\gamma}$ iff $pC > e^\mu$.

$$GW_{-1} \equiv \int_0^{+\infty} GW_0(\gamma) f(\gamma) d\gamma \quad (15)$$

where the probability distribution function $f(\cdot)$ characterizes the prior beliefs over the cost of reform before time 0. Function $f(\cdot)$ is assumed to be strictly positive everywhere, so that there is a non-zero probability, ex ante, that γ is in the heaven, purgatory or hell regions. Ex ante welfare, GW_{-1} reaches the first-best level if $GW_0 = GW_0^*$ for all possible values of γ .

3.2 Lending in last resort

The notion of international lender of last resort covers a range of very different proposals, from the creation of an international central bank issuing an international currency (Garten, 1998) to more modest measures, such as evolutions in the lending policies of international financial institutions (Fischer, 1999). It has been criticized from two different angles, some noting that the amounts that the lender of last resort would need to mobilize are unrealistically large (Eichengreen, 1999), while others argue that it might lead to pervasive moral hazard in international lending (Meltzer, 1998).

Going back to our model, let us assume that a “Fund”, endowed with the proceeds of a levy on investors’ wealth, is established in period 0.¹⁴ The Fund’s mission is to lend to the government so as to avoid a default when there is a self-fulfilling debt run—and only in that case. (The Fund, I assume, does not come to the rescue of governments that make themselves insolvent by not reforming.) At the end of the time interval the Fund is liquidated and its portfolio redistributed equally among investors.

If it is completely certain that the Fund will bail out all investors, the individual incentives to run disappear, so that the Fund never has to intervene in equilibrium. There might be reasons, however, why the Fund’s intervention could be less than completely credible—for example if its resources are insufficient to deal with simultaneous crises in several countries. Let us assume, to capture this idea, that in the event of a bad realization of

¹⁴While the terminology evokes the IMF, the question of the international lender of last resort has also arisen in connection with the role of the U.S. Federal Reserve in the countries that have dollarized.

the sunspot variable, the Fund bails out *all* investors with probability π , and bails out *no* investor with probability $1 - \pi$, where π may be strictly smaller than 1. I assume moreover that the “proof of the lending in the running”, i.e., investors do not know whether or not the Fund lends at the time they decide to run. Then, as we show below, self-fulfilling debt runs remain possible. This raises the question on the Fund’s optimal lending policy after a run.

I assume that following a debt run the Fund lends to the government on a short-term basis at the riskless interest rate, and decides whether or not to roll over its loan so as to maximize global welfare. (Lending at a penalty interest rate—one of the “Bagehot rules”—or allowing the Fund to lend long would not change the results.) Then we have:

Proposition 3 . *The international lender of last resort reduces the interest rate on short-term debt, and enlarges the range of parameters under which the government can roll over its debt on a short-term basis. If the lender of last resort’s intervention is less than completely certain ($\pi < 1$), self-fulfilling debt runs remain possible. Following a debt run, the government drops the fiscal reform and the lender of last resort rolls over its loan until the end of the time interval.*

Proof. Following a debt run investors lose their claim with probability $1 - \pi$ (instead of probability 1 in the absence of lender of last resort). Hence lending-in-last-resort reduces the risk premium on short-term debt from $r = \mu$ to $r = (1 - \pi)\mu$. As a result the government accumulates debt at a lower rate and the threshold under which the government can borrow short increases to $\bar{\gamma} = pR_H + C - e^{\mu(1-\pi)}$.

Self-fulfilling debt runs remain possible if $\pi < 1$. The reason is that investors, while indifferent between running and not running conditional on the Fund’s intervention, strictly prefer running if the Fund does not intervene. Ex ante, hence, running strictly dominates not running if there is a risk that the Fund will not intervene. After it is bailed in, the lender of last resort rolls over its loan until the end of the time interval whether or not the government implements the reform. Not rolling over and putting the government in default would reduce global welfare by pC , the probability of fiscal “good luck” times the default cost. Knowing this, the government does not implement the reform. **Q.E.D.**

Proposition 3 illustrates the difficulty of removing the risks of short-term finance without losing its disciplinary benefits. The lender of last resort solves the coordination failure that makes debt runs possible because it is a large lender. Precisely because it is a large lender, however, the Fund is also unable to discipline the government to implement the reform. The Fund’s intervention changes the nature of the relationship between the government and its creditors, replacing a dispersed set of creditors by a large strategic player—a change which the government is prompt to exploit to its advantage. The domestic government drops the fiscal reform as soon as the Fund is bailed in, knowing that the Fund will not put it in default.

The welfare implications of lending-in-last resort are spelled out in the following proposition.

Corollary 1 . *The international lender of last resort strictly increases ex ante global welfare but leaves it strictly below the first-best level.*

Proof. The lender of last resort strictly increases ex ante global welfare, GW_{-1} , in two ways: by giving access to short-term debt to governments that would otherwise default (by increasing $\bar{\gamma}$), and by reducing the welfare cost of runs by pC , the probability of fiscal “good luck” times the cost of default.

Ex ante global welfare remains strictly below the first-best level for two reasons. First, GW_0 remains strictly below the first-best level for the governments that remain in the hell region and for which the introduction of the lender of last resort does not change anything ($\gamma > \bar{\gamma}$). Second, GW_0 also falls short of the first-best level in the purgatory region. If the reform is globally efficient ($\gamma < \hat{\gamma}$) there is a welfare loss coming from the fact that the government drops the reform following the Fund’s intervention. In the opposite case ($\gamma > \hat{\gamma}$) it would be optimal never to reform, but the government reforms if there is no debt run. **Q.E.D.**

The international lender of last resort falls short of the first best—when it intervenes—because it is unable to discipline the government to implement the fiscal reform once it is bailed in. The first best could be achieved if the Fund could reproduce the incentives provided by short-term debt, i.e., roll over its loan conditionally on the reform being pursued, and put the government in default as soon as the reform is dropped. Such a policy,

however, is time inconsistent in the present model, since it is never optimal ex post to implement the threat of putting the government in default.

Economic agents and economic theory have come up with different ways to overcome time inconsistency problems. For example in a repeated game the lender of last resort could invest in a reputation for being “tough” with governments that fail to reform. It should be noted, however, that in principle such reputational strategies could also be pursued by large *private* investors. This raises the question of the lender of last resort’s comparative advantage relative to other large lenders. In a market where large and small private investors compete, the dispersed creditorship structures that can generate runs will arise in equilibrium when large investors are unable to provide the government with the incentives to reform. The international lender of last resort, hence, will have to intervene precisely when an incentives problem prevents the government from borrowing from large investors in the international financial market.

This subsection concludes with a comment on a much debated side effect of lending-in-last-resort: moral hazard. One way the promise of lending-in-last-resort could induce moral hazard, in this model, is by reducing the effort that the government is ready to make ex ante so as to avoid ending up in purgatory as opposed to heaven. The model would capture this effect if we assumed that the government can affect γ before time 0 at the cost of some effort. As it stands, the model points to a different sort of moral hazard, one that arises ex post, after the lender of last resort’s intervention. The lender of last resort is unable to discipline the government to implement the fiscal reform. This problem could aggravate moral hazard ex ante, to the extent that it makes purgatory even less costly for the government.

3.3 Coordinating creditors in the resolution of crises

It is often argued that the resolution of crises should be more orderly, and in particular involve more coordination of private creditors. Eichengreen (1999) suggests that resuscitating bondholder committees (that were common from the late nineteenth century through World War II) would contribute to solving the coordination problems between creditors that typically arise in crises. Eichengreen and Portes (1995) advocate the compulsory intro-

duction of renegotiation-friendly clauses in all sovereign debt contracts, and Eichengreen (1999) extends the proposal to private debt contracts. These proposals have been endorsed in several official reports (G-10, 1996; G-22, 1998).

A standing creditor committee could be interpreted, in this model, as an agent with whom the government can negotiate a new schedule of repayment. At any time t the government can convene the committee and ask investors to roll over their loan until the end of the time interval, at interest rate $r_{t1} \geq 0$. The committee maximizes the utility of the representative creditor. The committee and the government negotiate over r_{t1} , or equivalently the amount that the government must repay at time 1 to avoid default, $\rho = (1 + r_{t1})D_t$. The outcome of the negotiation depends on the allocation of the bargaining power between the government and its creditors. If, at one extreme, the government has all the bargaining power, the committee accepts a take-or-leave offer to roll over at $r_{t1} = 0$. At the other extreme, the committee can obtain the maximum pledgeable income $\bar{\rho} \equiv \min(R_H, C)$. In between, the outcome of the negotiation can be written:

$$\rho_t = \alpha \bar{\rho} + (1 - \alpha)D_t \tag{16}$$

where $\alpha \in [0, 1]$ denotes the relative bargaining power of creditors. (We discuss below the possible determinants of this variable.)

When does the government convene the committee? First, the government does not convene the committee when it can refinance its debt at a zero interest rate (since by assumption, the committee will not accept to reschedule the debt at a negative interest rate). On the other hand, it is clearly optimal for the government to convene the committee when it cannot roll over its debt, or following a debt run. The question is a bit more complicated when the alternative to convening the committee is to roll over short-term debt. Although the government could wait for a self-fulfilling debt run, it could also take the initiative of convening the committee in a strategic or opportunistic way at period 0. The government's decision in equilibrium is characterized in the following proposition.

Proposition 4 . *The existence of the creditor committee destroys equilibria with short-term debt if the bargaining power of creditors is too small:*

$$\alpha < \bar{\alpha} \equiv \frac{1-p}{p} \frac{1-e^{-\mu}}{\bar{\rho}-1} \quad (17)$$

In that case, the government strategically convenes the committee at time 0 (i.e., even if it can borrow short).

If the bargaining power of creditors is large enough ($\alpha > \bar{\alpha}$), there is a range of reform costs $[\underline{\gamma}, \tilde{\gamma}]$ for which the government rolls over short-term debt, and convenes the creditor committee in the event of a debt run only.

Proof. First, let us characterize the dynamics of short-term debt, assuming that the government rolls over short-term debt and pursues the reform as long as there is no debt run, and convenes the committee in the event of a debt run. Following a debt run the government reschedules its debt and drops the reform. In equilibrium the government's debt must yield a zero expected return, hence:

$$D_t = (1 - \mu dt)D_{t+dt} + \mu dt p \rho_t \quad (18)$$

where ρ_t , the repayment at the end of the time interval conditional on a good fiscal outcome, is given by equation (16). It follows from equation (18) that the level of debt follows the differential equation $\dot{D}_t = \mu\nu(D_t - \Delta)$, with $\nu \equiv 1 - p(1 - \alpha)$ and $\Delta \equiv \alpha p \bar{p} / \nu$. (Note that the equilibrium interest rate $r_t = \dot{D}_t / D_t$ is lower than the laissez-faire level μ .) The dynamics of debt are given by:

$$D_t = \Delta + (1 - \Delta)e^{\mu\nu t} \quad (19)$$

At time 0 the government has the choice between (i) rolling over short-term debt in the hope that no run will occur; and (ii) convening the committee without waiting for a debt run. The government's utility under the first option is equal to the probability weighted average of its ex post utility if there is no run and its ex post utility if there is a run, the latter being integrated over all the possible dates of run:

$$\begin{aligned} U_0^g &= e^{-\mu}(R_H - D_1 - \gamma) + \int_0^1 (p(R_H - \rho_t) - (1-p)C) \mu e^{-\mu t} dt \\ &= e^{-\mu}(R_H - \gamma) + (1 - e^{-\mu})(pR_H - (1-p)C) - 1 \end{aligned} \quad (20)$$

The second line of this formula can be derived by substituting out ρ_t using equations (16) and (19) and integrating over time, or more simply, by noting that the present value of debt repayment at time 0, $e^{-\mu}D_1 + \int_0^1 p\rho_t\mu e^{-\mu t}dt$, must be equal to 1 in equilibrium.

The government's utility is $U_0^g = p(R_H - \rho_0) - (1-p)C$ if debt is rescheduled at time 0. A necessary condition for a short-term rollover, thus, is that:

$$\gamma < \tilde{\gamma} \equiv (1-p)(R_H + C) - e^\mu(1-p(\alpha\bar{p} + 1 - \alpha)) \quad (21)$$

Equilibria with short-term debt arise if and only if the threshold defined by the equation above is larger than $\underline{\gamma}$, the threshold for long-term debt. Otherwise the government will always convene the committee in a strategic way at time 0 when it cannot borrow long. The inequality $\tilde{\gamma} > \underline{\gamma}$ implies the condition on bargaining power given in the proposition. If this condition is satisfied, there is a range of reform cost, $(\underline{\gamma}, \tilde{\gamma}]$, for which the government rolls over short-term debt. **Q.E.D.**

The institution of creditor committees has two opposite effects, an eviction effect and a price effect. On the one hand, it offers the government an alternative to borrowing short: convening the committee and rescheduling its debt. On the other hand, it reduces the cost of short-term debt by reducing its risk (by ensuring that creditors do not lose everything in a debt run). In equilibrium, the eviction effect dominates if the bargaining power of creditors is weak. It is clear that short-term debt cannot arise in equilibrium in the extreme case where the committee has no bargaining power since then, convening the committee effectively allows the government to gamble for redemption at the risk-free interest rate. Creditor committees, when they don't destroy short-term debt, can restrict or expand the set of parameters for which short-term debt arises, depending on the bargaining power of creditor committees.¹⁵

Corollary 2 . *Creditor committees may increase or decrease ex ante global welfare relative to laissez-faire, and always leave it strictly below the first-best level.*

¹⁵The range is expanded if $\tilde{\gamma} \geq \bar{\gamma}$, i.e., if $C \leq e^\mu(\alpha\bar{p} + 1 - \alpha)$.

Proof. Creditor committees may increase or decrease global welfare, GW_0 , depending on the value of the reform cost γ .

First, there are clearly values of γ for which global welfare is increased. If the reform is globally inefficient ($\gamma > \hat{\gamma}$) the government convenes the committee and reschedules its debt (it never rolls over its debt on a short-term basis if the reform is globally inefficient, since $\tilde{\gamma} < \hat{\gamma}$). Global welfare is increased to the first-best level.

Second, there are values of γ for which global welfare may be decreased by creditor committees. Assume that the committee is used strategically by the government, i.e., $\gamma \in (\tilde{\gamma}, \bar{\gamma})$. In that case global welfare is equal to $GW_0 = pR_H - (1-p)C + W_0$ with the committee, and $GW_0 = e^{-\mu}(R_H - \gamma) + (1 - e^{-\mu})(pR_H - C) + W_0$ without the committee. Global welfare is increased by the committee if and only if the probability of a run is high enough:

$$\mu > \bar{\mu} \equiv \log \left(\frac{(1-p)R_H + C - \gamma}{pC} \right) \quad (22)$$

The threshold $\bar{\mu}$ is strictly positive for $\gamma = \tilde{\gamma}$ and by continuity for values of γ that are sufficiently close to $\tilde{\gamma}$. For these values creditor committees strictly decrease global welfare to a third-best level if the probability of debt runs is not too large. Then the global social cost of runs is lower than the cost of a strategic use of committees by the government. **Q.E.D.**

It is often supposed that the lack of coordination between creditors is an unmixed evil, responsible for bad equilibria and wars of attrition that impede the orderly resolution of crises. This view begs the question of why such sub-optimal forms of lending arise in equilibrium. The answer, in this model, is that the lack of coordination between creditors, while a factor of risk, is also the source of the disciplinary advantage of short-term debt. Creditor committees make the world safer—in the sense that they prevent self-fulfilling defaults—but they can also be used opportunistically by the government, with an ambiguous impact on global welfare.

Corollary 3 . *In the presence of creditor committees ex ante global welfare is increasing with the bargaining power of creditors.*

Proof. Giving creditors more bargaining power expands the set of parameters under which the government rolls over short-term debt ($\tilde{\gamma}$ is increasing

with α). Global welfare GW_0 is strictly increased if the government switches from an opportunistic use of the committee to a short-term rollover, and remains unchanged otherwise. **Q.E.D.**

The intuition is that shifting bargaining power to creditors reduces the benefit for the government to use creditors committees in an strategic way. This enhances the disciplinary benefits of short-term debt without increasing its risk (since the probability of debt runs does not depend on the allocation of bargaining power between the government and investors).

Corollary 3 raises the question of how the bargaining power of creditors can be affected by public policy. In the international environment, with no strong legal framework or bankruptcy court to define and enforce the priority of claims and little possibility of backing sovereign debt by collateral, the bargaining power of creditors is largely determined by the rules governing the negotiation of the terms of the restructuring. In particular, rules requiring a larger majority of creditors to accept the terms of the restructuring are likely to increase the collective bargaining power of creditors, by giving a minority more power to hold up the process.¹⁶

Advocates of the compulsory introduction of renegotiation-friendly clauses in debt contracts generally argue that current rules make debt restructuring excessively difficult and time consuming. The model does not capture this idea since it assumes the negotiation to be successful and timeless once the creditor committee is convened. It suggests, instead, that there might be an important distinction to draw between *renegotiation*-friendly measures—which facilitate a quick and successful completion of the negotiation—and *borrower*- or *creditor*-friendly measures—which affect the allocation of the bargaining power between the two sides of the credit relationship. Instituting a creditor committee is a renegotiation-friendly measure, while increasing the bargaining power of creditors in the negotiation is a creditor-friendly measure. While renegotiation-friendly measures may be optimal—although not necessarily so, see Corollary 2—creditor-friendly measures are unambiguously welfare-increasing in this model (Corollary 3). Creditors should have as much bargaining power as possible for the disciplinary benefits of short-term

¹⁶U.S.-style bonds, governed by N.Y. law, typically require the unanimous consent of the bondholders to the terms of a restructuring. This contrasts with bonds governed by U.K. law which typically requires the consent of bondholders holding a smaller majority (typically 75 percent) of the outstanding principal.

debt to be preserved.

3.4 Taxing short-term capital inflows

The analysis so far has focused on measures coping ex post with the problems posed by short-term debt. An alternative, more preventive, approach to the problem is to discourage the emergence of short-term debt ex ante. Some argue that this can be achieved, for example, by Chilean-style controls on capital inflows,¹⁷ which might become one of the building blocks of a reformed international financial architecture (Eichengreen, 1999; Rodrik and Velasco, 1999).¹⁸ Alternatively, measures could be taken on the side of the lenders, for example by imposing larger Basle capital ratio on short-term foreign currency loans to emerging economies. Domestic capital controls and international bank capital standards involve very different sets of institutions, but both measures can be interpreted as taxing short-term credit flows. They are often justified by a second-best taxation argument—it is socially optimal to induce individual (private or public) agents to internalize their marginal contribution to the global systemic liquidity risk.

Let us assume, in our model, that short-term lending is continuously taxed at rate τ . I also assume that, because of collection costs, or because the tax is levied outside the domestic country, the government receives only a fraction $\lambda \leq 1$ of the proceeds of the tax. In order to show that the results are not trivially driven by this assumption, we count the remaining fraction, $1 - \lambda$, in global welfare. Then we have:

Proposition 5 . *Taxing short-term capital flows restricts the set of param-*

¹⁷Chile requires all nonequity foreign capital inflows to be accompanied by a one-year, noninterest-bearing deposit, whose tax equivalent therefore declines with the duration of the investment. The required deposit was 30 percent of the capital inflow until May 1998; it was subsequently reduced to zero.

¹⁸Controls on capital inflows are very different from the controls on outflows, that were introduced, for example, in Malaysia in the Asian crisis. Controls on outflows are an emergency and temporary measure, generally introduced in the heat of crises, when there are strong incentives to evade them, and for that reason then need to be drastic and aggressively enforced in order to be effective. By contrast, controls on capital inflows are operating on a more permanent basis and their intent is preventive.

eters under which the government rolls over short-term debt, and decreases ex ante global welfare relative to laissez-faire (strictly so if $\lambda < 1$).

Proof. The tax raises the effective cost of short-term debt from $r = \mu$ to $r = \mu + (1 - \lambda)\tau$. This decreases the threshold for short-term debt, $\bar{\gamma}$ to $(1 - p)R_H + C - e^{\mu + (1 - \lambda)\tau}$, so that some governments lose access to short-term debt. Global welfare GW_0 is strictly reduced if the government is excluded from the short-term debt market, and remains unchanged otherwise. **Q.E.D.**

There is a sense in which taxing short-term capital inflows is the worst of the measures we have considered until now. The tax unambiguously decreases ex ante global welfare to a third-best level. The reason is twofold. First, the prediction that taxing short-term debt will encourage a substitution toward long-term debt does not hold in this model. This is because the two forms of debt are not substitutable: short-term debt arises in equilibrium when the government cannot issue long-term debt. Second, the tax worsens the fiscal situation of the government by raising the cost of borrowing short.¹⁹ As a result, the set of parameters under which the government has access to short-term debt shrinks. For the governments that get rationed out of the short-term debt market, the tax has the effect of replacing the *risk* of a default due to a self-fulfilling liquidity crisis by the *certainty* of a default due to the absence of external finance. In some sense, the tax reduces uncertainty, but this is by making certain that the worst happens.

Admittedly the model does not include the factors that make the tax optimal according to its advocates. There is no externality (financial contagion) and the model portrays a situation in which there is no substitutability between long-term and short-term debt. In many real world situations short-term and long-term debt are substitutable, at least to some extent. What the model suggests, in this regard, is that the substitutability between short-term and long-term debt is likely to be much lower when there are doubts about the solvency of the borrower than in normal times. This is a reason to make the tax rate conditional on the state of the economy, which is possible with Chilean-style controls (they can be reinforced or relaxed depending on the tide of capital flows—this is indeed what the Chilean authorities have

¹⁹The situation is not strictly worsened if the government receives all the receipts of the tax ($\lambda = 1$). In this case the tax is completely neutral.

done), but not with international bank regulation that would apply across the board to all banks.

4 Concluding comments

This paper provides a welfare analysis of different reforms aimed at making the international financial system more resilient in the context of a model where the underlying source of fragility (short-term debt) arises endogenously. The model, although very stylised, lends itself to the analysis of a wide array of policy measures. The conclusions, however, may be viewed as rather specific to the underlying theory of debt maturity—that short-term lending acts as an enforcer of macroeconomic discipline. To conclude I discuss the robustness of my results and some possible extensions.

As it stands, the model does not include factors that have been argued to be important sources of inefficiency in the international financial system. Advocates of controls on capital inflows (Eichengreen, 1999) or international lending-in-last-resort (Fischer, 1999), for example, invoke the negative externality created by financial contagion to justify public intervention. While international financial contagion is excluded from my model by construction—since there is only one borrower—there is little doubt that it is an important topic in the research agenda that underpins this paper. It should be noted, however, that contagion is also made possible, or at least easier, by “dangerous” forms of liabilities of the type studied here, such as short-term foreign currency debt. If lenders and borrowers choose these forms of finance over less dangerous ones, this must be for the sake of private benefits that outweigh the private costs (including those of prospective crises), at least *ex ante*. The case for taxing dangerous forms of finance, hence, must rest on the idea that their social costs and their substitutability to safer forms of finance are sufficiently large. This is ultimately an empirical question.

The maturity of sovereign debt is not the only variable that one would like to endogenize. Another important question is its currency composition. As Falcetti and Missale (1999) show in a recent paper, foreign currency debt can be endogenized along the same line as in this paper—as an en-

forcer of macroeconomic discipline. The interaction between the maturity and the currency composition of debt—and their relationship to exchange rate regimes—is a key item in the research agenda underlying this paper. Another important topic for future research is the institutional structure of international lending (whether it takes the form of syndicated bank loans or bond flotations, in particular). More decentralized structures might provide better incentives to the borrower, but might be less conducive to effective monitoring by the lenders.

Another item in the research agenda behind this paper is to endogenize the structure of the external liabilities of the *private* sector. Although the model in this paper could easily be transposed to a private borrower by renaming the government “firm” or “bank”, such a transposition would miss important complications related to the spillovers between private and public solvency.²⁰ First, private debt crises would not require the intervention of *international* financial institutions in a world with perfectly solvent governments. In a such a hypothetical world, governments could deal with private debt crises at the domestic level, by borrowing foreign currency on a long-term basis. Hence, the notion that an *international* lender of last resort might be necessary to cope with private debt crises must rely on the hypothesis that the debt of the sovereign is subject to the same fragility as private debt in times of crisis. One reason why this might be the case is that private debt crises generate implicit fiscal liabilities that fragilize the sovereign borrower (Burnside, Eichenbaum and Rebelo, 1998). As the recent crises in emerging economies show, corporate debt and banking crises have rapid and drastic fiscal implications, as governments try to rescue and bail out domestic institutions.

This list of topics for further research, which is far from exhaustive, suggests that there remains considerable progress to be made in the welfare economics of the global financial architecture. Two customary justifications for economic theory—that it constrains the analyst to make explicit the assumptions and the normative criteria behind the policy recommendations,

²⁰Other sources of complication is that in the case of the corporate sector, the choice between debt and equity and the role of collateral can no longer be ignored. Rogoff (1999) notes the importance of the composition of capital flows between credit flows, equity flows and foreign direct investment for the resilience of the international financial system.

and that it shapes the questions one has in mind when going to the data— seem to apply with special force to the recent debates on reforming the global financial architecture. The fact that some of the results derived here are at odds with emerging conventional views on reforming the international financial system may be viewed as an encouraging signal on the benefits of theorizing in this area.

REFERENCES

- Berglöf, Erik and Ernst-Ludwig von Thadden, 1994, Short-term Versus Long-term Interests: Capital Structure With Multiple Investors, *Quarterly Journal of Economics* 109, 1055-1084.
- Bolton, Patrick, and David S. Scharfstein, 1996, Optimal Debt Structure, *Journal of Political Economy* 104, 1-25.
- Burnside, Craig, Eichenbaum, Martin and Sergio Rebelo, 1998, Prospective Deficits and the Asian Currency Crisis, NBER Working Paper No. 6758.
- Calomiris, Charles W., and Charles M. Kahn, 1991, The Role of Demandable Debt in Structuring Optimal Banking Arrangements, *American Economic Review* 81, 497-513.
- Chang, Roberto and Andrés Velasco, 1998, Banks, Debt Maturity and Financial Crises, New York University, processed.
- Chui, Michael, Gai, Prasanna, and Andrew Haldane, 2000, Sovereign Liquidity Crises: Analytics and Implications for Public Policy, Bank of England, processed.
- Cole, H.R, and T.J. Kehoe, 1996, Self-fulfilling Debt Crises, *Journal of International Economics* 41, 309-330.
- Diamond, Douglas W., and Philip H. Dybvig, 1983, Bank Runs, Deposit Insurance, and Liquidity, *Journal of Political Economy* 91, 401-19.
- Diamond, Douglas W., and Raghuram G. Rajan, 2000, A Theory of Bank Capital, University of Chicago, processed.
- Eaton, Jonathan, and Raquel fernandez, 1995, Sovereign Debt, in *Handbook of International Economics* vol.3, G. Grossman and K. Rogoff, eds., Elsevier Science, 2031-2077.
- Eichengreen, Barry, 1999, *Toward a New International Financial Architecture*, Institute For International Economics (Washington, DC).

- Eichengreen B., and R. Portes, 1995, *Crisis? What Crisis? Orderly Workouts for Sovereign Debtors*, CEPR, London.
- Falcetti, Elisabetta, and Alessandro Missale, 1999, The Currency Denomination of Public Debt and the Choice of the Monetary Regime, Università di Firenze, processed.
- Fischer, Stanley, 1999, On the need for an international lender of last resort, *Journal of Economic Perspectives* 13, 85-104.
- Garten, Jeffrey E., 1998, In This Economic Chaos, a Global Central Bank Can Help, *International Herald Tribune*, 25 September, 8.
- Group of 10 (G-10), 1996, *Resolving Sovereign Liquidity Crises*, Washington, G-10.
- Group of 22 (G-22), 1998, *Three Reports On International Financial Architecture Reform* (October 1998).
- Goldfajn, Ilan, and Rodrigo O. Valdes, 1999, Liquidity crises and the international financial architecture, Central Bank of Chile, processed.
- Jeanne, Olivier, 2000, *Currency Crises: A Perspective on Recent Theoretical Developments*, Special Papers in International Economics No.20 (March), International Finance Section, Department of Economics, Princeton University.
- Krugman, Paul, 1985, International Debt Strategies in an Uncertain World, in *International Debt and the Developing Countries*, G.W. Smith and J.T. Cuddington, eds., World Bank (Washington D.C.), 79-100.
- Kumar, Manmohan, Masson, Paul and Marcus Miller, 1999, Global Financial Crises: Mechanisms and Incentives, IMF, processed.
- Meltzer, Allan H., 1998, Asian Problems and the IMF, *The Cato Journal* 17, 267-274.
- Morris, Stephen, and Hyun Song Shin, 1999, Coordination Risk and the Price of Debt, mimeo.

- Rodrik, Dani, and Andrés Velasco, 1999, Short-term Capital Flows, NBER Working Paper 7364.
- Rogoff, Ken, 1999, International Institutions for Reducing Global Financial Instability, *Journal of Economic Perspectives* 13, 21-42.
- Sachs, Jeffrey, 1984, *Theoretical Issues in International Borrowing*, Princeton Studies in International Finance 54, International Finance Section, Department of Economics, Princeton University.
- Stiglitz, Joseph E., and Andrew Weiss, 1983, Incentive Effects of Terminations: Applications to the Credit and Labor Markets, *American Economic Review* 73, 912-27.

Figure 1. Government's Optimal Refinancing Strategies

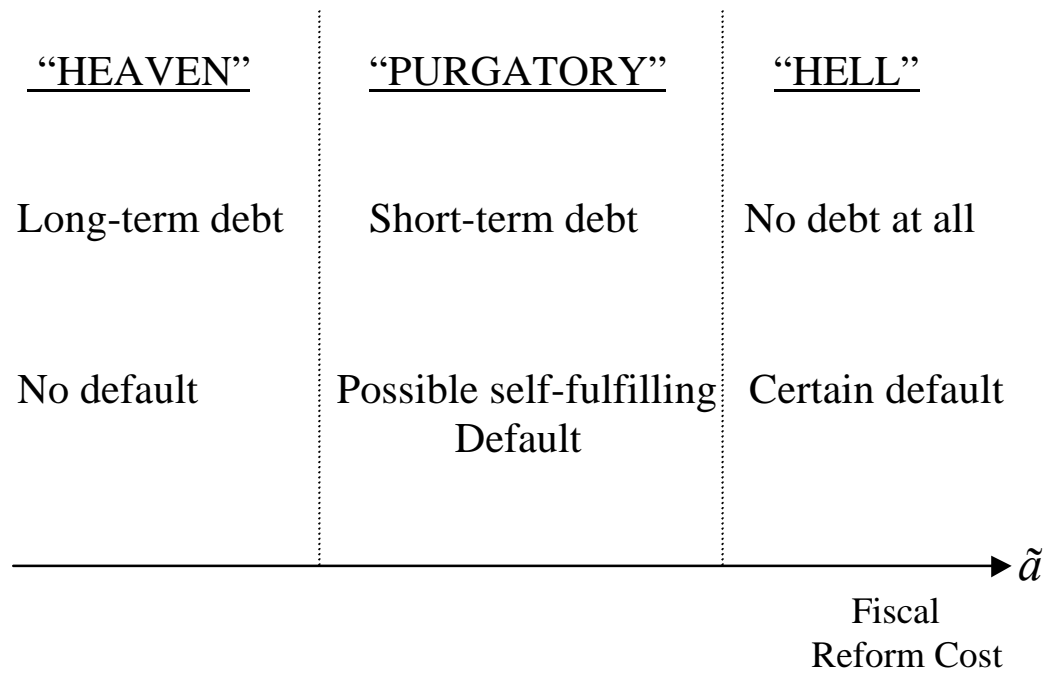


Figure 2.
Global Welfare

