Global Crisis, Official Bailout and the Long-run Demand for Official Lending

Jun I. Kim
Research Department
International Monetary Fund

Abstract

This paper presents an analysis of official bailout and emerging market debt structures and uses the analysis to argue that even in the absence of moral hazard an increased supply of official lending may create its own demand in the long run by encouraging risky short-term debt. In the analysis, short-term debt runs the risk of a rollover crisis and inefficient default but cheaper than long-term debt. Official bailout helps prevent default but only at the expense of long-term investors whose claims are subordinated to senior official loans. By increasing the relative price of long-term debt, official bailout biases the debt structure of the country toward more short-term debt than otherwise. The bias increases with the size of official lending if the latter is initially small. These results suggest that the recent reform of IMF lending facilities and funding options could lead to a higher long-run demand for official lending than might be warranted by the fresh market perception of the risk of global liquidity shock.

I. INTRODUCTION

The financial crisis of 2007-08 may well be characterized by a global sudden stop in capital flows with correspondingly global spillover effects across countries. A sharp curtailment in capital flows, together with a collapse in export demand, threatens the external sustainability of many emerging market countries. While some emerging market countries were ripe for a home-grown crisis after the end of an unsustainable domestic credit boom or fiscal spending, many were an innocent bystander caught in the storm. In the latter, money is leaving not because of a loss of confidence in the currency but because of global deleveraging by investors.

As a number of emerging market countries simultaneously fell victim to full-blown financial crises, there has been a renewed attention to the role of international financial architecture in addressing crises in global nature. At the center of such discussion were concerns about the appropriate modality of official bailout and the funding adequacy of official creditors, particularly the IMF. The traditional bailout package assembled by the IMF—which typically involves strong policy conditionality for adjustment but relatively small official financing—may be less appropriate for countries that were sound but nonetheless caught in a crisis because of global liquidity shock. Moreover, the IMF may not be adequately funded to deal with financial crises highly correlated across countries as it has been operating under the notion of global pooling of idiosyncratic country risks.

In response to these concerns, the IMF reformed its lending facilities in early 2009 by introducing a new lending facility and allowing larger and more upfront access by members to the existing facilities. The new facility, targeted for members with strong fundamentals and policy track, marks a significant departure from the past because unlike others, it involves neither policy conditionality nor any pre-specified access limit. In parallel, the IMF explored various funding options to expand its resource base, including the allocation of SDRs across the entire membership. As a result, the IMF is expected to be able to quadruple its resource base to about US$1 trillion.

If not reversed soon, the reform will lead to a permanent increase in the supply of official lending at more favorable terms. While the steep increase in the demand for official bailout during the global crisis is temporary in nature, the post-crisis demand may nonetheless remain higher than the pre-crisis level as the risk of global crisis is no longer hypothetical but real. In this respect, the reform might be warranted. However, a permanent increase in the supply of official lending might have quite different long-run implications for international lending. Most importantly, the demand for official bailout

itself may not be exogenous to the supply of official lending in the long run if the latter affects the incentives of investors and debtors systematically.

In this regard, two competing views are worthy of discussion. The first view stresses that bailout expectations may create moral hazard whereby debtor countries pursue excessively risky policies while investors under-price lending risks. According to this moral hazard view, the reform may have unintended consequences and eventually lead to a higher demand for official bailout than might be warranted by the fresh market perception of the risk of global financial crises. The second view highlights the positive role of official bailouts as public insurance. By reducing real hazard of a crisis ex post, official bailouts provide an ex ante insurance benefit to both investors and debtors and thus makes international lending less risky. As a result, international investors may lend more at lower interest rates while emerging market countries may take greater risks for higher returns than otherwise. According to this real hazard view, the recent reform of the IMF may lead to a higher demand for official bailout but as a result of an optimal response of investors and debtors to reduced riskiness of international lending.

The literature on financial crises does not provide a clear answer to which view should be considered more realistic. Corsetti et al (2006) and Morris and Shin (2006) analyze the catalytic role of the IMF using a global game framework and show that the liquidity support by the IMF may weaken policy effort for crisis prevention. However, Mussa (1999, 2004) argues that if the IMF does not make expected losses on its lending and the debtor government maximizes national welfare, then there can be no moral hazard. Intuitively, if the IMF does not make expected losses, there is no expected transfer from the IMF either to the borrowing country or to private investors. Without any expected transfer, ex ante incentives of both creditors and borrowers would not change, so there can be no moral hazard. This intuition is formalized by Jeanne and Zettelmeyer (2005) and Kim (2007).

Empirical evidence is also mixed at best. Lane and Phillips (2000) highlight that IMF resources are not large enough to create serious moral hazard and financial losses of creditors are far greater than the potential size of IMF loans. Zettelmeyer and Joshi (2005) show that implicit transfers in IMF lending to emerging market countries are negligibly small, a finding that lends some support for no IMF-induced moral hazard. In contrast, Dell'Ariccia, Schnabel and Zettelmeyer (2006) find that emerging market spreads are less differentiated across countries when bailout expectations are high. But this finding is consistent not only with the moral hazard view but also the real hazard view.

In any case, both views suggest the possibility that the demand for official bailout is endogenous with respect to the supply of official lending in the long run. More precisely, they suggest that the increased supply of official lending may have a self-fulfilling effect on the demand for official lending in the long run. The underlying mechanism could take various forms, ranging from excessive borrowing or weaker policy effort for crisis prevention to shorter maturities of external debt or lower foreign reserve holdings.

This paper presents an analysis of official bailout and emerging market debt structure in the context of a simple model of international lending, and uses the analysis to argue that even in the absence of moral hazard an increased supply of official lending may create its own demand in the long run by encouraging risky short-term debt. An important result arising from the model is that for countries with limited debt-servicing capacity, the optimal debt structure involves short-term debt only if official bailout is available. This result suggests that the availability of official bailout could be a reason for the emergence of short-term sovereign debt in the context of emerging market countries.

The model assumes that the country maximizes welfare by optimally choosing the debt structure but abstracts from the issue of incomplete information or strategic default. In this respect, the analysis of the paper is complementary to the existing literature on sovereign debt structures. Borrowing from the classic finance theory on the capital structure of banks or firms under incomplete information, the literature highlights the incentive effects of short-term or demandable debt in mitigating or resolving the commitment problem.[1] More recently, Jeanne (2008) presents a theory of the maturity of international sovereign debt based on a model in which the need to roll over demandable external debt disciplines the policies of debtor countries for creditor rights. In his model, the country borrows long-term and achieves the first-best equilibrium if it can credibly commit to strong creditor rights but otherwise cannot borrow either short-term or long-term. In the *laissez-faire* equilibrium, demandable debt—a mixture of short-term and long-term debt—helps toughen up the country's incentive not to default strategically ex post and thus enables the country to borrow. As such, the emergence of short-term debt is a symptom of the commitment problem, which does not exist in our model.

[1] See Sachs (1984), Rodrik and Velasco (2000), Diamond and Rajan (2001), and Tirole (2003). For the analysis on the capital structure at the bank or firm levels, see Calomiris and Kahn (1991), Berglöf and von Thadden (1994), Dewatripont and Tirole (1994), and Bolton and Scharfstein (1996).

The paper generates several other predictions that are worth highlighting. First, official bailout can have a crisis prevention effect as long as the country borrows in both short and long terms. This result follows because the efficiency gain from preventing inefficient default is optimally priced into a lower borrowing cost of the country which in turn leads to a lower likelihood of a crisis. A related result is that official bailout has a stronger crisis prevention effect if provided with conditional lending. Second, the conditionality of official lending matters for the optimal debt structure. Interestingly, conditional official lending encourages short-term borrowing more than does unconditional lending. Third, the risk of global liquidity shock reinforces the effect of official bailout on the debt structure.

Finally, the effect of official bailout on the emerging market debt structure would be most pronounced if official lending is limited in amount. More specifically, the model implies that an increase in the supply of conditional official lending from a low level leads to the same increase in short-term debt and thus the demand for official lending. This implication is taken to produce a crude, albeit speculative, estimate for the likely long-run effect on the demand for official lending of the recent reform of IMF lending facilities. The estimate suggests that the demand for IMF official lending could more than triple in the long run.

The remainder of the paper is organized as follows. Section II presents the basic setup of the model. Section III derives the equilibrium solutions of the model with and without the availability of official bailout. Section IV discusses how the availability of official bailout and the conditionality of official lending would affect the optimal debt structure of emerging market countries. Section V discusses the implications of the model on the long-run demand for official bailout and presents a crude estimate of the likely order of the increase in the long-run demand for official lending. Section VI concludes the paper.

II. BASIC SETUP OF THE MODEL

There are three periods denoted by $t = 0, 1, 2$. In period 0, the representative country invests k that yields an output y in period 2. The country has no wealth in period 0 so that the investment must be financed by external borrowing. The country can credibly pledge up to a fraction α of output for

debt services.[2] The country consumes only in period 2 and its utility function is $V(c_2) = c_2$ where c_2 represents consumption per each unit of initial investment.

We assume that δk is financed by short-term debt maturing in period 1 and the remaining $(1-\delta)k$ by long-term debt that matures in period 2. Since the investment is illiquid and yields an output only in period 2, the country must roll over its short-term debt in period 1. The initial investment could be liquidated in period 1 by short-term investors up to their investment shares. The remaining investment still yields an output but only at a loss. Denoting by k_1 the investment at the end of period 1, output in period 2 is characterized by

$$y(k_1) = \begin{cases} \theta k_1 & \text{if } k_1 = k \\ \rho\theta k_1 & \text{if } k_1 < k \end{cases}$$

where $0 \le \rho < 1$, and $\theta > 0$ is stochastic productivity distributed according to the cumulative probability distribution $F(\theta)$ with $E(\theta) > 1$. For simplicity but without loss of generality, θ is assumed to be publicly known with certainty in period 1. Since $\rho < 1$, liquidation is inefficient.

There is a continuum of private investors whose mass is normalized to one. As private investors are atomistic, coordination failure may occur and trigger a run by short-term investors. Upon a run, short-term investors exit by liquidating their share of investment unless the country finances debt outflows by official loans. For short-term investors, the liquidation value is $\lambda = 1$ per each unit of investment.[3]

All investors are risk neutral in period 0 but their risk preference is uncertain in period 1. Specifically, each investor is risk averse with probability *q* in period 1 or risk neutral with probability 1-*q*. The preference shock is a *global* shock as it is perfectly correlated across investors—either all investors are risk averse or all investors are risk neutral. We do not model how the investor risk preference translates into a specific level of risk premium, which is beyond the scope of this paper. Instead, we

[2] This assumption effectively rules out the possibility of a strategic default due to the country's unwillingness to repay, which plays an important role in Jeanne (2009).

[3] As shown below, this assumption greatly simplifies the analysis without loss of generality. All results and intuition remain essentially unaltered except that the short-term interest rate is positive if $\lambda < 1$.

capture the effect of the global shock in the simplest possible way by assuming that the expected rate of return required by investors jumps to $s > 0$ when investors are risk averse while it is zero otherwise.

Finally, there is an official creditor who is senior to all private investors and lends in an amount of L at an actuarially fair interest rate provided that the country faces a rollover crisis and requests the official support. We consider two types of official lending: unconditional official lending (UOL) and conditional official lending (COL). COL enables the country to credibly pledge up to a larger fraction $\beta(>\alpha)$ of output for debt services while UOL does not affect the country's debt-servicing capacity.[4,5] Since the country cannot be forced to repay more than contracted obligations, actual debt services are the smaller of pledged output and contracted debt obligations.

The assumption that the country maximizes national welfare, the production function is linear, and official lending is provided only at an actuarially fair interest rate rules out effectively the possibility of moral hazard associated with an official bailout. (Mussa, 1999, 2004). As a result, any effects of official bailout on the likelihood of a crisis or the welfare of the country should be associated with the role of official bailout in reducing real hazard of a crisis.

III. EQUILIBRIUM SOLUTIONS OF THE MODEL

In this section, we solve the model for given δ leaving to the next section the discussion on the country's optimal choice of the debt structure. Equilibrium solutions of the model consist of the short- and long-term interest rates contracted in period 0, the rollover interest rate in period 1, and the interest rate of official lending.

Regardless of the availability of official bailout, the rollover interest rate for short-term debt should equal the required rate of return for private investors simply because productivity is known with

[4] There is a large literature on how the IMF can play a catalytic role in crisis prevention with particular emphasis on the role of conditionality and liquidity support. For recent theoretical studies, see Corsetti et al. (2006), Morris and Shin (2006), Kim (2006), and Penalver (2002). For empirical evidence, see Eichengreen and Mody (2000), Mody and Saravia (2003), and Eichengreen et al. (2006). Finally, Cottarelli and Giannini (2002) and Bird and Rowlands (2002) provides a survey of the empirical literature on catalytic effects of official lending.

[5] Alternatively, COL could be modeled by assuming that conditionality requires policy effort by the country to raise productivity and that policy effort reduces the country's utility for given consumption. See Kim (2006) for a model along this line.

certainty. In equilibrium, therefore, the rollover interest rate should be equal to *s* (with probability *q*) or zero (with probability 1-*q*). Since short-term investors are risk neutral in period 0 and can freely exit at the liquidation value of unity or adjust the rollover interest rate as desired in period 1 under no uncertainty, the short-term interest rate contracted in period 0 must be zero in equilibrium. The same intuition suggests that the official creditor, if it lends, should lend at the zero interest rate in equilibrium because it faces no uncertainty regarding the debt-servicing capacity of the country and lends only at an actuarially fair interest rate.

This leaves only the long-term interest rate *r* for which the model is to be solved, where *r* is defined for convenience as the gross interest rate over two periods. Because long-term debt is locked in until period 2, long-term investors are exposed to an interest rate risk associated with the uncertain risk preference of investors in period 1. As a compensation for the risk, long-term investors should demand a positive expected rate of return for their lending to the country. By using the term structure relationship, it is straightforward to show that in equilibrium the required (gross) rate of return (over two periods) must be (1+*qs*) for long-term investors.

We also assume for the time being that the official creditor lends in the same amount as the outstanding stock of short-term debt, $L = \delta k$. Otherwise, official lending cannot help prevent inefficient default. This assumption is revisited in the next section where we discuss the country's optimal debt structure. For notational convenience, let us define $R \equiv r(1-\delta)$ which represents the country's long-term debt service obligation in period 2. In what follows, total investment *k* is normalized to unity without loss of generality.

For ease of exposition, we first discuss the equilibrium solutions when the country borrows both short- and long-term ($0 < \delta < 1$). We then look for the equilibrium solutions where the country borrows entirely in long term ($\delta = 0$) or entirely in short term ($\delta = 1$).

A. Country Borrows Both Short- and Long-Term

Probability of a rollover crisis

Short-term investors roll over their claims only if the country's pledged debt service is sufficient to meet all debt obligations in period 2. Otherwise, they run for the exit. Since the rollover interest rate is state dependent, so are the country's debt service obligations and the probability of a rollover crisis.

Specifically, the country faces a rollover crisis in period 1 if $\alpha\theta < \delta + R$ or if $\alpha\theta < (1+s)\delta + R$ depending on whether the global liquidity shock occurs or not. Defining $\theta^* = (\delta + R)/\alpha$ and $\theta^q = ((1+s)\delta + R)/\alpha$, the (ex ante) probability of a rollover crisis is characterized by

$$p = (1-q)p^* + qp^q \tag{1}$$

where $p^* = F(\theta^*)$ and $p^q = F(\theta^q)$.

Probability of inefficient default

The probability of inefficient default equals the probability of a rollover crisis if official bailout is unavailable. Otherwise, it is smaller than the probability of a crisis because no inefficient default occurs whenever official bailout is provided. Given the assumed seniority of official loans, the official creditor does not compete with long-term investors for the country's debt services in period 2. As a result, it can lend up to the point where the country's pledged output is just enough to repay official loans. Let us define $\theta^U = \delta/\alpha$ and $\theta^C = \delta/\beta$. The probability of inefficient default is then characterized by

$$p^N = p, \quad p^U = F(\theta^U), \quad \text{and} \quad p^C = F(\theta^C) \tag{2}$$

where superscripts N, U, and C are used to denote the case of no official bailout (NOB), UOL, and COL, respectively. Note that p^U and p^C are independent of *R* or *q*.

The country has always an incentive to request UOL whenever it faces a rollover crisis because it always yields higher ex post consumption. By contrast, COL is available to the country only at higher debt service burden for given output although it helps preserve output. Therefore, COL is in the interest of the country only if it yields higher ex post consumption than otherwise or, equivalently, only if

$$(1-\beta) \geq (1-\alpha)\rho(1-\delta).$$

In order to ensure that this incentive condition holds at all levels of short-term debt, we assume that $\beta \leq 1-(1-\alpha)\rho$. Given these restrictions, official bailout is always in the interest of the country ex post even if it may not be so ex ante.

Ex ante zero-profit conditions for long-term investors

We assume for simplicity (but without loss of generality) that long-term investors are never fully repaid upon the country's default in period 1. To this end, we further restrict the value of ρ to satisfy that $\rho < 1/(1+s)$. Given this restriction, long-term investors are fully repaid with probability $1-p^N$ in the absence of official bailout but with probability $1-p^*$ for UOL and $1-p^{**}$ for COL where $p^{**} = F(\theta^{**})$ and $\theta^{**} = (\delta + R)/\beta$.

For convenience, let us define $X^j = E[\theta < \theta^j]$. The expected payoff to long-term investors, Z^j, can be expressed as follows:

$$
\begin{aligned}
Z^N &= R(1-p^N) + \alpha\rho(1-\delta)X^N \\
Z^U &= R(1-p^*) + \alpha(X^* - X^U) - \delta(p^* - p^U) + \alpha\rho(1-\delta)X^U \\
Z^C &= R(1-p^{**}) + \beta(X^{**} - X^C) - \delta(p^{**} - p^C) + \alpha\rho(1-\delta)X^C
\end{aligned} \tag{3}
$$

where $X^N = qX^q + (1-q)X^*$. For later purposes, we highlight the following properties:

$$
\begin{aligned}
Z^N: &\quad \partial Z^N/\partial\rho > 0, \quad \partial Z^N/\partial q < 0 \\
Z^j\,(j = U, C): &\quad \partial Z^j/\partial\rho > 0, \quad \partial Z^j/\partial q = 0, \quad \partial Z^j/\partial R > 0, \quad \partial Z^j/\partial\delta > -1
\end{aligned} \tag{4}
$$

In equilibrium, Z^j must equal the expected return demanded by long-term investors. The ex ante zero-profit conditions for long-term investors are thus characterized by

$$Z^j = (1+qs)(1-\delta), \quad j = N,\ U,\ \text{and}\ C \tag{5}$$

Equilibrium Solutions

Let us denote by R^j the equilibrium solutions obtained by solving (5). While R^U and R^C always exist and are unique, neither the existence nor the uniqueness can be assured for R^N.[6] If R^N does not exists, the only option available to the country is to borrow entirely in long term or entirely in short term (see below). In case of multiple solutions, the lowest one should be considered as the economically relevant one. Equations (4) and (5) imply that $\partial R^j / \partial \delta < -(1+qs)$ and $\partial R^j / \partial q > 0$ for *j* = U and C. Consequently, in equilibrium with the availability of official bailout, the probability of a crisis is decreasing in short-term debt but increasing in the risk of global liquidity shock.

The following proposition summarizes the equilibrium solutions when the country borrows both short and long terms.

Proposition 1 Suppose that R^N exists. Then, $R^C \leq R^U \leq R^N$ for all $\delta \in (0, 1)$ if ρ is sufficiently small.

Proof. See the appendix.

Since the probability of a rollover crisis is increasing in *R* for given debt structure, the result in Proposition 1 implies that official bailout can have a crisis prevention effect even if it is provided contingently, and that COL can have stronger crisis prevention effect than UOL. Key intuition behind this result is that the ex post efficiency gain from preventing inefficient default is optimally priced into a lower ex ante average borrowing cost of the country, which in turn leads to a lower likelihood of a crisis for given fundamentals. UOL effectively subsidizes the country that would otherwise have suffered from inefficient output (and consumption) loss while taxing long-term investors by diluting their claims.[7] COL has stronger crisis prevention effect than UOL because it taxes the country as well by forcing larger debt services at crisis than otherwise. As a result, ex post taxes on long-term

[6] For given productivity distribution, R^N is less likely to exist the smaller are α or ρ. In a related context, Flood and Marion (2006) show that an emerging market borrower who might default can be shut out of international capital markets without warning even for a modest haircut on obligations.

[7] In the model, short-term investors incur no loss at any event because of the assumption that the liquidation value λ is unity. In a more general case where $\lambda < 1$, official lending also subsidizes ex post short-term investors by allowing them to exit at no cost.

investors are smaller than in UOL, which translates into a lower ex ante long-term interest rate and eventually into a lower likelihood of a crisis.

The model also suggests that the crisis prevention effect of contingent official bailout is stronger in the presence of the risk of global liquidity shock than otherwise. The risk of global liquidity shock leads to a higher probability of a crisis for given fundamentals. Starting from a higher probability of a crisis, therefore, official bailout—which provides full protection against the risk that global illiquidity translates into an inefficient default—results in a larger reduction in the probability of a crisis.

B. Country Borrows Either Short term or Long term

If the country borrows entirely in long term, there is no demand for official bailout simply because no crisis occurs. The ex post payoff to long-term investors is *R* if $\alpha\theta > R$ and $\alpha\theta$ otherwise. Defining $\theta^0 = R/\alpha$, the expected payoff Z^0 is expressed by

$$Z^0 = R(1-p^0) + \alpha X^0$$

where $p^0 = F(\theta^0)$ and $X^0 = E[\theta < \theta^0]$. The ex ante zero-profit condition for long-term investors is then given by $Z^0 = (1+qs)$. Let us denote by R^0 the equilibrium solution. Since Z^0 is strictly increasing in *R* and less than 1 at *R* = 1, R^0 always exists and is unique.

In the opposite case where the country borrows only in short term, the equilibrium solution always exists since the equilibrium short-term interest rate is already determined at zero. Substituting $\delta = 1$ into (1) and (2) yields

$$p^q = F((1+s)/\alpha), \quad p^* = p^U = F(1/\alpha), \quad p^C = F(1/\beta).$$

These results imply that official bailout has no crisis prevention effect (the probability of a crisis is independent of official bailout), and that UOL cannot help prevent inefficient default in a solvency crisis while COL can. The latter result follows simply because there is no long-term investor to tax under UOL while COL can still tax the country.

IV. Optimal Debt Structure

The analysis thus far is undertaken for given debt structure of the country. This section endogenizes the debt structure and discusses how the availability of official bailout would affect it. Before doing so, it should be useful at this juncture to remind that the possibility of moral hazard is ruled out at the outset. Therefore, any effect of official bailout on the emerging market debt structure implied by the model should be related to the positive role of official bailout in reducing real hazard of a crisis, not moral hazard.

In period 0, the country faces a basic trade-off between risky but cheaper short-term debt and safe but more expensive long-term debt. At the margin, the optimal debt structure is determined by balancing the tradeoff.[8] If the availability of contingent official bailout affects the relative price of long-term debt vis-à-vis short-term debt, it should also affect the tradeoff in an important way and thus the optimal debt structure.

The discussion in the previous section assumes that official lending is as large as the outstanding stock of short-term debt no matter how large is the latter, while in reality official resources are limited. If official lending is provided in a smaller amount than short-term debt, the insurance benefit of official bailout should be far smaller if not absent because the country cannot avoid inefficient default upon a crisis. For this reason, the discussion in what follows considers both unconstrained and constrained official lending.

A. Unconstrained Official Lending

Suppose that the amount of official lending is unconstrained and always as large as short-term debt. We begin by considering the corner solutions where the country takes the maximum risk by borrowing entirely in short term ("full risk-taking") or takes no risk at all by borrowing entirely in long term ("self-insurance").

[8] When the country borrows in both short and long terms, the country and long-term investors bear ex post the cost of inefficient default while short-term investors incur no loss by assumption. However, it is the country that bears ex ante the entire cost of inefficient default because long-term investors are risk neutral in period 0 and optimally price the default risk in their lending rate.

The full risk-taking option yields the highest level of welfare at no crisis but the lowest level of welfare in the event of default as consumption falls to zero. By contrast, the self-insurance option fully insures the country against the risk of inefficient default but is costly as the country must pay insurance premium for the entire amount of borrowing.

Since official bailout plays no role in case of self-insurance, the associated expected utility is a natural benchmark against which welfare of alternative options can be evaluated. Let us denote by EV^0 the expected utility under self-insurance. The zero-profit condition for long-term investors implies that $EV^0 = E(\theta) - (1+qs)$ in equilibrium. Since the country always has an option not to invest in which case the expected utility is simply zero, self-insurance would never be optimal if $EV^0 < 0$. Therefore, the risk of global liquidity shock could have a dramatic effect on long-term capital flows for countries where the investment is barely profitable (e.g., $E(\theta) \approx 1$) and self-insurance is optimal.

Given our focus on the optimal debt structure, we assume in what follows that $EV^0 > 0$ so that the no-investment option is never optimal. Let us denote the net gain or loss in the expected utility associated with short-term borrowing by $W^j(\delta) = EV^j - EV^0$ for j = N, U, and C. By definition, $W^j(0) = 0$. For $\delta > 0$, $W^j(\delta)$ can be characterized by

$$W^j(\delta) = \delta(p^j + qsp^q) - (1 - \rho(1-\delta))X^j \tag{6}$$

The specification of $W^j(\delta)$ has intuitive appeal. The first term reflects the expected benefit of short-term borrowing in terms of reduced debt services while the second term with negative sign corresponds to the expected welfare (or output) loss from inefficient default. To better understand the benefit of short-term borrowing, the first term in $W^U(\delta)$ can be reformulated to yield,

$$\delta(p^j + qsp^q) = (1+qs) - \{(1+qs)(1-\delta) + \delta(1-p^j) + qs\delta(1-p^q)\}.$$

The term (1+qs) represents the expected debt services under self-insurance while the expression inside of the bracket captures the expected debt services when the country borrows in short term. The first term in the bracket is the expected debt services to long-term investors while the second is the expected debt services to short-term investors or the official creditor when there is no global liquidity shock. Note that the country has debt service obligation neither to short-term investors nor to the

official creditor in case of inefficient default which occurs with probability p^j. Finally, the last term in the bracket captures the expected value of the rollover premium that the country must pay at no crisis if the global liquidity shock is realized.

The optimal debt structure can be identified by the value of δ that maximizes $W^j(\delta)$. We denote by δ^j the unconstrained optimal level of short-term debt for *j* = *N*, *U*, and *C*.

Optimal debt structure in the absence of official bailout

Assuming that official bailout is unavailable, it turns out that it would never be optimal to borrow in both short and long terms if default is sufficiently inefficient. This result follows from the fact that the country's welfare does not depend on the efficiency cost of default at corner solutions with $\delta = 0$ or 1.[9] The country's debt-servicing capacity turns out to be the determining factor for which corner solution to emerge as optimal. The following proposition summarizes the results for the optimal debt structure in the absence of official bailout.

Proposition 2 If $\rho < \alpha$, $W^N(\delta) < \max[W^N(0), W^N(1)]$ for all $\delta \in (0,1)$. There exists unique $\alpha^*(q) \in (0,1)$ such that $\delta^N = 0$ if $\alpha \le \alpha^*(q)$ and $\delta^N = 1$ otherwise.

Proof. See the appendix.

According to Proposition 2, in the absence of official bailout, countries with limited debt-servicing capacity are more likely to opt for self-insurance while those with stronger capacity are more likely to borrow entirely in short term. This result may appear counter intuitive at first glance.[10] Since the long-term interest rate is decreasing in α in equilibrium, one may think that self-insurance is cheaper and hence more likely to be optimal the stronger is the country's debt servicing capacity. However, the

[9] By construction, there is no risk of inefficient default under self-insurance. In the opposite case with δ=1, the country is fully exposed to the risk of inefficient default. But the inefficiency of default has no bearing on the welfare because output falls to zero anyway as no capital is left upon default.

[10] Proposition 2 is also in contrast to the first-best commitment equilibrium of Jeanne (2008) in which the country can afford long-term debt only if it commits to a high level of creditor rights or, equivalently, a higher level of debt services. Such difference between his and our models reflects different assumptions rather than different reasoning. In his model, private lenders simply cannot break even at a low level of creditor rights by assumption while no such restriction is imposed in our model.

expected utility at self-insurance EV^0 is independent of α.[11] By contrast, the expected utility under full risk-taking increases with the debt-servicing capacity because the probability of a crisis is inversely related to α at all positive levels of short-term debt.

In what follows, we take $\delta^N = 0$ as the unique optimal solution for NOL by assuming that $\alpha \le \alpha^* = \min \alpha^*(q)$. This assumption may well be justified for emerging market countries where the financial market is arguably less developed with relatively weak institutional capacity to support creditor rights. But there are also good theoretical reasons in the context of our model to rule out the case where $\delta^N = 1$. As discussed previously, in the model, the efficiency cost of default is irrelevant for welfare if the country borrows only in long term or only in short term. The irrelevance result makes intuitive sense for self-insurance because no default occurs. For the opposite case of full risk-taking, however, the irrelevance result is specific to the model and not robust to even a minor change of the model. To see this, suppose that the country has a small endowment in period 0 and use the endowment and external borrowing to finance investment. Then, liquidation is always partial and output never falls to zero upon default (except for $\theta = 0$). Consequently, the efficiency cost of default does matter for welfare at all positive levels of short-term debt, rendering the corner solution with $\delta = 1$ qualitatively no different from interior solutions.

For consistency and without loss of generality, we make additional assumptions formalized as follows.

Assumption 1 The country's debt-servicing capacity satisfies that $\rho < \alpha < \alpha^* = \min \alpha^*(q)$, and that $\beta = 1-(1-\alpha)\rho$.

Assumption 2 $W^j(\delta)$, j = U or C, are single peaked for $\delta > 0$.

Assumption 1 ensures that $\delta^N = 0$ is the unique optimal solution for NOB for all permissible q, while Assumption 2 is for sharper analytical results for the effects of official bailout on the optimal

[11] Under self-insurance, the country is not always better off ex post with stronger debt-servicing capacity despite that contracted debt obligations are smaller than otherwise. Note that consumption in period 2 is state-dependent: $c_2 = y-R$ if $\alpha y > R$ while $c_2 = (1-\alpha)y$ if $\alpha y < R$. An increase in α reduces R and increases consumption for given output if $\alpha y > R$. But the same increase in α results in lower consumption otherwise. In equilibrium, these opposite effects are canceled out exactly, leaving the expected utility EV^0 unchanged.

debt structure. In fact, Assumption 2 is not as restrictive as it appears because it holds for a wide range of probability distributions for θ.

Optimal debt structure with the availability of official bailout

The availability of official bailout tips the balance toward borrowing more in short term and less in long term. By providing protection against the risk of inefficient default, official bailout reduces the riskiness of short-term debt at a given price. Moreover, it does so at the expense of long-term investors, adding a premium on the long-term interest rate. As self-insurance becomes relatively more costly, the country has an incentive to borrow in short term, implying that the optimal level of short-term debt is greater than or equal to 0 if official bailout is available.

It is useful to emphasize at this juncture that what matters for the optimal debt structure is not the relative price of long-term debt in nominal terms but the relative price in risk-adjusted terms (or the relative price from the perspective of the debtor country). In nominal terms, the relative price of long-term debt is clearly at the highest under NOB (see Proposition 1). In risk-adjusted terms, however, the opposite is true. This is because in the model the fixed nominal price of short-term debt masks the underlying risk of inefficient default.

The model also implies that COL encourages short-term borrowing more than does UOL if the global liquidity shock is a tail risk. The intuition behind this result is similar to what explains the result in Proposition 2 because the key difference between COL and UOL is the ex post debt-servicing capacity. The country suffers at crisis more under COL than does under COL because it must forego a larger fraction of output for debt services. This is the very aspect of COL that encourages the country to borrow more in short term. Specifically, the country has an incentive to be compensated for higher welfare loss at crisis with higher welfare gain at no crisis, which can be achieved by borrowing more in short term to reduce debt services. At the margin, the balance between the benefit (at no crisis) and the cost (at crisis) of short-term borrowing is achieved at a higher level of short-term debt under COL than under UOL.

The following proposition formally summarizes the discussion.

Proposition 3 The optimal level of short-term debt is strictly positive for COL. If *q* is small, it is higher than the optimal level under UOL (i.e., $\delta^C > \delta^U \geq 0$).

Proof. See the appendix.

Effect of global liquidity shock

In the absence of official bailout, the risk of global liquidity shock reinforces the advantage of self-insurance and thus has no impact on the debt structure by Assumption 1. With the availability of official bailout, however, it encourages short-term borrowing unless the global liquidity shock is a significant risk.

Regardless of the availability of official bailout, the global liquidity risk raises the long-term interest rate by directly increasing the expected rate of return demanded by long-term investors. This direct effect should ceteris paribus strengthen the incentive to borrow in short term. The same risk also leads to a higher probability of a crisis for given fundamentals but does not cost the country if official bailout is provided. However, the global liquidity shock does cost the country at no crisis by increasing the rollover premium. This effect should work as a disincentive to borrow in short term, rendering ambiguous the net effect of the risk of global liquidity shock on the debt structure. The model suggests that the net effect should be positive if the global liquidity shock is a rare event and constitutes a tail risk (with possibly large *s* but small *q*). This implication is formalized in the following proposition.

Proposition 4 Suppose that $\delta^U > 0$ when $q = 0$. The risk of global liquidity shock leads to a higher level of short-term debt for both COL and UOL if *q* is small.

Proof. See the appendix.

B. Constrained Official Lending

Now we consider the case of constrained official lending which takes the center stage in the discussion of the post-crisis demand for official lending in the next section. Suppose that official lending is limited at or less than $\bar{L}$ where $0 < \bar{L} < 1$ so that $L = \min[\delta, \bar{L}]$. Obviously, the optimal debt structure remains the same as the unconstrained optimum if $\bar{L} > \delta^j$ for j = U, C. Otherwise, limited official lending becomes an important determinant of the optimal debt structure.

Let us denote by $\bar{W}^j(\delta)$ and $\bar{\delta}^j$, respectively, the net expected utility and the constrained optimal level of short-term debt associated with limited official lending. Using the same intuition as before, $\bar{W}^j(\delta)$ can be written for $\delta > 0$ as follows:

$$\bar{W}^j(\delta) = \begin{cases} W^j(\delta) & \text{if } \delta \le \bar{L} \\ \bar{W}^N(\delta) + \bar{L}(\rho X^\Omega - p^\Omega) & \text{otherwise} \end{cases} \tag{7}$$

where $\bar{W}^N(\delta) = W^N(\delta, \bar{R}^j)$, $X^\Omega = E[\theta \in \Omega]$ and $p^\Omega = \Pr[\theta \in \Omega]$, and Ω is a set of θ for which official bailout is provided in equilibrium.

If short-term debt is less than or equal to $\bar{L}$, official lending is always as large as short-term debt and thus yields the same expected utility as that of unconstrained official lending. If short-term debt is larger than $\bar{L}$, official bailout is of no help in preventing inefficient default as in case of NOB. This is why the term $\bar{W}^N(\delta)$ appears for $\delta > \bar{L}$. By augmenting capital, however, official bailout leads to higher output than otherwise and benefits the country to the extent that increased output yields higher consumption after paying off official loans. This (limited) benefit of official bailout is captured by the term, $\bar{L}(\rho X^\Omega - p^\Omega)$.

The following proposition formally summarizes the optimal debt structure under constrained official lending.

Proposition 5 Suppose that $L = \min[\delta, \bar{L}]$ where $0 < \bar{L} < \delta^j$. If $\bar{L}$ or ρ is sufficiently small, $\bar{\delta}^C = \bar{L}$ and $\bar{\delta}^U \le \bar{L}$.

Proof. See the appendix.

The results in Proposition 5 imply that the constrained optimal level of short-term debt never exceeds $\bar{L}$ if $\bar{L}$ is small or default is sufficiently inefficient. Moreover, an increase in COL leads to an equal increase in short-term debt at the margin (i.e., $\partial\bar{\delta}^C / \partial\bar{L} = 1$). The same increase in UOL may or may not affect the level of short-term debt. If it does, however, the resulting increase in short-term debt could be even higher than the increase in UOL particularly if the optimal level of short-term debt

was initially zero. These results have an important bearing on predicting the long-run demand for official lending following the recent reform of IMF lending facilities, which is discussed in the next section.

V. Long-run Demand for Official Lending

The analysis thus far could usefully be applied to predicting the long-run demand for official lending that would emerge following the 2007-08 global crisis, and to evaluating the long-run funding adequacy of the IMF. To this end, we highlight two factors that the model suggests should be an important determinant of the post-crisis demand for official lending: (1) risk of global liquidity shock of the similar scale to what was observed in the 2007-08 crisis and (2) recent reform of IMF lending facilities.

Risk of global liquidity shock

The fresh market perception of the risk of major global liquidity shock (with large s but small q) will result in a systematic increase in the emerging market spread and the likelihood of a crisis for given fundamentals. The model further suggests that the emerging market debt structure would evolve toward shorter maturities in the long run in response to the higher cost of external borrowing. These market developments will eventually lead to a higher demand for official lending than before.

Reform of IMF lending facilities

The recent reform of IMF lending facilities may create an additional incentive for emerging market countries to increase short-term debt. As discussed previously, key ingredients of the reform are the introduction of an unconditional lending facility (named as Flexible Credit Line (FCL)), grating a greater access to IMF official financing in the existing facilities, and the general allocation of SDRs which can be freely used by members just like foreign reserves. Since traditional IMF lending has been conditional, the model predicts that the introduction of the FCL and the allocation of SDRs may lead to a lower level of short-term debt than otherwise. At the same time, however, the model also predicts that a greater access to IMF official financing would yield the opposite result leading to a higher level of short-term debt. Thus, the net effect of the recent reform on the demand for official lending is ambiguous, and depends on which factor—new availability of unconditional lending or a general increase in access limit—dominates.

There are good reasons to expect a positive net effect though. First, the analysis in the previous section suggests that an increase in access to IMF official financing may result in an increase in short-term debt if the initial access were limited in size imposing a binding constraint on the optimal debt structure of emerging market countries. In this regard, the fact that IMF lending has typically been small relative to short-term debt of the borrowing country is highly suggestive of the possibility that an increased supply of official lending creates its own demand in the long run.[12]

Second, the availability of unconditional lending is unlikely to be a determining factor of the debt structure unless conditional lending is completely taken off the table. If both types of official lending are available, the country will seek access to unconditional official resources before requesting conditional lending.[13] Therefore, the most plausible post-reform scenario would be that the IMF will continue to lend with conditionality in the majority of emerging market crises while unconditional lending is limited to the case where the country is deemed fundamentally sound but nonetheless faces a crisis because of temporary and self-reversing illiquidity. In the context of the model, this post-reform lending scenario may be best characterized by the following cases:

- The country chooses between UOL and COL to its best interest, or
- The official creditor provides UOL for a pure liquidity crisis and COL for a solvency crisis.

[12] According to the model official lending should be equal in size to short-term debt under the constrained optimum, which is clearly at odd with the fact that IMF official lending has typically been small relative to the stock of short-term debt of the borrowing country. The key insight of the model could nonetheless be made valid if short-term debt is interpreted as the external financing gap. In reality, IMF official lending and conditionality for policy adjustment are simultaneously determined. By design, however, the size of IMF official lending is always equal to the projected financing gap remaining after policy adjustment. For given policy adjustment, therefore, a higher access to IMF official financing implies that the borrowing country can be bailed out for a larger initial financing gap. If the external financing gap is generally increasing in short-term debt and the existing level of short-term debt is suboptimally low, the country would increase short-term borrowing in response to an increase in access to IMF official lending.

[13] The primary effect of the allocation of SDRs is to augment foreign reserves because the allocated SDRs are at free disposal of members (until it is canceled by the IMF) at any time. Therefore, emerging market countries are likely to exhaust the allocated SDRs before seeking financial support from the IMF. The total amount of SDRs to be allocated to the emerging market as a whole is about US$100 billion which, in per country terms, is small or modest at best relative to foreign reserves or the external financing gap typically observed during a capital account crisis. Consequently, the demand for IMF official lending may not be affected much.

The first case proxies well the incentive structure created by the allocation of SDRs while the second is consistent with the basic presumptions underlying the creation of the FCL.

Interestingly, the expected utility in both cases has the same expression with that of COL shown in (6). If the risk of global liquidity shock is ruled out ($q = 0$), the expected utility becomes identical to that of COL and so does the optimal debt structure. In a more general case with $q > 0$, the calibration results (not reported) confirm that the optimal level of short-term debt remains almost identical to δ^C as long as the global liquidity shock constitutes a tail risk. These results suggest that the availability of UOL alone would have only limited impact on emerging market debt structures.

Post-crisis long-run demand for official lending

What would be the likely order of the increase in the long-run demand for official lending following the 2007-08 global crisis and the recent reform of IMF lending facilities? Albeit any estimates should necessarily be speculative, a simple calculation may shed light on this question. To this end, we introduce the following simplifying assumptions: (1) productivity is uncorrelated across a large number of emerging market countries, (2) IMF official lending to a crisis country has and will be limited in size imposing a binding constraint on the choice of optimal debt structure, and (3) post-crisis IMF lending is characterized by the scenario discussed above. The first assumption allows us to substitute the probability of a crisis of the representative country for the proportion of emerging market countries that face a crisis at any given moment. The last assumption allows us to focus on COL for both periods before and after the 2007-08 global crisis.

Given these assumptions and normalizing the number of emerging market countries to one, the demand for official lending L^D can be expressed as follows:

$$L_0^D = (p_0^* - p_0^C)\bar{L}_0 \quad \text{and} \quad L_1^D = (p_1^q - p_1^C)\bar{L}_1$$

where subscripts 0 and 1 are used to denote the period before and after the 2007-08 global crisis, respectively, and $\bar{L}$ represents the (fixed) supply of official lending. The specification simply states that the demand for official lending is determined by the probability of official bailout and the size of official lending. In fact, a number of studies estimate the aggregate demand for IMF official resources

by estimating the probability of a balance of payments crisis and the size of approved access to IMF resources conditional upon program approval.[14]

Note that L_0^D assumes no risk of global liquidity shock while L_1^D represents the demand for official lending upon the realization of the global liquidity shock which is higher than the ex ante post-crisis demand, $L_1^{DE} = (p_1 - p_1^C)\bar{L}_1$. We focus on L_1^D instead of L_1^{DE} because it is the appropriate level of the demand against which the funding adequacy of the IMF should be assessed. The ratio L_1^D / L_0^D is d be a natural metric for the order of the increase in the long-run demand for official lending. Assuming that the probability of inefficient default is negligibly small (relative to the probability of a crisis),[15] the ratio can be simplified to yield

$$\frac{L_1^D}{L_0^D} = \left(\frac{p_1^q}{p_0^*}\right) \times \left(\frac{\bar{L}_1}{\bar{L}_0}\right) \tag{8}$$

For the calculation of the ratio, plausible estimates of the crisis probabilities and the size of official lending are required.

Unfortunately, the model is too simplistic to produce any realistic estimates of the crisis probabilities. For this reason, the calculation turns to historical data. A crude estimate of the probability ratio, p_1^q / p_0^*, is obtained by using the financial market data on the EMBI or CDS spread (under a certain assumption for the recovery value) observed during the peak of the 2007-08 global crisis. To be specific, we assume that the global liquidity shock increases the crisis probability and the default probability implied by the spread in the same proportion:

[14] See Ghosh et al (2007) and the references therein. They employ a two-step approach to estimate the expected aggregate use of IMF resources by members. In the first step, a logit model is used to estimate the likelihood that a member will experience balance of payments difficulties requiring an IMF-supported program. In the second, a regression model is used to calculate the expected approved access to IMF resources with the inverse Mills ratio from the logit estimation controlling for the sample selection bias.

[15] There are only a few cases where the IMF denied the request for support by a crisis country. The calibration results of the previous section also show that the probability of default is small relative to the probability of a crisis.

$$\frac{p_1^q}{p_0^*} = \frac{p_1^{Market}}{p_0^{Market}}$$

where p^{Market} is the default probability implied by the financial market data. The average CDS spread for emerging markets rose to XX basis points at the peak of the global crisis, up from YY basis points at the start of the crisis. Assuming the recovery ratio of 40 percent, the observed change in CDS spread yields p_1^q / p_0^* = [1.5]. According to the model, this estimate may overstate the long-run probability ratio because no adjustment is made with regard to the effect on the crisis probability of the endogenous changes in the emerging market debt structure. At the same time, however, it may understate the long run probability ratio if a global crisis is highly contagious or productivity is correlated across countries.

Finally, the ratio, $\bar{L}_1 / \bar{L}_0$, is estimated by assuming that the supply of IMF lending is proportional to the resource base of the IMF. While a higher access limit does not necessarily mean that the IMF should lend more than before, it should be almost isomorphic to higher official lending at least with regard to the use of newly allocated SDRs for which the IMF has no say. Since the stipulated SDR allocation alone is expected to roughly double the resource base of the IMF, the lower bound for the ratio $\bar{L}_1 / \bar{L}_0$ should be 2. If all other measures to increase the funding base of the IMF are taken into account, the ratio could be as high as 4.

Collecting all these numbers, the long-run demand for IMF official lending could more than triple following the 2007-08 global crisis and the reform of IMF lending facilities. If the "stock" demand for IMF resources is proportional to the "flow" demand for official lending, the IMF may have to triple its resource base or more. In view of these estimates, the planned quadrupling of the resource base of the IMF appears broadly adequate.

VI. CONCLUSION

The 2007-08 global financial crisis is likely to result in a lasting change in the international financial architecture. Although it is hard to foretell what the post-crisis world would or should look like, it is not difficult to expect that the risk of global financial crises would no longer be considered hypothetical in international lending. As the risk is better priced in emerging market lending, the demand for official bailout may not return to the pre-crisis level even after the current global crisis is

fully resolved. In this respect, the recent reform of IMF lending facilities—geared toward increasing the supply of official lending at more favorable terms—may appear to be warranted.

In the long run, however, the increased supply of IMF official lending may create its own demand by encouraging short-term debt even in the absence of moral hazard. Key insight behind this result is that an increased availability of official bailout provides greater protection against the risk of inefficient default associated with short-term debt. As an optimal response, emerging market countries are likely to take better advantage of cheaper short-term debt. Although the model abstracts from foreign reserves, the same insight suggests that the likely response of emerging market countries would be the combination of more short-term debt and lower foreign reserve holdings (or reduced pace of reserve accumulation) than before. When this implication is taken to predict the long-run demand for official lending, a crude—albeit speculative—estimate suggests that the demand for IMF resources could more than triple in the long run.

APPENDIX

Proof of Proposition 1. We show that there exists $0 < \bar{\rho} \leq 1/(1+s)$ such that $Z^N \leq Z^U \leq Z^C$. Define $Z_0^N \equiv Z^N(q=0) < Z^N(q>0)$ and $H(\rho) = Z^U - Z_0^N$. It is straightforward to show that $H(0) > 0$ and $H' < 0$. Thus, there exists $\bar{\rho}_1 > 0$ such that $H(\rho) \geq 0$ for all $\rho \leq \bar{\rho}_1$.

Now define $G(\rho;\beta) = \partial Z^C / \partial \beta$. It is easy to show that $G(0;\alpha) > 0$ and $G'(\rho;\alpha) < 0$. Therefore, there exists $\bar{\rho}_2 > 0$ such that $G(\rho) \geq 0$ for all $\rho \leq \bar{\rho}_2$. Then, defining $\bar{\rho} = \min[\bar{\rho}_1,\ \bar{\rho}_2,\ 1/(1+s)] > 0$ completes the proof. *Q.E.D.*

Proof of Proposition 2. Assume that $\rho < \alpha$. Define $G(\delta,\theta) = (1+s)\delta - \{1-\rho(1-\delta)\}\theta$ and $H(\delta,\theta) = \delta - \{1-\rho(1-\delta)\}\theta$. For all $\delta \in (0,\ 1)$,

(A1) $$G(\delta,\theta) < \begin{cases} G(1,\theta) & \text{if } \theta \leq (1+s)/\alpha \\ 0 & \text{otherwise} \end{cases}, \quad H(\delta,\theta) < \begin{cases} H(1,\theta) & \text{if } \theta \leq 1/\alpha \\ 0 & \text{otherwise} \end{cases}$$

Rewrite $W^N(\delta)$ for $\delta > 0$ as follow:

(A2) $$W^N(\delta) = W_1^N(\delta) + W_2^N(\delta)$$

$$W_1^N(\delta) = q\int_0^{(1+s)/\alpha} G(\delta,\ \theta)dF(\theta) + (1-q)\int_0^{1/\alpha} H(\delta,\ \theta)dF(\theta)$$

$$W_2^N(\delta) = q\int_{(1+s)/\alpha}^{\theta^q} G(\delta,\ \theta)dF(\theta) + (1-q)\int_{1/\alpha}^{\theta^*} H(\delta,\ \theta)dF(\theta)$$

By (A1) and (A2), $W_1^N(\delta) < W_1^N(1)$ and $W_2^N(\delta) < W_2^N(1) = 0$ for all $\delta \in (0,1)$. It immediately follows that $W^N(\delta) \leq W^N(1)$ for all $\delta \in (0,1)$. This proves the first result.

Since $W^N(0) = 0$ by definition, $\delta^N = 0$ if $W^N(1) < 0$ and $\delta^N = 1$ otherwise. By using the fact that $W^N(1) = W_1^N(1)$, it is easy to show that

$$\lim_{\alpha \to 0} W^N(1) < 0, \quad \lim_{\alpha \to 1} W^N(1) > 0, \quad \partial W^N(1)/\partial\alpha > 0$$

where the first inequality follows from the assumption that $E(\theta) > (1+qs)$. These results ensure that there exists a unique $\alpha^*(q) > 0$ such that $W^N(1) < 0$ if $\alpha < \alpha^*(q)$ and $W^N(1) \geq 0$ otherwise. *Q.E.D.*

Proof of Proposition 3. Rewrite $W^j(\delta)$ in (6) for $\delta > 0$ as follow:

(A3) $$W^j(\delta) = W_0^j(\delta) + qs\delta p^q(\delta), \quad j = U,\ C$$

where $W_0^j(\delta) = \delta p^j - (1-\rho(1-\delta))X^j$. By Assumption 1, $W_0^C(\delta) > 0$ for all $0 < \delta \le \alpha$. This completes the proof that $\delta^C > 0$. The inequality $\delta^C > \delta^U$ holds trivially if $\delta^U = 0$. Otherwise, differentiating $W^U(\delta)$ with respect to δ and evaluating at $\delta' = (\alpha/\beta)\delta^C$ yields

$$W^{U\prime}(\delta') = -G(\delta^C) + qsH(\delta', \delta^C)$$

where

$$G(\delta^C) = \alpha^{-1}(\beta-\alpha)(1-\rho)X^{C\prime}(\delta^C) > 0$$
$$H(\delta', \delta^C) = p^q(\delta') - p^q(\delta^C) + \delta'(\partial p^q(\delta')/\partial\delta') - \delta^C(\partial p^q(\delta^C)/\partial\delta^C)$$

It follows from Assumption 2 that $\delta^C > \delta^U$ if $W^{U\prime}(\delta') < 0$ which is satisfied automatically if $q = 0$ or $H(\delta', \delta^C) \le 0$. Otherwise, $W^{U\prime}(\delta') < 0$ for all $q < q^* = G(\delta^C)/sH(\delta', \delta^C)$. *Q.E.D.*

Proof of Proposition 4. Let us define $\delta_0^j = \arg\max W_0^j(\delta)$, which is positive by assumption. Differentiating (A3) with respect to δ and evaluating at δ_0^j yields

(A4) $$W^{j\prime}(\delta_0^j) = qsM^j(s), \quad j = U,\ C$$

where $M^j(s) = p^q(\delta_0^j) + \delta_0^j(\partial p^q/\partial\delta_0^j)$. It is straightforward to show that $M^j(0) > 0$ and $\partial M^j/\partial s > 0$ if $q < 1 - p^*(\delta_0^j)$, implying that $W^{j\prime}(\delta_0^j) > 0$ if for small $q > 0$. By Assumption 2, $\delta^j \ge \delta_0^j$. *Q.E.D.*

Proof of Proposition 5. Let us define $\bar\delta_1^j = \arg\max \bar W^j(\delta)$ for $\delta \le \bar L$. By Proposition 3 and Assumption 2,

(A5) $$\bar\delta_1^C = \bar L,\ \bar W^C(\bar\delta_1^C) > 0 \quad \text{and} \quad \bar\delta_1^U = \bar L \text{ or } 0,\ \bar W^U(\bar\delta_1^U) \ge 0$$

If $\bar R^j$ does not exist for $\delta > \bar L$, $\bar\delta^j = \bar\delta_1^j$. Otherwise, $\bar R^j > R^j > (1-\delta)$ by Proposition 1. It follows from the proof of Proposition 2 that $\bar W^N(\delta) < 0$ for all $\delta > \bar L$. Since $\bar L(\rho X^\Omega - p^\Omega) < \rho\bar L E(\theta)$ by construction, there always exists $\varepsilon > 0$ such that for all $\delta > \bar L$,

(A6) $$\bar W^j(\delta) < 0 \text{ if } \rho\bar L \le \varepsilon$$

The results in (A5) and (A6) together complete the proof. *Q.E.D.*

REFERENCES

Berglöf, E., von Thadden, R., 1994. Short-term versus Long-term Interests: Capital Structure with Multiple Investors. Quarterly Journal of Economics, 109, 1055-1084.

Bird, G., Rowlands, D., 2002. Do IMF Programs Have a Catalytic Effect on Other International Capital Flows? Oxford Development Studies, 30, 229–249.

Bordo, M., Mody, A., Oomes, N., 2004. Keeping Capital Flowing: The Role of the IMF. IMF Working Paper 04/197 (Washington: International Monetary Fund).

Bolton, P., Scharfstein, D., 1996. Optimla Debt Structure. Journal of Polotical Economy, 104, 1-25.

Bolton, P., Jeanne, O., 2007. Structuring and Restructuring Sovereign Debt: the Role of a Bankruptcy Regime, Journal of Polotical Economy, 115(6), 901-924.

Corsetti, G., Guimaraes, B., Roubini, N., 2006. International Lending of Last Resort and Moral Hazard: A Model of IMF's Catalytic Finance. Journal of Monetary Economics 53 (3), 441-471.

Chang, R., Velasco, A., 1999. Liquidity Crises in Emerging Markets: Theory and Policy. NBER *Macro Annual*, Ben Bernanke and Julio Rotemberg eds., Cambridge: MIT Press.

Cottarelli, C., Giannini, C., 2002. Bedfellows, Hostages, or Perfect Strangers? Global Capital Markets and the Catalytic Effect of IMF Crisis Lending. IMF Working Paper No. 02/193 (Washington: International Monetary Fund).

Dell'Ariccia, G., Schnabel, I., Zettelmeyer, J., 2006. How Do Official Bailouts Affect the Risk of Investing in Emerging Markets? Journal of Money, Credit and Banking 38 (7), 1689-1714.

Diamond, D., Dybvig, P., 1983. Bank Runs, Deposit Insurance, and Liquidity. Journal of Political Economy, 91, 401-419.

Dreher, A., 2004. Does the IMF Cause Moral Hazard? A Critical Review of the Evidence. Available via the Internet: http://ssrn.com/abstract=505782.

Eichengreen, B., Mody, M., 2000. What Explains the Changing Spreads on Emerging Market Debt? In: Edwards, S. (Ed.), The Economics of International Capital Flows, University of Chicago Press, Chicago, IL.

Eichengreen, B., Kletzer, K., Mody, A., 2005. The IMF in a World of Private Capital Markets. IMF Working Paper no. 05/84. Washington, DC.

Eichengreen, B., Gupta, P., Mody, A., 2006. Sudden Stops and IMF Programs. IMF Working Paper no. 06/101. Washington, DC.

Flood, R., Marion, N., 1998. Perspectives on the Recent Currency Crisis Literature. NBER Working Paper No. 6380.

Flood, R., Marion, N., 2006. Getting Shut Out of the International Capital Markets: It Doesn't Take Much. IMF Working Paper 06/144 (Washington: International Monetary Fund).

Frankel, J., 2005. Contractionary Currency Crashes in Developing Countries. IMF Staff Papers 52.

Ghosh, A., Christofides, C., Kim, J., Papi, L., Ramakrishnan, U., Thomas, A., Zalduendo, J., 2005. The Design of IMF-Supported Programs. IMF Occasional Paper No. 241. Washington, DC.

Ghosh, A., Gorretti, M., Joshi, B., Thomas, A., Zalduendo, J., 2007. Modelling Aggregate Use of Fund Resources—Analytic Approaches and Medium-Term Projections. IMF Working Paper 07/70 (Washington: International Monetary Fund).

Haldane, A., 1999. Private Sector Involvement in Financial Crises: Analytics and Public Policy Approaches. Financial Stability Review, November.

Jeanne, O., 2008. Debt Maturity and the International Financial Architecture. Forthcoming in American Economic review.

Jeanne, O., Zettelmeyer, J., 2005. The Mussa Theorem (and Other Results on IMF-Induced Moral Hazard). IMF Staff Paper, Vol. 52, Special Issue (Washington: International Monetary Fund).

Kamin, S., 2002. Identifying the Role of Moral Hazard in International Financial Markets. International Finance Discussion Papers, No. 736 (Washington: Board of Governors of the Federal Reserve System).

Kim, J., 2006. IMF-Supported Programs and Crisis Prevention: An Analytical Framework. IMF Working Paper 06/156 (Washington: International Monetary Fund).

Kim, J., 2007. Unconditional IMF Lending and Investor Moral Hazard. IMF Working Paper 07/156 (Washington: International Monetary Fund).

Lane, T., Phillips, S., 2000. Does IMF Financing Result in Moral Hazard? IMF Working Paper 00/168 (Washington: International Monetary Fund).

Mody, A., Saravia, D., 2006. Catalyzing Private Capital Flows: Do IMF Programs Work as Commitment Devices? Economic Journal, 116, 843-867.

Morris, S., Shin, H., 2004. Coordination Risk and the Price of Debt. European Economic Review, vol. 48, pp133-153.

Morris, S., Shin, H., 2006. Catalytic Finance: When Does It Work? Journal of International Economics, 70, 161–177.

Mussa, M., 1999. Reforming the International Financial Architecture: Limiting Moral Hazard and Containing Real Hazard. In: Gruen D., Gower, L. (Eds.), Capital Flows and the International Financial System. Reserve Bank of Australia, Sydney, pp. 216-36.

Mussa, M., 2004. Reflections on Moral Hazard and Private Sector Involvement in the Resolution of Emerging Market Financial Crises. In: Haldane A. (Ed.), Fixing Financial Crisis in the Twenty-first Century. Routledge, London, pp. 33–51.

Penalver, A., 2002. How can the IMF Catalyze Private Capital Flows? A Model. Bank of England.

Ramakrishnan U., Zalduendo, J., 2006. The Role of IMF Support in Crisis Prevention. IMF Working Paper 06/75 (Washington: International Monetary Fund).

Rodrick, D., 2006. The Social Costs of Foreign Exchange Reserves. International Economic Journal, 20 (3), 253-266.

Rodrik, D., Velasco, A., 1999. Short-term Capital Flows. NBER Working Paper No. 7364, National Bureau of Economic Research.

Tirole, J., 2003. Inefficient Foreign Borrowing: A Dual- and Common-Agency Perspective. American Economic Review, 93 (5), 1678-1702.

Zettelmeyer, J., Joshi, P., 2005. Implicit Transfers in IMF Lending: 1973-2003. IMF Working Paper 05/8 (Washington: International Monetary Fund).

Global Crisis, Official Bailout and the Long-Run Demand for Official Lending

Jun I. Kim
International Monetary Fund

I. Introduction

2007-08 Global Crisis for ADCs

- Started from US housing market but quickly spread to other ADCs and EMEs
- Highly contagious through financial linkage
- Rooted in regulatory failures and misaligned macroeconomic policies
- Proves global need for new international financial architecture (IFA)

2007-08 Global Crisis for EMEs

- Twin shocks—sudden stop (SS) in capital flows and collapsing external demand
- SS due to investor deleveraging rather than a loss of confidence in currency
- Proves riskiness of FX STD and some insurance benefit of FX reserve holdings
- Surge in the demand for official bailout (OB)

G-20 initiative for IFA reform

- Strengthening global macro surveillance and financial monitoring by IMF
- Expanding IMF resource base to US$1 tr to deal with global or correlated crisis
- Greater flexibility in IMF lending to be better tailored to country circumstances and underlying causes of crisis

Key Questions

1. How will the risk of global crisis affect cross-border lending to EMEs?
2. Why do EMEs contract risky STD and hold large reserves to guard against SS?
3. Would the increased supply of official lending lead to higher demand for it?

→ Need better understanding on interaction between OB and EM debt structure

Objectives of the Paper

- Present a simple model of international lending with OB
- Show that OB could be a reason for the emergence of risky STD in EMEs
- Argue that even in the absence of moral hazard, increased supply of official lending may create its own demand in the long run

Key Features of the Model

- International lending with OB
- Two classes of debt: STD and LTD
- Two shocks: global liquidity shock and country-specific output shock
- Two types of official lending: conditional (COL) and unconditional (UOL)
- Endogenous debt structure

Assumptions of the Model

- Default is sufficiently inefficient
- Debt-servicing capacity is limited in EMEs or creditor rights are relatively weak
- Global liquidity shock constitutes a tail risk
- Official lending may be limited in size and binding at optimum
- Demand for official lending is proportional to STD

Main Analytical Findings

- OB may optimally encourage STD by lowering the risk-adjusted price of STD vis-à-vis LTD
- EM debt structure may involve risky STD only if OB is available
- Risk of global liquidity shock strengthens the incentive effect of OB on EM debt structure

Main Analytical Findings (continued)

- Increased supply of official lending (from low level) may create its own demand by increasing STD in EMEs
- OB can have crisis prevention effect (CPE) by making international lending less risky

Literature on Optimal Debt Structure

- Large finance literature on optimal capital structure of banks or firms
- Jeanne (2008) for sovereign debt
- Debt contracts under incomplete information and absence of commitment
- Focus on incentive effects of STD in toughening-up the borrower’s disincentive for strategic default

II. Basic Setup of the Model

Country

- Three periods: t = 0, 1, 2
- Invests k at t=0 that yields y at t=2
- Finances δk by STD and $(1-\delta)k$ by LTD
- Credibly pledge up to αy for debt services
- Debt crisis if STD is not rolled over at t=1
- May default upon debt crisis

Private Investors

- STIs may exit at t=1 by liquidating their share of investment while LTIs are locked-in until t=2
- Liquidation value is 1
- Risk-neutral at t=0, but risk-averse with probability *q* at t=1
- If risk-averse, they demand return $s > 0$ (global liquidity shock)

Official Creditor

- Lends *L* only at actuarially fair interest rate (this assumption rules out the possibility of moral hazard)
- Official lending is senior to private claims
- Official bailout with COL can extract higher debt services up to βy ($\beta > \alpha$) while UOL cannot

Output

- Default involves inefficient liquidation by short-term investors
- Output

$$y = \begin{cases} \theta k_1 & \text{if } k_1 = k \\ \rho\theta k_1 & \text{if } k_1 < k \end{cases}$$

- Productivity $\theta > 0$ is uncertain at t=0 but publicly known at t=1

III. Equilibrium Solutions under Exogenous Debt Structure

Notations and Assumptions

- Normalize $k = 1$
- $R = r(1-\delta)$: contracted debt-service obligations for LTD at t=2 (r = LT i-rate)
- PC = Pr(crisis), PD = Pr(default)
- N = NOB, U = OB/UOL, C = OB/COL
- $L = \delta$ so that no inefficient default occurs under official bailout

Interest Rates

- Since no uncertainty at t=1 (θ is known), STD rollover interest rate is either *s* or 0
- Official lending interest rate is 0 for same reason
- ST interest rate at t=0 is 0 because STIs are free to exit at unit liquidation value
- LT interest rate at t=0:

$$R^C \leq R^U \leq R^N$$

Probability of Crisis and Default

- PD = PC at NOB: country always defaults upon debt crisis with no official bailout
- PD < PC at OB: country avoids default at crisis if official bailout is provided
- Official creditor can lend at crisis because of seniority and/or conditionality of official lending

Key Results

1. OB has crisis prevention effect (CPE) if country borrows both ST and LT

$$PC(OB) < PC(NOB) \text{ if } 0 < \delta < 1$$

- Ex post efficiency gain from preventing default is priced into lower ex ante borrowing costs
- Ex ante lower borrowing costs lead to lower probability of crisis

Key Results (continued)

2. CPE is stronger for COL than UOL

$$PC(C) < PC(U)$$

- COL taxes ex post both LTIs and country while UOL taxes only LTIs

3. CPE is stronger under the risk of global liquidity shock

- Risk of global shock raises (risk-adjusted) relative price of LTD

IV. Optimal Debt Structure

Notations

- Self-insurance: $\delta = 0$
- Full risk-taking: $\delta = 1$
- Unconstrained official lending: $L = \delta$
- Constrained official lending: $L = \min[\delta, \bar{L}]$
- Optimal debt structure: δ^j or $\bar{\delta}^j$ (j=N, U, C)

Assumptions

- Linear Utility: $V = C_2$
- Default is sufficiently inefficient ($\rho < \alpha$)
- Debt-servicing capacity is limited ($\alpha < \alpha^*$)
- Global liquidity shock constitutes a tail risk (large *s* but small *q*)
- Expected utility is single-peaked in δ
- $\bar{L}$ is small

Optimal Debt Structure (ODS)

- Basic tradeoff is between risky but cheaper STD and safe but more expensive LTD
- OB should tip the balance toward more STD by making STD less risky and LTD more costly
- Risk of global liquidity shock works in a similar way

ODS with Unconstrained Official Lending

1. Self-insurance is optimal for NOB ($\delta^N = 0$)
2. Optimal debt structure involves STD only if OB is available
3. COL encourages STD by more than does UOL ($\delta^C > \delta^U \geq 0$)
4. Risk of global liquidity shock leads to a higher level of STD than otherwise

ODS with Constrained Official Lending

1. Optimal level of STD never exceeds $\bar{L}$
2. An increase in $\bar{L}$ leads to an equal (or larger) increase in STD at the margin

V. Demand for Official Lending

Assumptions

- Pre-crisis IMF lending was conditional and limited in size
- Post-crisis IMF lending will also be limited in size but involve both UOL and COL:
  * UOL for self-correcting liquidity crisis
  * COL for crisis that requires adjustment
- SDR allocation has one-to-one effect on the size of official lending

Demand for Official Lending

- Pre-crisis demand assumes no risk of global liquidity shock
- Post-crisis demand represents demand at times of global liquidity shock

$$L_0^D = (PC_0 - PD_0^{COL})\bar{L}_0$$

$$L_1^D = (PC_1^{Global} - PD_1^{COL})\bar{L}_1$$

Demand for Official Lending (continued)

- Ignore the probability of default (small)
- Demand ratio as a measure of the likely order of an increase in the long-run demand for official lending

$$\frac{L_1^D}{L_0^D} = \left(\frac{PC_1^{Global}}{PC_0} \right) \times \left(\frac{\overline{L}_1}{\overline{L}_0} \right)$$

Demand for Official Lending (continued)

- Use financial market data (e.g., CDS or EMBI spreads) to compute PC ratio
- Use information on IMF resource base to compute official lending ratio
- Demand for IMF official lending could increase by a factor of 2 or 3 in the long run

VI. Conclusion

Conclusion

- Availability of OB could explain the emergence of risky STD in the context of EMEs
- Even in the absence of moral hazard, the increased supply of official lending may create its own demand in the long run
- Key insights of the analysis prevails for precautionary demand for foreign reserves