ABSTRACT

Title of Dissertation: INTERNATIONAL MONETARY FUND. PROGRAMS AND CAPITAL MARKET ACCESS

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This thesis studies how International Monetary Fund (IMF) loans interact with private capital flows and how they affect the level of welfare of borrower countries and private lenders.

The first chapter presents a model highlighting the fact that the IMF has both *de jure* and *de facto* seniority rights over private creditors. It is shown that IMF lending affects borrowers and lenders in different ways. Ex-post, once the initial borrowing decisions have been made, an IMF intervention always make the borrower country better off. The effects on private lenders depend on the size of the senior intervention and on what they expect to get in case that the IMF does not intervene. For some parameter values, IMF interventions make existing lenders worse off when the liquidity situation is either good or weak and make them better off when it is in an intermediate range. This is consistent with

the empirical evidence presented in Chapter 2. The expectation of a future IMF intervention may reduce the level of borrowing and borrowers' welfare ex-ante, because seniority allows the IMF to lend in cases where it is not socially optimal to do so. This effect is contrary to the moral hazard view where "too much" rescuing leads to "too much" borrowing. Thus, the country may have incentives to commit today not to borrow tomorrow from the IMF in the future, although this promise is not time consistent.

The second chapter, which is a joint work with Ashoka Mody, analyzes empirically if IMF programs influence the ability of developing country issuers to tap international bond markets and whether they improve spreads paid on the bonds issued. It is found that Fund programs do not provide a uniformly favorable signaling effect. Instead, the evidence is most consistent with a positive effect of IMF programs when they are viewed as likely to lead to policy reform and when undertaken before economic fundamentals have deteriorated significantly. The size of the Fund's program matters, but the credibility of a joint commitment by the country and the IMF appears to be critical.

INTERNATIONAL MONETARY FUND. PROGRAMS AND CAPITAL MARKET ACCESS

by

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DEDICATION

To Rosario, for everything, and to my parents.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

On the Role and Effects of IMF Seniority

1.1 Introduction

The role that the IMF should play in the New International Financial Architecture is an important issue in the current policy and academic debate, especially after the crisis that took place in the 1990s, beginning with Mexico in December of 1994. It has been recognized that the IMF has some characteristics that make it a special player in the international lending community, capable of attracting capital flows to a country and improving in this way its economic situation. For example, it is argued that the IMF may have more information than other lenders and that its presence may be a positive signal about countries' characteristics that are not observed by other creditors (Rodrik 1996); a related argument is that the IMF can be used by less informed investors as a country's screening device (Marchesi and Thomas 2001). Another hypothesis is that the IMF could act as a delegated monitor through its conditionality and surveillance functions or could serve as a country's commitment device to behave well (for example

Rodrik (1996), Tirole (2002), Mody and Saravia (2003)).[1]

This chapter focuses on a different aspect of IMF lending, specifically its status as senior lender. This focus is motivated by some facts about IMF lending that have received little analytical attention. These are: (1) countries have shown a higher aversion to defaulting on IMF loans than on loans from private creditors.[2] and (2) the IMF has contractual seniority on its loans. Arguably, these two characteristics imply two other characteristics of IMF lending: (1) the IMF lends at a lower interest rate than private creditors, and (2) the IMF lends in circumstances where other creditors are not willing to do so.

This chapter addresses the following questions: Is IMF seniority good? For whom? Under what circumstances? Since we are interested in the seniority issue, we will study the IMF as a creditor of a country with the only difference being that it has seniority rights. The crucial distinction in the model is, therefore, between senior and non-senior lenders. In this chapter, one can think either that senior lending is realized by lenders acting competitively, or by a deep-pocket investor, who can make senior loans and in addition chooses to make zero profits in expectation. Arguably, this is a realistic assumption about IMF behavior.

The presence of senior lending may introduce a conflict of interest between non-senior creditors and the debtor country. Consider a country that has been hit by shocks that prompt a need for new financing. It may be the case that

[1]Cottarelli and Gianini (2002) clasiffy the channels in which flows are "catalyzed" in five categories similar to the mentioned here as an example.

[2]For example, Argentina, Indonesia, Ecuador, Pakistan and Ukraine have defaulted on private debts and not on IMF loans. "...the IMF typically gets paid back (instances of arrears being the exception to the rule..)" (Eichengreen (2003)).

no new lending will be provided without seniority rights; for example a highly indebted economy would have problems attracting new non-senior funds because of credit ceiling and debt overhang considerations. A senior lender would have less problems lending since the probability of being repaid is higher than for non-senior lenders. Thus, seniority may be a necessary condition to have financing that allows the economy to cope with shocks. However, non-senior lenders may be worse off in the presence of a senior lender since in case of bankruptcy they have to wait until senior debts are repaid.

The chapter presents a model with three periods: a planning period, a period when a shock hits the economy, and a final period where output is obtained, and consumption and debt repayment take place. In the planning period, the country borrows to invest in capital, which is used in the production process in order to maximize expected utility. In the middle period, the country potentially has to borrow more money to cope with a liquidity shock that hits the economy. The way that the IMF adds value in this model is by lending in circumstances where non-senior creditors are not willing to lend in equilibrium. If the shock is big enough, non-senior lenders will expect losses on new lending and, assuming initial lenders are atomistic and cannot coordinate efforts to make "emergency loans", will not be willing to offer credit; in these cases a deep-pocket lender with seniority rights (IMF) will be necessary to cope with the shock. Once capital is installed and the initial lending and borrowing decisions have been made (i.e. ex-post), a senior intervention always makes the country better off, since senior creditors lend at a lower interest rate, allowing a higher consumption level. The effects of the IMF's lending on non-senior lenders depend on the size of the liquidity shock and on what non-senior lenders would get when the IMF does not intervene. On the one

hand, having senior lending allows the economy to cope with a higher range of liquidity shocks, but on the other hand, a senior lender jeopardizes what private creditors expect to get in case of bankruptcy. As a consequence of these opposing effects, lenders may prefer to discontinue the project, and would be ex-post worse off with an IMF intervention.

Lenders take into account these effects when making their initial lending decisions (i.e. ex-ante). It may be the case that the option of a future senior intervention makes contractual conditions more onerous in the planning period and that, as a consequence, the country ends up borrowing (and investing) a lower amount than in the case where the IMF is not allowed to intervene. Moreover, it may be the case that the borrower country would be ex-ante better off by committing not to borrow from the IMF to cope with future shocks, because seniority allows the IMF to lend in circumstances when it is socially optimal not to continue with the project, making the country ex-ante worse off. Since the country has incentives to borrow from the IMF once the shock occurs, this promise is not time consistent and a commitment technology will be necessary to maintain it.

The chapter is related to the discussion about the role of International Financial Institutions as a Lender of Last Resort (LOLR) (for example Fischer (1999), Zettelmeyer (2000) and Calomiris (1998)). This discussion is often based on models where a crisis occurs as a self-fulfilling equilibrium caused by coordination problems between creditors. An important point in this debate is the trade off between ex-post efficiency and ex-ante moral hazard. Some argue that having a LOLR institution able to fill liquidity needs reduces the probability of a crisis and ameliorates their effects once they occur. Others claim that having a LOLR

would trigger debtor and other creditors' moral hazard. Our model abstracts from coordination and moral hazard issues and adds to this literature in two aspects. *First*, we highlight the point that IMF intervention affects borrowers and lenders differently, and need not lead to ex-post efficiency, and in fact can create ex-post socially inefficient outcomes. *Second*, contrary to the *moral hazard* view that predicts that the possibility of a future bail-out will lead to excessive lending by making lenders take riskier strategies, our model predicts that the possibility of a future bail-out may lead to less lending, in equilibrium, as a consequence of the conflict of interest mentioned above.

Recent theoretical work by Corsetti et al. (2003) studies the role of the IMF in catalyzing capital flows by providing liquidity in a model with coordination problems between creditors having asymmetric information about the state of the economy.[3] In one of the extensions to their model, they consider the case where the IMF is a senior lender. They conclude that since a senior lender is more willing to intervene, the probability of a crisis would be reduced, but since the return to junior lenders is lower they would be less willing to roll over their debts. As noted above, in our paper, we are not concerned with coordination problems and roll-over of short term debt issues although we recognize they are important. Rather, our framework allows us to analyze the impact of senior interventions on borrowers' and lenders' ex-ante and ex-post welfare, highlighting the conflict of interest between borrowers and lenders that a senior intervention may imply. This is something that previous work has abstracted from and it is what allows

[3]Morris and Shin (2003) use a similar analysis to Corsetti et.al. to analyze the IMF's ability to catalyze capital flows. Penalver (2002) reaches similar conclusions to Morris and Shin's work with a different modelling strategy. None of these works analyzes the role of IMF seniority.

us to generate the result that the amount borrowed and the country's welfare may be lower when senior lending is allowed.

Section 2 describes the elements of the model. Section 3 solves the model backwards, allowing for cases in which senior lending either is or is not allowed. We first examine the effects of senior intervention on the country's and private creditors' welfare ex-post, once capital is installed and the shock hits the economy. We then study how the possibility of a senior intervention affects the initial level of investment and the country's welfare ex-ante. Section 4 relates this work to the empirical evidence presented in the second essay of this thesis. Section 5 concludes.

1.2 Model

Time. There are three periods, indexed by t=0,1,2. In period 0, agents make real investment and borrowing decisions. In period 1, the economy can be hit by a shock that affects the production process. In order to cope with this shock, agents have to borrow again. In period 2, output is realized, debt issued in period 0 and 1 is repaid and consumption takes place.

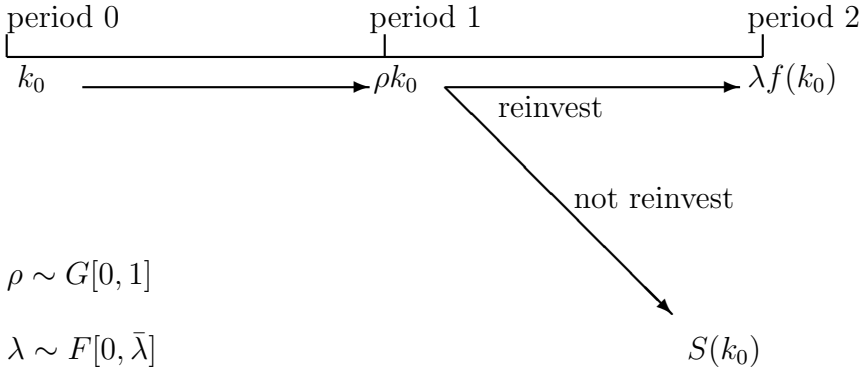
Agents and production. The economy is populated by a continuum of identical consumer-producers with linear preferences over consumption of a single good at date 2; i.e their utility function is $U(c_0, c_1, c_2) = c_2$. The production process has a time-to-build aspect: investment is realized in period 0 and 1 and output is realized in period 2. It is assumed that agents do not have any endowment of goods in period 0 and 1, so they have to borrow from abroad in order to import goods used as inputs in the production process. In period 0, agents borrow to install capital, k_0, which will be depreciated totally at the end of period 2.

To avoid borrower's moral hazard considerations, we assume that investment is verifiable, or alternatively, that there is no storage technology available, so that the amount borrowed has to be invested in the production process.

Following Holmstrom and Tirole (1998) and Caballero and Krishnamurthy (2001) we introduce a liquidity shock in period 1 as a production shock that the economy has to cope with by borrowing additional funds. Let ρ be the aggregate liquidity shock that hits the economy in period 1. Agents will need a reinvestment of ρk_0 to continue the project. If they do not reinvest this amount, then the project cannot continue and a scrap value, $S(k_0)$, is obtained in period 2. S is assumed to be quasiconcave, increasing in k_0 and satisfies $S \leq k_0$.

Assume ρ is a random variable distributed between $[0, 1]$ with cumulative distribution function $G(\rho)$. In order to introduce market incompleteness, we assume that ρ is observable but not verifiable, so that contracts in period 0 cannot be made contingent on realized values of the shock in period 1. We do not consider idiosyncratic shocks since we are interested in cases in which the economy as a whole needs liquidity, and we are not concerned with heterogeneity between residents.

If reinvestment is made in period 1, then the project continues and output in period 2 is $\lambda f(k_0)$, where λ is a random productivity shock distributed between $[0, \bar{\lambda}]$ with cumulative distribution $F(\lambda)$, and where $f(k_0)$ is a concave function. It is assumed that $E(\lambda)f(k_0) > k_0$; otherwise, investors will not invest in period 0.



Financial contracts. As noted above, residents have to borrow from abroad in order to produce. This is an ability-to-pay model with no deadweight losses associated with bankruptcy. That is, when realized output is lower than debt face value or when the project is discontinued, lenders can seize output or the scrap value.

It is assumed that debt issued in period 0 and debt issued in period 1 both mature in period 2. International lenders are risk neutral, act in a competitive environment and have enough wealth to provide liquidity to the country when needed. Clearly, for any amount lent they will charge a positive interest rate since the default risk is positive (remember that the minimum value that λ can take is zero).

Without loss of generality, it is assumed that the gross international interest rate is equal to 1. At date 0 domestic agents borrow an amount L_0 (equal to k_0) and agree to pay a total amount of D_0 (i.e. initial amount borrowed plus interest) in period 2. At date 1 they borrow an amount L_1 (equal to ρk_0) whose face value in period 2 is D_1.

1.3 Equilibrium

In what follows we will solve the model backwards beginning with period 2. In period 1, when the shock hits, we will consider what happens when a senior lender(s) is allowed in that period. Then we will consider period 0.

1.3.1 Period 2

In period 2, if reinvestment has been made in period 1, output is realized, debt is repaid, and consumption takes place. Consumption will be greater than zero if and only if output is greater than the total face value of debt contracted in period 0 (D_0) and in period 1 (D_1), which occurs when:

$$\lambda f(k_0) - D_0 - D_1 > 0$$

or, equivalently:

$$\lambda > \frac{D_0 + D_1}{f(k_0)} \equiv \lambda^*. \tag{1.1}$$

Thus, total debt will be repaid and consumption will be positive if and only if the productivity shock is higher than a threshold value λ^*.

Assumption 1. *When no senior lender is allowed, in case of default (i.e. $\lambda < \lambda^*$) the proportion of output that goes to each creditor equals the share of his loan in total loans, i.e $\frac{L_i}{L_i+L_{-i}}$.*

That is, absent seniority, creditors have *equal footing* on output in case of bankruptcy. We have not assumed that the share of output going to each creditor is equal to the share of his debt in total debt, i.e. $\frac{D_i}{D_i+D_{-i}}$, for simplicity and because, if this were the case, second period debt could be made effectively senior

by having a high enough D_1. Since $\frac{L_i}{L_i+L_{-i}}$ need not be the same as $\frac{D_i}{D_i+D_{-i}}$, it is possible that the output due to a creditor in case of default is higher than his debt face value. To rule this out, assume:

Assumption 2. *In case of default, if* $\frac{L_i}{L_i+L_{-i}}\lambda f(k_0)$ *is greater than* D_i *then lender* i *gets* D_i*.*

Thus, a creditor's repayment in period 2 will be the maximum of his contractual value of debt and his share of output under the equal footing scheme.

If reinvestment has not taken place in period 1, the scrap value of the project, $S(k_0)$, is divided between creditors, and consumption is equal to zero (remember that by assumption $S(k_0) < k_0$ and, consequently, $S(k_0) < D_0$).

1.3.2 Period 1

At the beginning of this period the random variable ρ is observed and the economy inherits installed capital (k_0) and a stock of debt contracted in period 0 (D_0). Agents need to borrow ρk_0 in order to continue the project. Since it is assumed that if reinvestment is not made the project ends and consumption is zero, the borrower country will always want to reinvest as long as the highest possible output level is higher than the total value of debt. So the demand for loans is determined by the size of the shock.

Supply of loans under equal footing

As noted above, international capital markets are competitive and the international gross interest rate is equal to 1. Competition between lenders will ensure that expected profits from lending to the country will be zero.

Define λ^1 as the threshold productivity level above which period 1 lenders' output share, computed under equal footing, is greater than their contractual debt value,

$$\lambda^1 \equiv \left[\frac{L_0 + L_1}{L_1}\right] \frac{D_1}{f(k_0)},$$

or equivalently, since L_1 equals ρk_0 and L_0 equals k_0:

$$\lambda^1 \equiv \left[\frac{1+\rho}{\rho}\right] \frac{D_1}{f(k_0)}. \tag{1.2}$$

Similarly, define λ^0 as the threshold value above which period 0 lenders' output share is greater than D_0:

$$\lambda^0 \equiv [1+\rho] \frac{D_0}{f(k_0)}. \tag{1.3}$$

This last expression follows from the fact that $[1+\rho]$ is equivalent to $\left[\frac{L_0+L_1}{L_0}\right]$.

Note that $\left[\frac{\rho}{1+\rho}\right]\lambda^1 + \left[\frac{1}{1+\rho}\right]\lambda^0 = \lambda^*$, so that the threshold productivity shock above which all debts are repaid (λ^*) is a weighted average of λ^1 and λ^0. When λ^1 is lower than λ^*, it means that D_1 is totally repaid when the productivity shock is at least λ^1; for productivity shocks between λ^1 and λ^*, D_0 holders get output in excess of D_1; and when the productivity shock is higher than λ^*, output is enough to repay both D_0 and D_1. A comparable analysis holds when λ^0 is lower than λ^*. Also, note that λ^0 will be higher than λ^1 if and only if the interest rate charged on period 0 loans is higher than the interest rate charged in period 1; both interest rates are determined in equilibrium below.

Thus, period 1 lenders' zero profit condition under equal footing satisfies:

$$\begin{aligned}\rho k_0 \;=\; & \left[\frac{\rho}{1+\rho}\right] \int_0^{\min(\lambda^1,\lambda^0)} \lambda f(k_0) dF(\lambda) + \int_{\min(\lambda^0,\lambda^*)}^{\lambda^*} [\lambda f(k_0) - D_0]\, dF(\lambda) + \\ & + \int_{\min[\lambda^1,\lambda^*]}^{\bar{\lambda}} D_1 dF(\lambda).\end{aligned} \tag{1.4}$$

The right hand side is period 1 lenders' expected repayment from investing in the country and the left hand side is the amount lent. Alternatively, we can express the same condition in terms of each unit lent:

$$1 = \left[\frac{1}{1+\rho}\right]\int_0^{\min\left(\lambda^1,\lambda^0\right)}\frac{\lambda f(k_0)}{k_0}dF(\lambda)+\frac{1}{\rho}\int_{\min(\lambda^0,\lambda^*)}^{\lambda^*}\left[\frac{\lambda f(k_0)}{k_0}-\frac{D_0}{k_0}\right]dF(\lambda)+ \\ +\int_{\min[\lambda^1,\lambda^*]}^{\bar{\lambda}} r_1 dF(\lambda), \tag{1.5}$$

where $r_1 = \frac{D_1}{\rho k_0}$ is the gross interest rate charged to the country by international lenders.

Lemma 1. *The interest rate r_1 is increasing in the amount lent.*

Proof in Appendix A.1.

So, the higher the period 1 shock is, i.e. the higher the amount needed to continue the project, the more expensive, per dollar, it will be for the borrower to continue.

Proposition 1. *If and only if*

$$\int_0^{\bar{\lambda}}\lambda\frac{f(k_0)}{2k_0}dF(\lambda)+\int_{\min\left[\lambda^0,\bar{\lambda}\right]}^{\bar{\lambda}}\left[\frac{1}{2}\frac{\lambda f(k_0)}{k_0}-\frac{D_0}{k_0}\right]dF(\lambda)<1, \tag{1.6}$$

there is a set of liquidity shocks sufficiently close to 1 for which no credit is supplied in period 1 under equal footing.

Proof. A necessary and sufficient condition to have lending in period 1 that satisfies the zero profit condition under equal footing is:

$$\rho k_0 \leq \frac{\rho}{1+\rho}\int_0^{\bar{\lambda}}\lambda f(k_0)dF(\lambda)+\int_{\min\left[\lambda^0,\bar{\lambda}\right]}^{\bar{\lambda}}\left[\frac{1}{1+\rho}\lambda f(k_0)-D_0\right]dF(\lambda). \tag{1.7}$$

This is because, given the loan size (ρk_0) and the value of debt issued in period 0 (D_0), period 1 lenders' expected repayment is increasing in D_1; and the right

hand side of (1.7) is lenders' expected repayment when the value of D_1 is high enough that total debt $(D_1 + D_0)$ is greater than or equal to the highest possible repayment $(\bar{\lambda} f(k_0))$.[4] If condition (1.7) is not satisfied then period 1 creditors will expect losses on any loan of size ρk_0. The set of values for ρ satisfying (1.7) is not empty. The right hand side is unambiguously greater than the left hand side for values of ρ near zero since $\int_0^{\bar{\lambda}} \lambda \frac{f(k_0)}{k_0} dF(\lambda)$ is greater than one.

Since the first term of the right hand side of (1.7) is a continuous, increasing and concave function of ρ and the second term is continuous and decreasing in ρ, a necessary and sufficient condition to have a range of liquidity shocks where expected profits are negative is that (1.7) is not satisfied when ρ is equal to one. So, if condition (1.6) holds, there will be a threshold value of ρ strictly less than one above which expected profits to lenders are negative. Since the expected repayment function is increasing and continuous in D_1, there will be a value of D_1 such that expected repayment equals the loan size.

In what follows we assume that condition (1.6) holds, in which case there is a $\hat{\rho}$ less than 1 that satisfies:

$$\hat{\rho} k_0 = \frac{\hat{\rho}}{1+\hat{\rho}} \int_0^{\bar{\lambda}} \lambda f(k_0) dF(\lambda) + \int_{\min\left[\lambda^0, \bar{\lambda}\right]}^{\bar{\lambda}} \left[\frac{1}{1+\hat{\rho}} \lambda f(k_0) - D_0 \right] dF(\lambda) \qquad (1.8)$$

such that for $\rho > \hat{\rho}$ there will be no lending under equal footing. A sufficient condition to have $\hat{\rho} < 1$ is that (1.6) is true even in the case where D_0 is equal to k_0, which is the lowest possible interest rate on period 0 debt and thus the case most likely to favor lending in period 1. Therefore, a sufficient condition for (1.6)

[4] If $D_1 + D_0 > \bar{\lambda} f(k_0)$, then $\lambda^* > \bar{\lambda}$ and $\lambda^1 > \bar{\lambda}$. Thus, the left hand side of (1.7) follows from replacing λ^* by $\bar{\lambda}$ in the left hand side of (1.4), taking into account that the third term vanishes.

to hold is:

$$E(\lambda)\frac{f(k_0)}{2k_0} + \int_{\min[\frac{2k_0}{f(k_0)},\bar{\lambda}]}^{\bar{\lambda}} \left[\frac{\lambda f(k_0)}{2k_0} - 1\right] dF(\lambda) < 1.$$

Note that it may be in the interest of period 0 lenders, as a group, to lend in period 1 at an expected loss in order to protect their initial claims. However, any individual lender will be better off if the other lenders provide liquidity allowing the project to continue. That is, there is a conflict between private and collective interests; each period 0 lender has an incentive to 'free-ride'.[5] This free rider problem has been discussed in the sovereign debt literature; see for example Krugman (1988) and Eichengreen (2002).

Clearly, creditors that have not lent in period 0 do not have any incentive to lend at an expected loss in period 1. In this essay we assume that lenders are atomistic, act in a purely competitive market and cannot coordinate actions to pursue their collective interests (i.e. the free-rider issue is severe).[6]

Senior Lender allowed in period 1

Consider the case where a senior lender(s) is allowed to intervene in credit markets in period 1. The concept of seniority is relevant when contractual obligations cannot be totally satisfied; i.e. in the case of bankruptcy. If this is not the case,

[5]The best way to coordinate creditors' actions in the case of a debt crisis, in order to overcome the free-rider problem, is an important issue in current policy and academic debate about the way to construct the New International Financial Architecture.

[6]In a recent speech Anne Krueger stated: "...These far-reaching developments in capital markets over the last three decades have not been matched by the development of an orderly and predictable framework for creditor coordination. Because the creditor community is increasingly diverse and diffuse, coordination and collective action problems result when scheduled debt service exceeds a country's ability to pay" (see IMF survey April 2000).

there is no conflict of interest between creditors and the concept of seniority is not important.

Since senior creditors have priority on output in case of default, they do not consider the stock of existing debt when making their own lending decisions.

Lemma 2. *Senior lenders are willing to lend for any shock ρ.*

Proof: Senior lenders are willing to lend any amount up to $E(\lambda)f(k_0)$, which is greater than ρk_0, for all ρ, by previous assumption.

Thus, senior lenders are willing to lend in more states of nature than non-senior creditors; seniority allows the economy to overcome more severe liquidity shocks.

Let D_1^s be the value of debt owed to a senior creditor; the threshold productivity shock above which senior lenders are totally repaid is:

$$\lambda^s \equiv \frac{D_1^s}{f(k_0)}. \tag{1.9}$$

If the productivity shock is lower than this threshold value, senior creditors will not be totally repaid and non-senior creditors will get nothing. The interest rate charged by a senior lender satisfies:

$$\frac{1}{L_1^s}\int_0^{\lambda^s} \lambda f(k_0) dF(\lambda) + \int_{\lambda^s}^{\bar{\lambda}} r_1^s dF(\lambda) = 1, \tag{1.10}$$

where L_1^s and r_1^s are the amount lent by a senior creditor and the interest rate charged, respectively. The interest rate charged by a senior lender will not be the same as that charged by a non-senior one. In particular:

Lemma 3. *For a given sized loan, the interest rate charged by a senior lender is lower than that charged by a lender without seniority rights.*

Proof in Appendix A.2.

This result implies that total expected consumption in period 2 is higher when a senior lender intervenes and, consequently, the country is ex-post better off (i.e. conditional on k_0) under seniority. Obviously, borrowers prefer to pay less for a given amount lent.

At the beginning of period 1 there is a stock of debt issued in period 0 (D_0) that matures in period 2. The period 1 value of this stock of debt will be affected by the size of the liquidity shock and by the nature (senior or non-senior) of period 1 lenders.

To see the impact of a senior intervention on the period 0 lenders' position, we have to consider whether the liquidity shock is greater or less than $\hat{\rho}$, the threshold value above which non-senior creditors are unwilling to lend.

Consider first the case when $\rho < \hat{\rho}$. In this situation non-senior lenders are willing to lend to the borrower country and a senior intervention will make period 0 lenders worse off. To see why this is the case note that output is divided in period 2 between the country, period 0 and period 1 creditors. At the beginning of period 1, the expected value of output is given, since with $\rho < \hat{\rho}$ the project will continue whether period 1 lenders are senior or not. Meanwhile period 1 lenders, independent of their seniority rights, set the price of the new debt (r_1 or r_1^s) so that expected repayments in period 2 are equal to the size of the loan (ρk_0), by the zero profit condition.

Since expected output and expected repayment to period 1 lenders are the same with and without senior lending, but expected consumption is higher in the first case, it must be the case that period 0 lenders' expected repayment (or, equivalently, the period 1 value of their claims) is lower under a senior interven-

tion. A senior lender does not add value when the country is able to finance the liquidity shock using non-senior sources, but instead merely transfers resources from period 0 debt holders to the country. So, a senior intervention when $\rho < \hat{\rho}$ reduces the period 1 price of the debt issued in period 0.

Consider now the case where $\rho > \hat{\rho}$. In this case, the only way to finance the liquidity shock is by issuing senior debt.

To see how senior lending affects existing creditors in this situation, we compare the period 1 value of existing debt with and without seniority. When senior lending is not allowed, the project is cancelled and the scrap value is obtained. Since this is an ability-to-pay model, period 0 lenders get the entire scrap value (remember that we have assumed that the scrap value is less than k_0). Let V^n be the period 1 value of D_0 when there is no refinancing, that is:

$$V^n(k_0) = S(k_0)$$

and let V^s be the period 1 value of D_0 when a senior intervention is allowed,

$$V^s = \int_{\lambda^s}^{\lambda^B} \left[\lambda f(k_0) - D_1^s(\rho)\right] dF(\lambda) + \int_{\lambda^B}^{\bar{\lambda}} D_0 dF(\lambda)$$

where

$$\lambda^B \equiv \frac{D_0 + D_1^s}{f(k_0)} \tag{1.11}$$

and

$$\lambda^s \equiv \frac{D_1^s(\rho)}{f(k_0)}.$$

The period 1 value of debt issued in period 0 is equal to the face value (D_0) times the probability of being fully repaid, which occurs when the productivity shock is higher than the threshold value λ^B, plus what existing creditors expect to get when output is not enough to cover total contractual obligations. When

the productivity shock is between λ^s and λ^B output is enough to cover senior debt in full but covers only part of non-senior debt. When the shock is less than λ^s, output is not enough to cover senior debt, and non-senior creditors get nothing.

Define the function $\psi(S, \rho)$ as the difference between the period 1 value of debt when a senior intervention is allowed and when it is not:

$$\psi(S, \rho) \equiv V^s - V^n.$$

That is, positive values of ψ imply that period 0 lenders are better off with a senior intervention.

ψ is a function of the liquidity shock and of the scrap value, since both parameters affect the present value of debt with and without senior lending. We have [7]:

$$\frac{\partial \psi}{\partial \rho} = -\int_{\lambda^s}^{\lambda^B} \frac{\partial D_1^s}{\partial \rho} dF(\lambda) < 0$$

and

$$\frac{\partial \psi}{\partial S} = -1 < 0.$$

Thus, $\psi(S, \rho)$ is a decreasing function in both arguments.

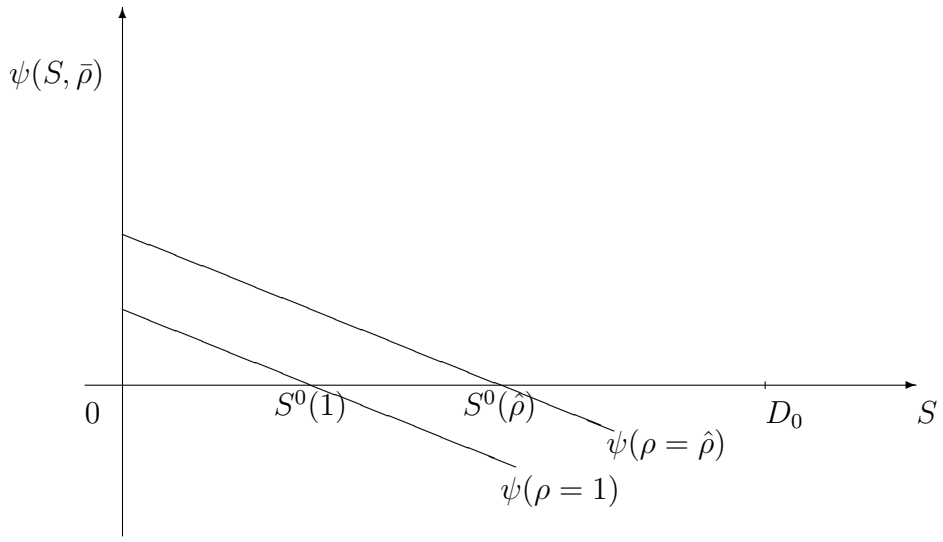
Note that when there is no scrap value (i.e. $S = 0$), $\psi(0, \rho)$ is greater than zero for all values of ρ. This is because cancellation leaves existing creditors with zero, while continuation leaves existing creditors with strictly positive expected returns.[8] Also note that if the scrap value were equal to D_0, $\psi(D_0, \rho)$ is strictly

[7] The terms derived from the differentiation of the integration limits cancel each other out.

[8] The only case when period 0 debt holders expect to get nothing in case of continuation is when D_1^s is equal to $\bar{\lambda} f(k_0)$; but in this case senior lenders' expected profits will be strictly positive (since k_0 is lower than $E(\lambda) f(k_0)$) contradicting the zero profit condition.

negative for all values of ρ since cancellation gives period 0 debt holders the full value of debt with certainty, while a senior intervention reduces the probability of repayment below one.

Since $\psi(S, \rho)$ is a continuous and decreasing function in both arguments, and since $\psi(0, \rho) > 0 \; \forall \rho$ and $\psi(D_0, \rho) < 0 \; \forall \rho$, there is for each ρ a unique value of S, denoted by $S^0(\rho)$, where $\psi(S, \rho) = 0$. The higher the liquidity shock, the lower the value of S^0. We can express this in the following figure:



Thus, existing creditors' view of senior intervention depends on the size of the liquidity shock and the project's scrap value. We can distinguish three situations. First, when the scrap value is lower than $S^0(1)$, a senior intervention will raise the value of existing debt for all $\rho > \hat{\rho}$. In this case, the value of liquidation is so low that even in the worst possible scenario (highest senior debt) period 0 lenders prefer to continue the projects.

Second, when the scrap value is between $S^0(1)$ and $S^0(\hat{\rho})$ there is a set of liquidity shocks in the vicinity of 1 where a senior intervention makes period 0 debt holders worse off. Moreover, there is a set of liquidity shocks close enough

(from the right) to $\hat{\rho}$ where a senior intervention makes period 0 debt holders better off. So, in this zone seniority has ambiguous effects on existing creditors depending on the size of the liquidity shock. In particular, there is a nonlinear effect of senior intervention on the price of the debt issued in period 0 that is consistent with the empirical evidence, as will be seen in section 4 below. When the shock is small ($\rho < \hat{\rho}$) a senior intervention reduces this price (i.e. increases spreads over the international interest rate); when the shock is not too far above $\hat{\rho}$, a senior intervention increases this price; and when the shock is close to 1 the price is reduced by senior intervention again.

Finally, when the scrap value is higher than $S^0(\hat{\rho})$, a senior intervention always makes period 0 debt holders worse off. Because the scrap value is so high, initial lenders prefer to get that value for sure rather than continuing the project and taking the risk of not being repaid.

We can summarize the findings of this section in the following proposition:

Proposition 2. *Conditional on k_0, a senior intervention will improve debtors' situation in all cases since it allows a higher level of consumption. The effect on period 0 debt holders depends on ρ and S:*

- *If $\rho < \hat{\rho}$ a senior intervention will always make existing creditors worse off.*
- *If $\rho > \hat{\rho}$ we have three possible scenarios:*
    1. *If $S < S^0(1)$ senior lending makes existing creditors better off for all values of ρ.*
    2. *If $S^0(1) < S < S^0(\hat{\rho})$ existing creditors' situation will improve if ρ is close enough to $\hat{\rho}$ and will be worsened if ρ is close enough to 1.*
    3. *If $S^0(\hat{\rho}) < S$ senior lending always makes existing creditors worse off.*

That is, senior lending may affect borrowers and lenders differently; in some cases, it will allow for the continuation of projects when existing creditors would prefer to liquidate them. In these cases, there is a conflict of interest between the borrower and the lenders since the former is always willing to finish the project.

1.3.3 Period 0

Period 0 is the planning period. Borrowers decide how much to invest and borrow in order to maximize their expected utility (expected consumption in period 2), and lenders set the price of their loans in order to attain zero expected profits.

In period 0 individuals have uncertainty about two shocks: the liquidity shock (ρ) and the productivity shock (λ). That is, expectations have to be taken over two random variables. We consider the case where all agents have perfect foresight about the nature of future interventions. That is, borrowers and lenders take their decisions knowing whether interventions in period 1 will be senior or equal footing.

Equal footing in period 1

Agents make their decisions taking into account that if the liquidity shock in period 1 is high enough the project will have to be discontinued and there will be no consumption and only partial debt repayment.

In equilibrium, borrowers in period 0 decide the amount they want to borrow in order to maximize their expected utility, taking into account how their decisions affect the credit conditions they face. Borrowers maximize:

$$V_0 = \max_{k_0} \int_0^{\hat{\rho}(k_0)} \left\{ \int_{\lambda^*}^{\bar{\lambda}} \left[\lambda f(k_0) - D_0 - D_1(\rho k_0) \right] dF(\lambda) \right\} dG(\rho) \tag{1.12}$$

subject to

$$k_0 = \int_0^{\hat{\rho}(k_0)} \left\{ \left[\frac{1}{1+\rho}\right] \int_0^{\min\left(\lambda^1,\lambda^0\right)} \lambda f(k_0) dF(\lambda) + \int_{\min(\lambda^1,\lambda^*)}^{\lambda^*} \left[\lambda f(k_0) - D_1\right] dF(\lambda) + \right.$$
$$\left. + \int_{\min[\lambda^0,\lambda^*]}^{\bar{\lambda}} D_0 dF(\lambda) \right\} dG(\rho) + \int_{\hat{\rho}(k_0)}^{1} S(k_0) dG(\rho) \tag{1.13}$$

and

$$\rho k_0 = \left[\frac{\rho}{1+\rho}\right] \int_0^{\min\left(\lambda^1,\lambda^0\right)} \lambda f(k_0) dF(\lambda) + \int_{\min(\lambda^0,\lambda^*)}^{\lambda^*} \left[\lambda f(k_0) - D_0\right] dF(\lambda) +$$
$$+ \int_{\min[\lambda^1,\lambda^*]}^{\bar{\lambda}} D_1 dF(\lambda). \tag{1.14}$$

V_0 is borrowers' expected utility, and λ^* , λ^1 and λ^0 are as defined above in (1.1), (1.2) and (1.3) respectively. The outer integral of (1.12) corresponds to expectations taken over the liquidity shock, recognizing that if $\rho > \hat{\rho}(k_0)$ consumption is zero under equal footing. The inner integral corresponds to expectations taken over the productivity shock, knowing that consumption will be positive if output is enough to cover the total value of debt contracted in period 0 and in period 1. That is, consumption will be positive if and only if $\rho > \hat{\rho}(k_0)$ and $\lambda > \lambda^*$.

Equation (1.13) is the zero expected profit condition for period 0 lenders who face uncertainty about both the liquidity shock and the productivity shock. They know that if $\rho > \hat{\rho}(k_0)$, the project will not continue and they will get the scrap value. If $\rho < \hat{\rho}(k_0)$ (i.e. there is no liquidation in period 1) what they expect to get in period 2 depends on the productivity shock. Analogously with the period 1 lenders' zero profit condition in equation (1.4), if output is not enough to cover either D_0 or D_1, period 0 lenders receive a share $\frac{1}{1+\rho}$ $\left(\text{i.e. } \frac{L_0}{L_0+L_1}\right)$ of output. If the proportion of output that corresponds to period 1 lenders allows D_1 to be repaid for output levels lower than that required to cover total debts $\left(\text{i.e. } D_0 + D_1\right)$,

then period 0 debt holders get output minus D_1 until output is enough to pay D_0. When output is higher than this amount, they are repaid in full.

Equation (1.14) is lenders' zero profit condition in period 1 for a given ρ, as analyzed above in equation (1.4).

Integrating equation (1.14) from zero to $\hat{\rho}(k_0)$ and adding this expression to equation (1.13) we get:

$$k_0 + \int_0^{\hat{\rho}(k_0)} \rho k_0 dG(\rho) = \int_0^{\hat{\rho}(k_0)} \left\{ \int_0^{\lambda^*} \lambda f(k_0) dF(\lambda) + \int_{\lambda^*}^{\bar{\lambda}} [D_0 + D_1] \, dF(\lambda) \right\} dG(\rho) + \\ + \int_{\hat{\rho}(k_0)}^{1} S(k_0) dG(\rho). \tag{1.15}$$

Adding and subtracting $\int_0^{\lambda^*} \lambda f(k_0) dF(\lambda)$ in equation (1.12) we get:

$$V_0 = \max_{k_0} \int_0^{\hat{\rho}(k_0)} \left\{ \int_0^{\bar{\lambda}} \lambda f(k_0) dF(\lambda) - \left[\int_0^{\lambda^*} \lambda f(k_0) dF(\lambda) + \int_{\lambda^*}^{\bar{\lambda}} (D_0 + D_1) \, dF(\lambda) \right] \right\} dG(\rho). \tag{1.16}$$

Inserting equation (1.15) into (1.16) we can express the borrower value function as:

$$V_0 = \max_{k_0} \int_0^{\hat{\rho}(k_0)} \left[\int_0^{\bar{\lambda}} \lambda f(k_0) dF(\lambda) \right] dG(\rho) - k_0 \left(1 + \int_0^{\hat{\rho}(k_0)} \rho dG(\rho) \right) + \int_{\hat{\rho}(k_0)}^{1} S(k_0) dG(\rho). \tag{1.17}$$

For simplicity, assume that the scrap function is linear in the investment level; i.e. $S(k_0) = sk_0$. Then, the optimal investment (and borrowing) level under equal footing satisfies the following first-order condition:

$$\int_0^{\hat{\rho}(k_0)} \left[E(\lambda) \frac{\partial f(k_0)}{\partial k_0} \right] dG(\rho) + \int_{\hat{\rho}(k_0)}^{1} s \, dG(\rho) = 1 + \int_0^{\hat{\rho}(k_0)} \rho \, dG(\rho) - \\ - \{ E(\lambda) f(k_0) - \hat{\rho} k_0 - s k_0 \} G'(\hat{\rho}) \frac{\partial \hat{\rho}}{\partial k_0}, \tag{1.18}$$

where $\frac{\partial \hat{\rho}}{\partial k_0} < 0$; that is, the higher the level of investment, the lower the range of

liquidity shocks for which continuation in period 1 will be possible without senior lending. See Appendix A.3 for the proof.

To set the optimal investment level borrowers balance the marginal benefit, given by the marginal productivity of capital and by the effect that one more unit invested has on the scrap value; and the marginal costs, given by the cost of investing in period 0, the expected cost of reinvesting in period 1 and the negative effect that one more unit of investment has on the threshold value $\hat{\rho}(k_0)$. Since higher scrap values allow period 0 lenders to offer better terms (see equation (1.13)), the optimal level of investment increases in s.[9]

Senior lending in period 1

Assuming that senior lending is allowed in period 1, the objective function is:

$$V_0^s = \max_{k_0^s} \int_0^1 \left\{ \int_{\lambda^B}^{\bar{\lambda}} \left[\lambda f(k_0^s) - D_0^s - D_1^s(\rho k_0^s) \right] dF(\lambda) \right\} dG(\rho) \tag{1.19}$$

subject to:

$$k_0^s = \int_0^1 \left\{ \int_{\lambda^s}^{\lambda^B} \left[\lambda f(k_0^s) - D_1(\rho k_0^s) \right] dF(\lambda) + \int_{\lambda^B}^{\bar{\lambda}} D_0 dF(\lambda) \right\} dG(\rho) \tag{1.20}$$

and

$$\rho k_0^s = \int_0^{\lambda^s} \lambda f(k_0^s) dF(\lambda) + \int_{\lambda^s}^{\bar{\lambda}} D_1^s dF(\lambda), \tag{1.21}$$

where the superscript "s" implies that senior lending is allowed; and λ^B and λ^s are as defined in (1.11) and (1.9) above. Now individuals choose investment knowing that the projects will continue in period 1 for all possible values of the liquidity shock, so the expectation in (1.19) is taken over the whole range of ρ.

[9] Analytically, this follows from applying the implicit function theorem to (1.18), taking into account that the second order condition is satisfied.

Equation (1.20) and equation (1.21) are the zero profit conditions for period 0 and 1 respectively. Period 0 lenders know that there will not be liquidation in period 1 and, consequently, they do not consider scrap value in their zero profit condition. They know that senior lenders will have priority on output and they will begin receiving repayment if and only if senior debts are totally repaid. Equation (1.21) is the same as equation (1.10) above.

As before, integrating equation (1.21) over all possible values of ρ and adding this expression to equation (1.20) we obtain:

$$k_0^s + \int_0^1 \rho k_0^s dG(\rho) = \int_0^1 \left\{ \int_0^{\lambda^B} \lambda f(k_0^s) dF(\lambda) + \int_{\lambda^B}^{\bar{\lambda}} \left(D_1^s + D_0^s\right) dF(\lambda) \right\} dG(\rho). \tag{1.22}$$

Adding and subtracting $\int_0^{\lambda^B} \lambda f(k_0^s) dF(\lambda)$ in equation (1.19) and plugging equation (1.22) in the resulting expression, the borrowers' value function is:

$$V_0^s = \max_{k_0^s} \int_0^1 \left[\int_0^{\bar{\lambda}} \lambda f(k_0^s) dF(\lambda) \right] dG(\rho) - k_0^s \left[1 + \int_0^1 \rho dG(\rho) \right]. \tag{1.23}$$

Optimal investment satisfies the following first order condition:

$$\int_0^1 \left[E\left(\lambda\right) \frac{\partial f(k_0^s)}{\partial k_0^s} \right] dG(\rho) = 1 + \int_0^1 \rho \, dG(\rho). \tag{1.24}$$

Thus, borrowers balance the expected marginal product of capital with the expected marginal cost of investing one more unit, given by the marginal cost at date 0 plus the expected marginal cost of continuation in period 1.

Comparison

In this section we compare how the optimal level of investment and borrowers' welfare is affected by allowing senior lending in period 1.[10] As noted above, having senior lending allows the project to continue in circumstances where it otherwise would have had to be liquidated. Although borrowers always prefer to continue ex-post, non-senior lenders would prefer to liquidate the project if the scrap value is high enough. In this case, the anticipation of senior lending makes period 0 lenders offer more onerous terms in their lending, leading to a lower level of investment. When the scrap value is low enough, so that period 0 lenders prefer a senior intervention in period 1, the expectation of the intervention leads to a higher level of investment.

To see how optimal investment is affected, compare equation (1.18) and equation (1.24). First, assume that there is no scrap value in case of liquidation (i.e. $s = 0$ in (1.18)). In this case, the term in brackets that multiplies $\frac{\partial \hat{\rho}}{\partial k_0}$ in (1.18) is positive (otherwise there will be no investment in period 0), implying that $\int_0^1 [E(\lambda)f'(k_0^s) - \rho]\, dG(\rho) < \int_0^{\hat{\rho}} [E(\lambda)f'(k_0) - \rho]\, dG(\rho)$. This inequality can be expressed as:

$$E(\lambda)f'(k_0^s)\left[1 - \frac{f'(k_0)}{f'(k_0^s)}\Pr(\rho \leq \hat{\rho})\right] < E(\rho/\rho > \hat{\rho})\left[1 - \Pr(\rho < \hat{\rho})\right].$$

Since the first term on the left hand side is greater than one (by (1.18)), while the first term on the right hand side is less than one by definition, it must be the case that $f'(k_0) > f'(k_0^s)$, implying that $k_0 < k_0^s$.

[10]Since lenders always set the price of their period 0 loans in such a way that expected profits are zero, allowing a senior lender in period 1 does not affect period 0 lenders' welfare ex-ante as long as lenders are fully informed about the nature of future interventions.

In this case borrowers are ex-ante better off with a senior intervention. The intuition is that the only effect of a senior intervention is to avoid inefficient liquidation of the project. We define efficiency as the outcomes that would be reached under a first-best complete contract (contingent on ρ) signed in period 0. Under such a contract, liquidation would occur ex-post iff $E(\lambda)f(k_0) < \rho k_0 + S(k_0)$. If $s = 0$, liquidation is never efficient, since $\rho \leq 1$.

Note that in this model the expectation of senior lending does not make individuals take riskier actions, so the increase in borrowing and lending in period 0 is not the consequence of *moral hazard* but of avoiding inefficient liquidation.

Now consider the case where the scrap value is different than zero. As noted above, the scrap value makes period 0 credit conditions under equal footing less onerous, because it represents a positive payoff in case of liquidation. From equation (1.18) we can see that the higher is s, the higher the level of investment under equal footing. When s is equal to one, the term in brackets on the right hand side of (1.18) is less than or equal to zero (see equation (1.8)), and a comparison of (1.18) and (1.24) yields

$$E(\lambda)f'(k_0^s)\left[1 - \frac{f'(k_0)}{f'(k_0^s)}\Pr(\rho \leq \hat{\rho})\right] > E(\rho/\rho > \hat{\rho})\left[1 - \Pr(\rho < \hat{\rho})\right].$$

In this case we can not rule out the possibility of k_0^s being lower than k_0.

Note that a higher scrap value increases the ex-ante utility level when senior intervention is not allowed in period 1. A comparison of (1.17) and (1.23) suggests that borrowers may be ex-ante better off when senior lending is not allowed in period 1, depending on the size of s. The intuition is that senior lending guarantees continuation of the project for all sizes of the shock in period 1, even if for some values of ρ it is socially optimal to liquidate. By insuring continuation of the project even when $E(\lambda)f(k_0) - \rho k_0 < S(k_0)$, senior lending is reducing the

social value of the project and making the borrowers worse off ex-ante.

Numerical exercise. We present a numerical example to show that for scrap values sufficiently high it is possible to have a lower level of investment and welfare when a senior lender is allowed. Consider the case where $f(k_0) = k^{0.8}$, λ is uniformly distributed in [0,3], ρ is uniformly distributed in [0,1], and $s = 1$. In this case we obtain that $V_0^s = 0.12 < V_0 = 0.15$ and $k_0^s = 0.32 < k_0 = 0.59$.

As noted above, there may be circumstances where senior lending creates a conflict of interest between lenders and borrowers in period 1. Ex-post, lenders may want liquidation although it is always in borrowers' interest to continue. Assume borrowers are able to set institutions in period 0 that govern the availability of senior lending in period 1. If $V_0 < V_0^s$, borrowers will allow for senior lending in period 1, and lenders will set the price of debt, knowing that there will be senior lending, in such a way that expected profits are zero.

If $V_0 > V_0^s$, borrowers will maximize ex-ante expected utility by committing not to allow senior lending in period 1. Note that this promise is not time consistent, since ex-post, borrowers would always prefer senior lending to equal footing lending in period one. If no commitment technology is available, then period 0 lenders will set the price of debt anticipating senior intervention in period 1 and the borrower country will be worse off.

1.4 Empirical Evidence

There are several empirical papers that study the effects that IMF interventions have on countries' access to capital markets, with varying conclusions among

them.[11] The second chapter of the thesis studies the effects of IMF loans on spreads and on the probability of issuing bonds by emerging markets economies. The empirical findings that are related to this work are:

- The impact of IMF lending on spreads depends on the level of countries' indebtedness. In particular, there is a 'U' shaped effect on spreads; IMF intervention raises spreads when the country's solvency situation is at the extremes, either solid or weak, and reduces spreads for intermediate levels.

- 'Precautionary programs', in which the country does not disburse the money made available by the IMF, reduce spreads and increase the probability of issuing bonds.

The first finding implies that when the countries' solvency situation is either good or weak, an IMF intervention raises spreads, while spreads are reduced by intervention when solvency is in an intermediate range. In our model, the higher the period 1 (middle period) liquidity shock, the worse is the country's solvency situation. The model is able to show that for small liquidity shocks (when non-senior credit is available) an IMF loan raises spreads; but when shocks are higher than a threshold value above which non-senior lending is not available, the effect on spreads depends on what lenders' expect to get in the case that reinvestment does not take place (the project's scrap value in the model). When the scrap value is in an intermediate range, an IMF intervention will reduce spreads when the liquidity shock is not too far above the threshold value, and will increase spreads when the shock is in the upper tail of the distribution. Thus, there is a nonlinear effect consistent with the empirical evidence.

[11] See Cotarelli and Giannini (2002) for a survey.

The second empirical finding is related to our model's planning period. A precautionary program is a proxy for the possibility of future interventions, since it is money that has already been lent to the country but is not being used (insurance). We have seen that in equilibrium the initial borrowing level and its cost are affected by the possibility of a future senior intervention, and that the model replicates the empirical finding when the project's scrap value is not too high.

1.5 Conclusions

This paper presents a model that emphasizes the effects of senior lending (such as IMF lending) on the borrower country's and on creditors' welfare. When the shock that hits the economy is big and markets are incomplete, seniority allows continuation of projects that otherwise would have to be abandoned; in this sense the IMF completes markets by financing liquidity needs when existing creditors are not willing (or cannot coordinate efforts) to do so. Ex-post, once the shock has occurred, an IMF loan would increase borrower welfare by providing cheaper funds than non-senior lenders, allowing for a higher consumption level. The effects on non-senior creditors depend on the size of the shock and on what they expect to get when projects are discontinued. When non-senior financing could be attracted to the country, a senior intervention makes existing creditors worse off, since it does not improve the country's repayment capacity but worsens their relative position. Even when senior lending is necessary to cope with the shock, other creditors may be worse off with an IMF intervention, depending on the size of the shock and the project's scrap value.

In the absence of clear rules set ex-ante governing the types of permissable

intervention, an institution providing senior lending would have to weigh the potentially conflicting wishes of borrowers and lenders, and decide when to intervene according to whose interests it more closely represents.

The anticipation of a senior lender can make the borrower country ex-ante better off by avoiding inefficient liquidation. More interestingly, however, the anticipation of a senior intervention can make the country ex-ante worse off and reduce the investment level. The reason is that the IMF may allow continuation of the project when it is socially optimal to liquidate, reducing the social value of the project and making borrowers worse off.

This result is the opposite to the standard moral hazard story associated with IMF interventions. The usual story is that the IMF "rescues" investors too much ex-post and thus leads to too much investment ex-ante. Here, however, the IMF may rescue the country too much ex-post and thus leads to too little investment ex-ante.

It may be the case that the country would maximize expected utility by committing itself not to borrow from a senior lender to cope with shocks that hit the economy. Since the country has incentives to borrow from a senior institution once the shock occurs, this promise is not time consistent.

The IMF could maximize ex-ante utility by intervening if and only if it is socially optimal to continue, taking into account that sometimes it might be better not to intervene even if it benefits the country ex-post.

Chapter 2

Catalyzing Private Capital Flows: Do IMF-Supported Programs Work as Commitment Devices?

2.1 Introduction

Does the International Monetary Fund (IMF or Fund) succeed in its objective of "catalyzing" capital flows to developing economies? A not inconsiderable literature concludes that the answer is "no"—that is, Fund programs do not enhance countries' access to capital markets and, indeed, a program may actually make things worse in this respect [for a recent review, see Bird and Rowlands, 2002].

Why would we expect to observe a catalytic effect? International contracts, more so than domestic contracts, are incomplete, and foreigners are, therefore, often unwilling to lend. A Fund program can potentially substitute for missing contracts and act as a commitment device that improves access to international capital. The Fund's role is, in Tirole's [2002] terminology, that of a "delegated monitor," mediating between the country and international investors.

This chapter explores the possibility that the delegated monitoring role works, and successful catalysis occurs, when a credible joint commitment by the country and the Fund leads to improved prospects for honoring debt contracts. In other

words, the catalytic effect—or the Fund's "seal of approval"—is not automatic and the mere presence of a Fund program does not lead to more capital flows. Rather, an IMF program is effective as a commitment device when other available information does not negate its credibility. As such, the value of the commitment implied by a Fund program, and its ability to catalyze capital flows, are likely to depend on initial country conditions, program design, and the country-Fund relationship. Our contribution then is to move from a presumption of undifferentiated effects to identify country, program, and relationship characteristics that create the conditions for credible commitments and, hence, contribute to enhanced capital flows under IMF programs.

We reach four conclusions that outline the conditions under which the market values the Fund's role as a commitment device:

- The presence of a Fund-supported program reduces the adverse effect that a country's export volatility has on its access to international markets and cost of funds. It is as if contracting a Fund program strengthens commitment to repay when volatility is high.

- An IMF program is effective when foreign exchange reserves and debt levels make the country vulnerable but have not deteriorated to a point where their restoration to normal levels within a reasonable time frame has a low probability. Thus, the Fund catalyzes flows when, for example, solvency is not at stake.

- The size of the Fund-supported program matters, but large programs have often been successful when the money committed has not actually been used, suggesting that their precautionary deployment can be valuable.

- Repeated relationships between a country and the Fund can imply commitment to solve structural problems, but diminishing returns set in as use of Fund resources is prolonged, suggesting that, beyond a certain point, the likelihood of improvement in performance begins to be called into question.

Our empirical analysis centers on the ability of Fund programs to help developing country issuers tap international bond markets and to reduce spreads paid on the bonds issued. We use an empirical model developed by Eichengreen and Mody [2001] to evaluate the determinants of international bond issuance and of spreads charged at the time of issuance. The transactional data used reduce the severity of the reverse-causality problem—that is, the possibility that observed outcomes influence the likelihood of Fund programs. This is so because the feedback from an individual bond issue to explanatory country aggregates is likely to be less serious than when the dependent variable is, itself, a country aggregate such as growth or capital flows. At the same time, by allowing a more careful consideration of timing than was possible in past studies, transactional data at higher frequency allow us to more precisely consider the rate of issuance and spreads paid in the period following the initiation of a Fund program and, hence, further reduce the problem of reverse causation.

In the next section, we provide a brief background of the Fund's objective in stimulating capital flows and its ability to act as a "delegated monitor." We then review the literature on the impact of IMF programs to identify key substantive conclusions and methodological issues. This is followed by a description of the methodology and data. The empirical results deal first with the influence of initial country conditions and then with the implications of Fund program design. The final section concludes.

2.2 Background and Hypothesis

Enhancing its members' access to international capital markets is widely regarded as an important objective of the International Monetary Fund. Though the objective is not an explicitly stated purpose in the Fund's Articles of Agreements, the flow of international capital is essential to such stated purposes as the stability of the international monetary system, efficient trade, and productive resource use, and to providing confidence when a member country experiences difficulties with its balance of payments.[1] The Fund's interest in private international capital flows has, moreover, increased over the last decade. Reflecting this evolution, the Fund's Managing Director affirmed in a recent speech:

"Because private flows are an indispensable source of financing for development, another crucial function of the IMF's new Capital Markets Department will be to strengthen our ability to help countries gain access to international capital markets [Köhler, 2001, para. 13]."[2]

[1]Article I of the International Monetary Fund's Articles of Agreement lists a number of objectives ("purposes") for the Fund. These include international monetary cooperation, facilitation of international trade to enable productive use of resources, exchange rate stability, establishment of a multilateral system of payments, and giving confidence to its members by making available the general resources of the Fund to permit "correction of maladjustments" in their balances of payments without a high cost to the domestic or international economy.

[2]Each member country is required by Article IV of the Articles of Agreement to, among other things, foster orderly growth, price stability, and orderly monetary and financial conditions. Article IV authorizes the Fund to oversee compliance of member countries with these obligations. The Fund is asked—and has agreed in the past—to monitor and certify a country's policy program without any commitment of resources. A distinction may be made, in this context, between the role of the Fund's staff and that of its Board. A positive staff report can signal to investors a professional judgment that the country has a credible adjustment program.

The Fund's monitoring function is critical to the catalytic role it plays. Fund resources do help and Fund financing can signal confidence in the course the country is charting. But it is the signal that counts and hence the Fund's knowledge of, and confidence in, the country's policies is necessary to induce private capital flows. The Fund's website describes its role in these very terms:

"In most cases, the IMF, when it lends, provides only a small portion of a country's external financing requirements. But because the approval of IMF lending signals that a country's economic policies are on the right track, it reassures investors and the official community and helps generate additional financing from these sources. Thus, IMF financing can act as an important lever, or catalyst, for attracting other funds. The IMF's ability to perform this catalytic role is based on the confidence that other lenders have in its operations and especially in the credibility of the policy conditionality attached to its lending."[3]

Tirole [2002, p. 99] refers to such a role as "delegated monitoring." The IMF, Tirole argues, acts to "substitute for the missing contracts between the Sovereign and individual foreign investors and to thereby help the host country to fully benefit from its capital account liberalization." Tirole notes that missing contracts are not just a problem when foreigners lend to the sovereign. The problem is serious even when the lending is to private domestic borrowers. The ability of private borrowers to repay is a function of a variety of government actions that are unpredictable and can de facto expropriate foreign lenders.

The Board's approval sends a signal that the international community is prepared to support the country's program. At least in theory, these two signals can be distinct and separable. The Fund's Board "expressed some degree of reservation" about unbundling policy certification (or "enhanced surveillance") from the use of its resources [Boughton, 2001, p. 413].

[3]http://www.imf.org/external/publs/ft/exrp/what.htm

In this paper, we examine the implications of Fund programs for capital market access. A program combines resources and surveillance, with different programs offering different combinations of these functions. Programs are typically contracted in periods of external economic imbalances, though the extent of the imbalance varies and countries can, and do, enter programs for "precautionary" reasons. For a Fund program to catalyze new private capital flows, it must credibly convey a significant likelihood of success—an improvement in the program country's external payments position and growth prospects. Success of a program, in turn, depends on several factors. In particular, country and global market conditions influence the outcome. To deal with this heterogeneity, Fund programs differ in design (e.g., size of resources, duration, and the nature and extent of program conditionality). In addition, program outcomes depend on country-Fund relationships, reflected, for example, in the frequency of programs.

With respect to country conditions, an important consideration in the sovereign debt literature has been the volatility that a country is exposed to. In an early contribution, Eaton and Gersovitz [1981] argued that when countries are exposed to a high degree of volatility, they are more likely to repay their external debt since failure to do so would close them off from international borrowing and thus prevent them from dampening the future effects of continued volatility. But countries with high volatility may also find it more difficult to repay debt—or may be able to use the fact of the volatility to claim inability to repay debt. In assessing these countervailing forces, Catao and Sutton [2002] find that macro volatility is a strong predictor of sovereign debt defaults. Thus, under volatile conditions, a commitment device should help. A Fund program is a joint commitment. From the country, it is a commitment to good policies, and from the Fund, to provide

resources that serve as a substitute for a country's reserves.

Commitment through the Fund, however, is likely to be effective when countries are vulnerable but have not yet crossed thresholds that imply inability to service external debts even with Fund assistance. When vulnerability is high, the role of a "delegated monitor" may be especially valuable if a country's commitment to international contracts is more suspect than in "tranquil" or more normal periods. Also, in periods of vulnerability, information about the country may be fuzzy. However, when a country is past the point of vulnerability—when reserves and external debt levels have reached levels that imply low probability of reversing into a more normal state—the country's ability and incentives to achieve policy objectives are suspect and the Fund's leverage is likely to be limited.[4] Thus, for example, a Fund program is unlikely to catalyze new capital when solvency is at stake. Even if a country does not "gamble for resurrection," as some have argued [e.g., Powell, 2002], new shocks will continue to prevent recovery. In such a situation, the Fund as a delegated monitor will add limited value.

In recent theoretical contributions, Morris and Shin [2003] and Corsetti, Giumares, and Roubini [2003] reach a similar conclusion. They show that IMF lending is most effective in catalyzing capital flows when a country is an "intermediate" zone between bad and good fundamentals. In this intermediate, or vulnerable zone, an IMF program elicits an adjustment effort (IMF program and country effort are strategic complements). An implication of this analysis is that

[4]Powell [2002] suggests that a country's response to a Fund program is likely to weaken as its economic situation deteriorates. Supporting that notion, Ivanova, Mayer, Mourmouras, and Anayiotos [2001] find that larger government fiscal deficits, which they believe reflect internal political competition, are associated with more frequent program failure.

not all IMF lending is the source of moral hazard. To the contrary, lending generates a positive country response in the vulnerable region; moral hazard kicks in when fundamentals are irretrievably bad.

These considerations are consistent with the Fund's own preferred approach to early intervention. For example, in discussing policy toward access to Fund resources, the Fund's Treasurer's Department notes: Over the years, it has come to be recognized that the efficacy of the mixture of adjustment policies and financing depends largely on the early adoption of corrective policy measures. Early resort to an adjustment program supported by IMF resources can help to avoid more drastic policy actions that may otherwise be required, thereby limiting the impact of the adjustment on other members. [IMF 2001a, p. 29] A 1979 decision by the Fund's Executive Board had an almost identical wording: "Members should be encouraged to adopt measures...at an early stage of their balance of payments difficulties or as a precaution against the emergence of such difficulties."[5]

The Fund can signal strong commitment by making available a large amount of resources. All else being equal, we would, therefore, expect programs with larger resources (in relation to country debt obligations) to be associated with better capital market access. However, the joint commitment is even stronger when the country does not actually use those resources. In that situation, a country subjects itself to the discipline implied by a Fund program without drawing on the available resources. The delegated monitoring function should be particularly valuable in such programs that are "precautionary" in nature. Finally, the Fund can signal commitment by deeper engagement in a country. One measure of deeper engagement is the length of time over which a country contracts a

[5]Decision No. 6056-(79/38), March 2, 1979, in IMF [2001b], pp. 167-168.

Fund program. Where problems are of a structural nature, markets are likely to value the continued presence of the Fund. However, excessive repetition of Fund programs ("prolonged use") is likely to reduce the perception of the country's commitment and the Fund's ability to resolve matters.[6]

2.3 Literature Review

In this review, we cover three aspects of the literature. First, we briefly describe the main body of the literature on IMF programs, which focuses on their macro implications. Second, we discuss the smaller set of writings on the Fund's ability to catalyze private capital flows. And, finally, we discuss two methodological issues (the need to move away from considering programs as homogeneous and the need to correct for sample selection bias arising from unobserved differences between program participants and nonparticipants).

On the implications of IMF programs for macro country performance, the results display considerable consistency despite different methodologies and coverage of different time periods. Two early studies [Edwards, 1989, and Khan, 1990] reached three conclusions that have stood the test of time. First, Fund programs help improve the external payments position; this improvement takes effect within a year, and is sustained beyond the program. Second, the impact on inflation is statistically insignificant. Third, growth actually suffers during the period of an IMF program but recovers once the program ends, though pos-

[6]In light of results obtained by Stone [2002], loss of credibility when there is a high incidence of program repetition may also reflect that such repetition reflects, in part, political affinity with the United States, which serves to reduce the incentive to undertake demanding reform measures.

sibly not to the level prior to the initiation of the program.[7] The problem of the appropriate counterfactual against which to compare IMF programs has plagued all studies.[8] However, continued econometric refinement confirms these findings [Mussa and Savastano, 1999].

That the maximum effectiveness is achieved with respect to the external payments situation is not surprising. The Fund's principal objective and its analytical approach both lead to that focus. Fisher [1997] notes: "Fund programs are designed to restore balance-of-payments viability, and more generally to restore macroeconomic stability—seen as a necessary condition for economic growth."[9] Thus, though growth is an objective, especially in programs that have longer duration and greater structural content, the immediate emphasis is on the external payments position [see also Schadler and others, 1995]. The ambiguity with respect to the growth effect follows, as Krueger [2000] notes, from the remedy

[7]Much of the recent debate has centered on the growth effects. Przeworski and Vreeland [2000] find the most significant adverse effect on growth. Hutchison [2001] finds a small negative growth effect while Barro and Lee [2001] find that a Fund program has no impact on growth. At the other extreme, Dicks-Mireaux, Mecagni, and Schadler [2000], who focus only on countries that undertake structural adjustment programs and hence are in the low-income category, find a significant positive growth effect of IMF programs.

[8]The generalized evaluation estimator suggested by Goldstein and Monteil [1986] and employed by such influential papers as Khan [1990] and Conway [1994] has been the preferred approach to dealing with the problem of the counterfactual. For recent applications, see Dicks-Mireaux, Mecagni, and Schadler [2000] and Hutchison [2001]. This estimator allows for the possibility of "mean-reversion," that is, of a return towards normalcy from distress even in the absence of a Fund program, possibly on account of an endogenous policy response.

[9]This focus leads to a Fund program being "built around three identities: the central-bank balance sheet, the balance of payments constraints, and the government budget constraint."

in addressing the traditional balance-of-payments crises: devaluation of the domestic currency and tightening of monetary and fiscal policy to contain domestic demand.

On the indicator of most interest to this paper, private capital flows, strong presumptions, anecdotal evidence, and statistical analysis lead to quite different conclusions. It is often taken as axiomatic that a Fund program is necessary for the resumption of capital flows [Dhonte, 1997, and Fisher, 1997]. Bird and Rowlands [2001a] say it is a "commonly held view" that the IMF helps attract private capital to a country by endorsing the country's economic reform plan. They cite, for example, a U.K. Treasury Committee report on the IMF that refers to "an all pervasive conventional wisdom" that an IMF program buys a "good housekeeping seal of approval." Marchesi and Thomas [1999] state: "Overall, there is evidence to suggest that those who accept the intervention of the Fund can more easily obtain better conditions on their loans, consistent with our thesis that program adoption plays an information role." However, with the exception of Marchesi [2001], which is a follow-up to Marchesi and Thomas [1999], the statistical evidence to date goes the other way.

Killick, Malik, and Manuel [1992] do a before-after comparison of net capital flows and find that these flows decline after an IMF program is put in place. Much of the decline is due to an increase in repayments rather than to a decline in gross inflows. Bird and Rowlands [1997 and 2001a] are especially skeptical of the Fund's "catalytic effect." They find no empirical evidence for such an effect, consistent with their priors. IMF programs are a sign of economic distress and they are not persuaded that the country's macroeconomic performance improves following the start of a program. Similarly, in a regression to explain spreads charged on

commercial bank loans, Ozler [1993] finds a positive sign on the dummy variable for an IMF program, suggesting that the program is an indicator of "repayment difficulties."[10] These studies, however, have their limitations. Ozler's results are quite sensitive to the inclusion of other explanatory variables. Once variables are added to characterize the loan and whether a country achieved sovereign status only recently, the coefficient falls sharply and is no longer significant at the 5 percent level. The Bird and Rowlands [1997 and 2001a] and Ozler [1993] analyses also do not formally address the possibility that a drop in capital flows may trigger IMF programs, the reverse causality or selection problem.

Edwards [2000], in reexamining the catalytic effect of Fund programs, considers the possibility that self-selection into Fund programs may bias the results, but finds that correction for self-selection makes no difference—there is still no evidence of a catalytic effect. This is not surprising since probit estimates of program participation fare poorly in their predictive ability [Hutchinson, 2001, and Garuda, 2000], and tend, moreover, to be highly sensitive to choice of sample [see, especially Bird and Rowlands, 2001b, for an extensive discussion of the history and weaknesses of these estimates]. Edwards does find, however, that program countries that have a recent history of lack of compliance with the agreed reform agenda are penalized in terms of access to capital markets. Thus, he finds evidence for an asymmetric effect: Fund programs do not necessarily help, but programs with noncompliance appear to hurt. The important point the paper makes is that all Fund programs cannot be taken to have the same effect, since

[10]Hajivassiliou [1986] reaches the same conclusion as Ozler [1993] in his estimate of a supply function for capital, where he finds that a dummy variable representing IMF programs (and also instances of debt rescheduling) is associated with reduced capital flows.

the nature of country and Fund involvement is likely to vary considerably across programs.

The one study that finds an indirect impact of IMF programs on capital market access is Marchesi [2001]. She examines a country's ability to reschedule its private debt obligations and finds that the presence of a Fund program helps in this respect. She interprets her finding as evidence that participation in a Fund program signals a commitment to policy reform that is a precondition to debt rescheduling and continued market access.

The bulk of the literature described above treats IMF programs as undifferentiated. Thus, a single dummy variable represents the presence or absence of a Fund program. However, differences between Fund programs have recently received some attention. An advance, in this respect, is distinguishing between types of Fund programs (for example, Stand-By Arrangement and Extended Fund Facility) as in Eichengreen and Mody [2001] and Bird and Rowlands [2002]. In addition, program effectiveness is likely to vary with country conditions. Edwards [2000], as noted, finds differential effects for countries in and out of compliance with the program. Ivanova, Mayer, Mourmouras, and Anayiotos [2001], in explaining the success or failure of Fund programs, distinguish between countries on the basis of internal political competition for resources. Stone [2002] focuses on a number of differences, important among which is a measure of the country's political affinity to the United States as a proxy for the inability of the Fund to discipline domestic policymakers in that country. Garuda [2000] also differentiates across country characteristics.[11] Specifically, within the group of countries

[11]He classifies countries by a "propensity" score, that is, by a measure of the likelihood that the country is in a Fund program. A country's propensity is derived from a probit as

with a high propensity to enter IMF programs, an IMF program is associated with a worsening income distribution. In the medium- and low-propensity groups, an IMF program is associated with an improvement in the income distribution.

In summary, this review of the literature on Fund programs highlights both substantive conclusions and methodological issues. On substance, Fund programs help with respect to the current account and the balance of payments. Thus, net capital flows should decrease following the start of a Fund program. With respect to gross flows also, the literature has generally concluded that no IMF catalytic effect exists. Methodologically, the literature points to concerns with regard to counterfactuals, reverse causality, and omitted variables that affect both program participation and capital market access.

2.4 Methodology and Data

In this paper, we move away from using volumes of gross capital flows and focus instead on the probability of bond issuance in international markets and the spreads charged on individual bonds. In thus limiting our focus, we do not consider other forms of capital flows, such as syndicated loans and foreign direct investment. However, flows through bond issuance were a major source of international capital to emerging markets in the 1990s. The spotlight on the available transactional bond data improves, we believe, the prospects of addressing both substantive and methodological issues. In this section, we first present our basic framework for analyzing the determinants of bonds issuance and spreads. We then discuss our approach to dealing with the econometric concerns highlighted

the probability of IMF program participation and is a function of such variables as growth, inflation, reserves, and current account balances of current and past periods.

by the literature review. Finally, we present some descriptive statistics.

2.4.1 Framework for Analyzing Spreads

We adopt an estimation approach developed in earlier papers [see Eichengreen and Mody, 2001]. We estimate a two-equation model: the "spreads" equation, which specifies the determinants of spreads charged on a particular bond, and the "selection" equation, which is a probit for the decision to issue the bond. Throughout, the spread we use is the so-called primary or launch spread and is defined as the premium paid at the time of bond issuance over the risk-free rate for a bond of similar maturity and currency denomination. Because we use primary spreads, we do not "follow" a particular bond "over time." Bond frequency issuance varies over time, resulting in varying numbers of bonds for a given country in any given time period.

The spreads equation is a linear relationship:

$$(1) \qquad log(spread) = X + u_1$$

where the dependent variable is the logarithm of the spread; X is a vector of issue, issuer [12], and period characteristics; and u_1 is a random error. The X vector contains a dummy variable for an IMF program, other program characteristics, and also interactions between the program and country characteristics, as we discuss below in detail. Since the spread will be observed only when the decision to borrow and lend is made, we correct for this sample selection problem. Assume

[12]We believe that the reverse causality problem that may be argued to be present in some of the country characteristics control variables is not serious in our case. Our dependent variable is the individual bond issue, not an aggregate variable, and it is less likely that an individual spread observation determines the aggregate variables that we use as controls.

that spreads are observed when a latent variable B crosses a threshold B' defined by:

$$(2) \qquad B' = \gamma Z + u_2$$

where Z is the vector of variables that determines the desire of borrowers to borrow and the willingness of lenders to lend (and will also contain the IMF program variables and their interactions), and u_2 is a second error term. We further assume that:

$$\begin{aligned} u_1 &\sim N(0, s) \\ u_2 &\sim N(0, 1) \\ corr(u_1, u_2) &= \rho \end{aligned}$$

This is a sample selection model à la Heckman [1979] and equations (1) and (2) can be estimated simultaneously by a maximum likelihood procedure. Estimating the determinants of market access requires information on those who did not issue bonds. For each country we consider three categories of issuers: sovereign, (other) public, and private. For each quarter and country where one of these issuers did not come to the market, we record a zero, and where they did we record a one.

Leung and Yu [1996] note that the estimation does not require the variables in the selection equation and the spread equation to be different. What is critical instead is to avoid multicollinearity between the variables in the spreads equation and the "inverse-Mills ratio" constructed from the selection equation. That, in turn, requires the value of the variables not be concentrated in a small range and that the truncated observations (no bond issuance) should not dominate the set of observations. In our case, most variables have a large range and about a third of the observations have a bond issued. We do include in the probit selection

equation, the ratio of debt service to exports, which appears to influence the issuance decision but not the determination of spreads.[13]

The data sources for the dependent and explanatory variables are documented in Appendix A.4. Details on bonds issued and their characteristics are obtained from Bondware, a commercial data source. *Bond characteristics* included in the spreads equation are: the dollar value of the bond issued, its maturity, whether the issuer was in the public or private sectors, the industrial sector of the issuer, the currency of issue, and whether the bond had a fixed or floating rate.

The *global variables* included in both the spreads and selection equation are: U.S. industrial growth rate during the quarter in which the bond was issued; the daily swap rate (as a measure of liquidity risk); and, as a measure of market uncertainty, the standard deviation of daily Emerging Market Bond Index (a commonly followed index of emerging market spreads) over the relevant quarter.

In the spreads equation, we use the following *country characteristics* as control variables: country credit ratings provided by *Institutional Investor*, external debt relative to GNP, a dummy variable for whether the sovereign has restructured debt within the previous year, the growth rate of real GDP, the variance of export growth, the ratio of short-term debt to total debt, the ratio of reserves to imports,

[13]Dell'Ariccia, Godde, and Zettelmeyer [2000] follow a similar research strategy but also add as instruments in the probit equation the bonded debt issued in the previous year, the number of bonds issued in the previous year, the natural logarithm of per capita GDP in 1993, and a dummy variable for countries directly affected by the Asian crisis. Ideally, the instruments should influence the issuance decision but not the spreads. It is not obvious that these four variables fulfill that objective and, in practice, it is hard to find such variables. For example, Asian-crisis countries were rationed during specific years but also paid higher spreads in those years. Hence, it is not sufficient to rely on exclusion conditions.

and the ratio of domestic private credit to GDP. Note that the debt-restructuring variable we use is not the same as debt rescheduling: restructuring reflects a positive effort at debt management and typically involves exchange new debt for old more expensive or inflexible debt. Also, while it is common to use the ratio of reserves to short-term debt as a measure of country liquidity, we use short-term to total debt and reserves to imports since we want to examine separately the influence of short-term debt and reserves. The IMF variables we use in alternative specifications in the spreads and selection equation are: IMF program dummy, a measure of repeated Fund programs, the size of the program relative to the country's external debt, and whether a program was "precautionary," that is, if in practice there was no, or limited, drawing down of Fund resources. The onset of the Fund program was dated by the month in which it originated, which contrasts with the typical practice of using an annual dummy variable if a program was initiated at any time during the year. Dicks-Mireaux, Mecagni, and Schadler [2000] note that the timing of IMF programs makes a difference to the empirical results. In their analysis, they code the IMF dummy variable to take the value one if a program was in effect for six or more months during the year. Kaminsky and Schmukler [1999] use daily announcements to track movements in stock markets and find, on average, that stock markets respond positively on the days agreements are reached with international organizations such as the IMF. We believe that the more precise timing of programs in this paper helps with reducing the reverse-causality problem.

2.4.2 Evaluating IMF Programs: Econometric Issues

The literature review has highlighted the need to: (1) identify the direction of causality; and (2) consider the possibility of omitted variables bias (of which, as we discuss below, selection bias is a special case).[14]

Consider first the identification issue. In a recent paper, Barro and Lee [2001] use as instruments for participation in Fund programs, such variables as the political affinity of the country to the United States, the national composition of the Fund's staff, and past participation in Fund programs.[15]

The reverse-causality problem, we believe, is less serious in our case than for those who have addressed this issue in the past. All previous studies use data at frequencies of at least one year [Barro and Lee, 2001, use five-year averages]. Moreover, the outcomes they test (such as growth, current account balances, inflation) are national outcomes just as the IMF program is a national decision. It is quite likely that over these time spans, and especially as the time span gets longer, national economic outcomes will influence the decision to participate in Fund programs.

In our case, there are two key differences relative to the past literature. First, the outcome we observe is an individual bond issue. While a bond issue may be large and reflect broad market sentiment towards the country, a single bond issue

[14]. The mean-reversion problem does not apply in our case. That problem arises when the change in the indicator of interest is the dependent variable. The extent of the change, it is argued, depends among other things on the initial level of the indicator. In our case, we are not examining changes in spreads but rather the level of spreads in any period.

[15]It is not clear that past participation in Fund programs is a good instrument since it could reflect unobserved country characteristics that constrain the country's economic growth. In that case, some part of the country's low economic growth will be attributed to the Fund.

is unlikely to trigger an IMF program. And this leads to our second point. Our observations are at a much higher frequency than is the case with past studies. Figure 2.1 shows that if the IMF program is initiated at the time shown by the solid vertical line, but the dotted line is the starting date that the econometrician uses, then we are likely to find a positive correlation between IMF programs and spreads, reflecting reverse causation. However, if we record the actual starting date, then we are more likely to observe whether a Fund program was associated with a reduction in spreads. A bond issuance is recorded on the day it occurs and the start of an IMF program is recorded in our data in the month in which it occurs. Since the actual start of a program reflects many considerations, including negotiations between a country and the Fund and internal Fund procedures, this further reduces the likelihood that there is significant feedback from an individual transaction to an IMF program. As it turns out, the sign on the coefficient of the IMF program in the spreads equation is typically negative, implying that a Fund program is, all else equal, associated with lower spreads. Thus, if poor market sentiment towards a country leads to a Fund program, then our result suggesting that a Fund program lowers spreads would only be strengthened.

Figure 2.1 also points to the importance of controlling for variables that move the level of spreads: thus the rise in spreads before the onset of a Fund program could reflect worsening of country characteristics, which could be misattributed to the Fund program. This further concern with respect to omitted variables is often stated as a "selection bias" problem and the Heckman selection correction is sometimes applied. However, as the literature review has shown, Fund programs are in place in a variety of circumstances that are not easily captured through a probit equation that forms the first step of the selection bias correction. Edwards

[2000] finds that correction for selection bias does little to change his results. With our higher frequency data, predicting Fund programs is likely to be even more difficult (not least because the right-hand-side variables are often measured at much lower frequencies). In addition, a variable that consistently works well in predicting participation in Fund programs is past participation [see Barro and Lee, 2001, and Bagci and Perraudin,1997]. If this is a key omitted variable, then it appears to us that the best approach is to include it directly in the outcome equation. Indeed, our results below show that the history of past participation in Fund programs has a significant bearing on capital market access. In addition, we include some nonlinear terms that also could proxy for some omitted variables.

2.4.3 Descriptive Statistics

Between 1990 and 2000, over 250 IMF programs were negotiated, with the number of programs varying between 20 and 35 a year, except in 1990 and 2000 when there were less than 20 programs. There is no trend in either the number of programs or the amount of financial support committed by the Fund. In particular, financial support has been large at times of crises: the big jump in 1995 reflects the large package to Mexico and the large commitments in 1997 and 1998 followed the East Asian and Russian crises.

Table 2.2 shows that between 1991 and 2000, the period covered by this paper, about one-third of all developing country and emerging market bonds were issued by borrowers from countries with IMF programs. The spreads charged (yield to maturity minus the risk-free rate) on the bonds were typically higher for program countries (406 basis points) compared with countries that did not have such programs at the time the bonds were issued (223 basis points). Also,

bonds issued by program countries had shorter maturities (5.44 years versus 6.67 years).

It was thus the case that IMF programs were associated with poorer access terms. This is not surprising, since Fund programs were also associated with worse fundamentals: higher debt/GDP ratios, lower recent growth, and greater volatility. Countries with Fund programs appear to have better credit quality in one dimension: among those that issued bonds, those with Fund programs have higher reserves. Also, issuers with Fund programs have had lower ratios of short-term debt to total debt; however, that may reflect their lack of access to short-term credit. In the next section, we examine the relationship between Fund programs and capital market access after controlling for country fundamentals-and also for bond characteristics and global fundamentals.

2.5 The Role of Countries' Fundamentals

We begin with the conventional approach representing an IMF program as a dummy variable signifying whether an IMF program was ongoing or not. Then we explore the influence of the country's external vulnerability by interacting the IMF program dummy with a variety of country characteristics. As noted above, we jointly estimate the decision to issue a bond and the determination of the spread on the bond. A complete set of results for the base equation is reported in Appendix A.5. In the rest of this paper, we continue to use the controls in this base equation but, to conserve space, we report only the coefficients on the relevant IMF variables and their interactions with other determinants of bond issuance and spreads.

Column 1 in Table 2.3 shows the simple effect of the Fund's presence at

the time of bond issuance. Fund presence is seen in the selection equation to significantly improve market access, raising the frequency of bond issuance. Fund programs are also associated with reduced spread. The point estimate suggests that the presence of a Fund program reduces spreads by about 10 percent. If there were mainly "reverse" causation, with periods of market aversion to a country causing a Fund program, we would have found the coefficient on the Fund program dummy to be negative in the selection equation and to be positive in the spread equation. If we repeat this regression omitting country characteristics from the control variables (keeping bond features and global variables), then we *do* find that the IMF dummy is negative and highly significant in the selection equation and positive and significant in the spreads equation. Clearly, the failure to control for the country variables results in this misattribution of the country weakness to IMF programs. The omission of relevant country controls in some of the studies cited above could be the reason for their reaching a bleaker conclusion on IMF programs than is warranted.

We next examine how IMF programs interact with country characteristics. The first question we ask is whether a Fund program is helpful in dampening the effect of external volatility (Table 2.3, Column 2). We use a measure of the volatility of the country's exports (the standard deviation of the monthly growth of exports). When entered independently, this measure is associated with higher spreads and lower probability of bond issuance suggesting that volatility shifts the supply of funds to the left (see Appendix A.5). This is consistent with the Catão and Sutton [2002] finding that under conditions of macroeconomic volatility, sovereign debt defaults are more likely and hence will result in reduced access and higher spreads. When we interact export volatility with the IMF

program dummy, the interaction term enters with a negative and significant sign. Thus, absent a Fund program, an increase in volatility from the median to the 75th percentile raises spreads by 6.5 percent; with a Fund program, that increase is only 2 percent. The evidence supports the possibility, discussed above, that the Fund program acts a commitment mechanism that counteracts the effect of volatility. Viewed alternatively, the result indicates that an IMF program is particularly beneficial as country volatility increases, reducing spreads and increasing the probability of bond issuance. The effects are not small. At the median volatility, an IMF program is associated with a 7.4 percent reduction in spreads but at the 75th percentile of volatility, spreads are lower by 12.0 percent. Thus, once again, where volatility is high, the presence of the IMF acts to reduce investor aversion to the country.

But the Fund is not able to counteract all types of volatility. The interaction, for example, of Fund programs with the volatility of the Emerging Market Bond Index (the EMBI) is statistically insignificant in the selection and spreads equation, suggesting that a country with a Fund program is not insulated from high volatility in international capital markets.

We next consider the possibility that IMF programs are most effective when countries are vulnerable but not without hope of return to normalcy. This could be the case, as discussed above, if contracting and information problems are especially severe in periods of vulnerability. The goal is to determine if the credibility of joint commitment is eroded if country fundamentals are past the point of early remedial action. We examine the effectiveness of IMF programs with respect to the availability of reserves (proxied by the ratio of reserves to imports) and the country's external debt-to-GDP ratio. A simple interaction

of the IMF program dummy and reserves/imports showed no statistical effect. Thus, we were led to consider the possibility that IMF programs may interact with reserves availability (and other domestic conditions) in a nonlinear manner. In other words, could it be that countries with very high or very low reserves do not benefit from IMF programs but those in the middle do?

To examine the nonlinearity, we specified a piece-wise linear function.[16] We split the reserves-to-imports ratio at the median, creating two variables: the reserves-to-imports in the low range and in the high range. Column 3 of Table 2.3 reports the coefficients for the IMF dummy intercepts and the interaction terms for low and high ranges of country reserves-to-imports.[17] For countries with low reserves, the results suggest that spreads are higher with a program rather than without a program. The IMF effect improves with reserve availability and a Fund program turns beneficial when the reserves cover at least 3 months of imports. At the median value of reserves to imports (about 4.5 months of imports), the effective coefficient on the Fund program is -0.19, that is, a Fund program lowers spreads by about 19 percent. However, past the median value of reserves to imports, the Fund effect worsens again, and turns to a small positive effect on spreads when reserves are larger than about a year's worth of imports. The effects on probability of issuance are also nonlinear and we find, in particular, that the IMF's assistance in improving the probability of issuance declines rapidly after the median value of reserves-to-imports, though the magnitude of the effects are

[16]While this approach imposes considerable structure, it allows a simple test of the possibility that country conditions matter in a nonlinear manner. Adding a quadratic interaction term was not feasible because of a multicollinearity problem.

[17]The full equation, which is not reported here, now has two variables representing reserves to imports in the low and high ranges.

not large in this case.

The evidence, therefore, suggests that if a country's reserves are very low, Fund programs are unable to compensate for the economic difficulties faced by the country. In contrast, when reserves are low—but have not yet fallen to the extremely low levels that signify deeper structural problems—Fund programs can be very effective. The results further suggest that as reserves increase Fund effectiveness falls off, as may be expected. But a point may also be reached where Fund programs may come in the way of market access if undertaken when reserves are high—as if the presence of an ambulance is a sign of trouble.

We repeated the same methodology with debt-to-GNP ratio, with similar results.[18] Thus, once more we created two variables, one with the debt-to-GNP ratio in the low range (below its median value) and another in the high range. We interacted these two variables with the IMF dummy to test if these interactions vary with the range in which the debt-to-GNP ratio falls. The results support the analysis above. The estimates presented in Column 4 of Table 2.3 imply that IMF programs are effective in reducing spreads when the debt-to-GNP ratios are between 34 and 61 percent. For debt-to-GNP, interactions with IMF programs are also strongly nonlinear in influencing the probability of issuance, with the favorable effects on issuance lying in the range of 25 to 63 percent. Interestingly, Pattillo, Poirson, and Ricci [2002] find that an external-debt-to-GDP ratio of about 35 percent marks the threshold beyond which additional debt accumulation has a negative effect on growth. This threshold is at the lower end of our estimated range in which the Fund has a catalytic effect. Thus, once a country has crossed the threshold, the Fund can counteract the negative impact of the high level of

[18]Results were similar also when considering the ratio of short-term to total debt.

debt, but at a diminishing rate.

In summary, the results clearly support the idea that country fundamentals matter in determining the effects of Fund programs. These programs help when the country's export composition makes it is prone to external volatility. However, along other dimensions—reserves and debt—poor country fundamentals can hurt. It is as if the credibility of Fund programs is weakened when the country has already placed itself in a highly vulnerable external position. Instead, the Fund is effective when countries are in the early stages of external payment difficulties and the restoration of balance is reasonable likely.

2.6 Implications Of Fund-Supported Program Design

In this section, we explore three dimensions of IMF programs: (1) size of lending (normalized by country debt); (2) whether a program was "precautionary" or not; and (3) "prolonged" use of Fund resources.

The Fund can signal the credibility of a stabilization process and its intention to support that process not just through its presence but also through the size of the program. In Column 1 of Table 2.4, we replace the IMF program dummy with the amount committed (as a percentage of the country's long-term debt). The results show that program size is important. Larger programs both increase the probability of bond issuance and lower spreads. The results imply that an additional program size equal to 10 percent of the country's long-term debt lowers spreads by about 13 percent.

Why would a larger program size have a greater catalytic effect? It could be

that investors view the country's repayment capacity to have improved when IMF funds become available. However, while repayment difficulties may be relieved in the short term, over a more medium term, the Fund also has to be repaid and so, over that longer time horizon, the country's repayment capacity is not improved by the mere fact of an IMF loan. Moreover, to the extent that the IMF is a preferred creditor, it is possible that some private creditors may take the view that their repayment prospects have in fact become worse. Thus, if it were mainly the case that the amounts received from the Fund were helping repay existing debt, access to new debt should not improve and spreads on that new debt should not decline. An alternative interpretation of the better market access is that the size of the Fund program signals greater commitment to economic reforms that, in turn, improves the medium-term capacity of the country to honor new contractual obligations.

The amount committed in a Fund program is not necessarily disbursed—programs may be "precautionary." Programs may be precautionary in two senses. First, at the time the program is agreed upon, the borrowing country may declare its intention to not draw on the resources made available. While this is not a contractually binding restriction, and the country can change its mind with no penalty, declaration of the intent to not borrow implies that Fund resources are not critical. Rather the country is volunteering to subject itself to the discipline of the Fund's program. Second, the country may negotiate a Fund program and draw on Fund resources initially but thereafter voluntarily halt disbursements while keeping the IMF program in place. Yet, by its later action of not drawing on the resources, the country may treat the program as precautionary. Such

programs may be referred to as "turned precautionary."[19] Programs that "turn" precautionary are larger in size than the "outset" precautionary programs and, presumably, have more demanding policy conditionality. Of the 245 programs between 1991 and 2000 covered in this analysis, only 38 were precautionary at the outset and 13 "turned" precautionary. However, of the bonds issued while a country was in a Fund program, over 45 percent were during precautionary programs (18 percent were precautionary at outset and 33 percent "turned" precautionary).

How do precautionary programs fare? Column 2 of Table 2.4 shows that precautionary programs of the two varieties ("outset" and "turned" precautionary) have differing implications. The results suggest that "declared" precautionary programs do not have a significant effect over and above that already implied by the presence of the program and the program size (as reflected in the variable representing the IMF committed amount divided by the country's debt level). In contrast, turned precautionary programs add significantly to the value of the IMF's presence both in terms of spreads and access.

Recall, that "turned" precautionary programs are significantly larger than the "outset" precautionary programs.[20] Thus, the highly significant sign on the "turned" precautionary dummy reflects the benefits deriving both from the precautionary nature of the program and the program's large size. Thus, the size coefficient falls from 1.28 to 0.82. The evidence suggests, therefore, that those

[19]The country chooses to continue the arrangement and pay the commitment fee rather than simply cancelling it.

[20]The median size of "outset" precautionary programs is about 40 million SDRs whereas that for "turned" precautionary programs is almost 10 times larger at 330 million SDRs. When normalized by country debt, the "turned" precautionary programs are still much larger.

subjecting themselves to the Fund's discipline can benefit even when the resources are not drawn.

There is yet another Fund facility that combines large size and precautionary intent. This is the "Supplemental Reserve Facility (SRF)," that has been used for large-sized programs at times of crises. The premise is that a country in the midst of a crisis could be subject to a loss of investor confidence even though its fundamentals are relatively sound. The goal thus is to restore investor confidence to the country, and at the same time to prevent "contagion", or the loss of confidence from spreading to other countries. The SRF overlaps to a considerable extent with programs that turned precautionary.[21] As such, in Column 3 of Table 2.4, we find that while the coefficients on program size, the dummy variable for the SRF, and the dummy variable for "turned precautionary" programs are all negative, their significance is marginal. When we repeat the regression without the IMF amount (Column 4), both the SRF and the "turned precautionary" programs come in with significantly negative signs in the spreads equation and significantly positive signs in the selection equations.

These findings can be linked back to our discussion of country fundamentals. Though the fundamentals in countries with "turned precautionary" programs are worse than in non-program countries, they are superior to those in countries with other forms of IMF programs. In particular, "turned precautionary" countries do better than other program countries with respect to lower debt/GDP ratios, higher growth, and lower volatility. In contrast, their reserves/import ratios are not very different from those in countries with other programs. Thus, a

[21]The analysis here includes those loans that were made under "exceptional circumstances" and were thus similar in intent to the SRF.

possible interpretation of our results is that "turned precautionary" countries are vulnerable to external pressures and that their vulnerability has further led to a liquidity problem. However, because the underlying fundamentals are not yet beyond a point of no return in the short-run, a reform program with IMF support carries credibility.

Finally, we ask if there may be diminishing returns to a country's repeated interactions with the Fund. Two opposing forces may be at work here. Repeated Fund involvement may be warranted in light of medium-term problems that the country faces and may reflect a joint commitment on the part of the country and the Fund to resolve the problems. However, it may be the case that "prolonged" use of Fund resources implies an inability to resolve the problems at hand and is an indicator, therefore, of more deep rooted problems. The term "prolonged" use has many different indicators but one of them recently proposed by the IMF's new Independent Evaluation Office is the existence of a program for more than 70 percent of the time over a given period.

Thus, we examine if repeated Fund presence in a country makes a difference to program effectiveness in a non-linear manner. The measure of repeated Fund presence we use is the number of months that a Fund program was in place in the country during the four-year (48-month) period from 1987 to 1990. Use of a prior time period ensures that we do not pick up a reverse causation from poor market access to a high frequency of Fund programs. It turns out that there is a high correlation between the number of months the country had a program in the late 1980s and the number of months a program was in place in the 1990s. This persistence suggests that our measure of the Fund's ongoing involvement in a country reflects a combination of continuing economic difficulties and the

inability of the Fund and the country to work together to achieve the necessary reforms. Since we have already controlled for external indicators such as debt and reserves, the number of months that a Fund program was in place in the late 1980s proxies for these other (unobserved) country characteristics and the Fund-country relationship. With this interpretation in mind, the results support the speculation above (see Column 5). Continued Fund presence helps up to a point. These results suggest that the "turning point" is at about 18 months out of the 48-month window over which our measure of repeated interaction is taken. Beyond that length of time, continuing Fund effectiveness in helping with market access begins to decline and at about 32 months, or about 75 percent of the time window, continued presence raises spreads. At that point, investors apparently believe that the problems are either deep-rooted or that the Fund is unable to exercise the necessary influence to resolve them. These results and interpretation are consistent with Conway's [2001] conclusion that a continuing Fund-country relationship reaches diminishing returns.

To summarize the findings in this section, the evidence suggests that constructive engagement between the Fund and the member country can be demonstrated in different ways. Credibility is established by the size of the program, and thus resources made available do matter. However, the results also show that large Fund resources and voluntary country commitment under so-called "turned" precautionary programs go together in signaling both country intentions and Fund discipline. The programs under the Supplemental Reserve Facility (SRF) have also been of this nature, but the SRF has not been the only vehicle to establish confidence by committing significant resources that are ultimately not used. Finally, where Fund programs are frequently repeated, the credibility of effective

reforms seems to be called into question by the market.

2.7 Conclusions

Except for some recent efforts to distinguish between programs in terms of their degree of compliance with agreed policy initiatives, the vast bulk of the empirical literature does not distinguish between one program and another—each program takes an identical value of 1 in the program dummy variable. This chapter takes seriously the diversity in Fund programs and demonstrates that they do vary significantly in their effects. on the impact of IMF programs Country fundamentals and program design differ widely across interventions and, not surprisingly, these do have a bearing on the outcomes.

Thus, a Fund program is not an automatic or standardized "good housekeeping seal of approval."[22] Investors appear to value the Fund's participation in resolving a country's external payment difficulties only when they view it is as likely that the effort will be successful.[23] Our further contribution, we believe, is

[22]The gold standard, which apparently did provide a "good housekeeping seal," was associated with a narrow range of prudential macroeconomic policies [Bordo and Rockoff, 1996]. In contrast, the current range of IMF member countries—and the variety of economic challenges facing them—leads to a much larger variation in appropriate economic policy measures. Obstfeld and Taylor [2002] conclude even in the case of the gold standard that its credibility was diminished in the interwar period [1925-31] and unlike Bordo, Edelstein, and Rockoff [1999], they find that only those who devalued before reentering the gold standard benefited in the form of lower spreads. The implications of the Obstfeld and Taylor analysis are thus, similar to ours: country conditions matter in determining the credibility of policy actions.

[23]It is not straightforward to distinguish a "good" catalytic effect from a "bad" one in which moral hazard predominates. We find that Fund effectiveness in catalyzing flows declines as the

to suggest the conditions under which programs are likely to succeed. A successful outcome, measured in this paper as improved access to international markets, depends on the market's perception of credible reform measures.

The interplay of country fundamentals with IMF programs also points to the importance of the credibility of reform measures. Here our finding is that the Fund can help mitigate the market's aversion to volatility of export growth, acting as if to bolster a country's reserves. The market apparently discounts stated efforts to undertake reform and, indeed, countries with weak external payments positions could adopt risky strategies to overcome their problems, hence deviating from the course of action agreed on with the Fund.

A large program size can help signal stronger commitment on the part of the country and the Fund, but it appears the program-size effect weakens when the effect of "precautionary" programs is considered. Precautionary programs help boost the frequency of market access and reduce spreads, especially for programs that turn precautionary, which are much larger in size than those declared precautionary at the outset. Thus, both the voluntary nature of inviting Fund discipline and the potential for drawing on resources, if needed, help improve market access. Repeated use of Fund programs sends a bad signal in this respect. The implication of our results is that where programs are repeated often, markets infer additional problems that are not reflected in the most commonly observed indicators of country solvency and liquidity.

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country's own repayment capacity becomes less credible, which suggests that moral hazard is not dominant. Moreover, moral hazard is likely to reflect itself in cross-country effects rather than a renewed burst of imprudent lending to a country that enters into a Fund program [Lane and Philips, 2000].

Table 2.1: Frequency of IMF Programs.
Number of Programs per year
(Size of Programs in billions of SDRs)

	SBA	EFF	ESAF	Total
1990	12	0	3	15
	(1.70)	(0)	(0.56)	(2.25)
1991	19	2	8	29
	(5.30)	(2.34)	(0.69)	(8.33)
1992	15	4	6	25
	(2.74)	(4.59)	(0.44)	(7.78)
1993	13	2	7	22
	(1.64)	(1.42)	(0.28)	(3.34)
1994	18	4	13	35
	(2.61)	(1.49)	(2.19)	(6.29)
1995	21	2	7	30
	(19.09)	(1.28)	(1.20)	(21.57)
1996	12	6	14	32
	(3.52)	(14.25)	(1.30)	(19.07)
1997	10	4	7	21
	(28.02)	(1.03)	(1.37)	(30.42)
1998	6	4	11	21
	(11.71)	(10.01)	(1.06)	(22.77)
1999	7	4	9	20
	(9.94)	(2.80)	(0.86)	(13.60)
2000	10	2	0	12
	(7.36)	(3.66)	(0)	(11.02)
1990-2000	**143**	**34**	**85**	**262**
	(93.62)	**(42.87)**	**(9.95)**	**(146.45)**

Note: SBA is for Stand-By Arrangement; EFF is for Extended Fund Facility; and ESAF is for Enhanced Structural Adjustment Facility (includes Structural Adjustment Facility and the now renamed Poverty Reduction Growth Facility.)

Table 2.2: Bond Issuance, Terms, and Country Characteristics

	No Program	Fund Program	Total
	A: Bond Issued		
Number of Bonds	2156	1139	3295
Spread (basis points)	223	406	282
Maturity(years)	6.67	5.44	6.25
Amount ($ millions)	154	177	162
Debt/GDP	0.27	0.43	0.32
Annual GDP growth (percent)	5.04	3.29	4.40
Short-term/total debt	0.66	0.50	0.56
Reserves/imports (months of imports)	5.91	6.78	6.21
Volatility of exports	0.08	0.11	0.09
	B: No Bond Issued		
Debt/GDP	0.39	0.56	0.46
Annual GDP growth (percent)	4.00	2.65	3.30
Short-term/total debt	0.55	0.49	0.52
Reserves/imports (months of imports)	4.89	4.68	4.83
Volatility of exports	0.14	0.18	0.16

Table 2.3: Interaction of Country Characteristics with Fund Programs

	Log of Spreads at Time of Issue			
	(1)	(2)	(3)	(4)
IMF program, low range	-0.089	0.012	0.371	0.680
	(-3.05)	(0.18)	(2.11)	(2.00)
IMF program, high range			-0.176	-0.287
			(-1.67)	(-2.28)
IMF program interacted with:				
EMBI volatility		-0.396		
		(-0.13)		
Export growth volatility		-0.902	-0.974	-1.151
		(-2.84)	(-3.10)	(-3.58)
Low range of Debt/GNP				-1.958
				(-1.82)
Debt/GNP				0.470
				(1.96)
Low range of Reserves/Imports			-0.332	
			(-2.01)	
High range of Reserves/Imports			0.056	
			(1.82)	

	Probability of Issuance			
	(1)	(2)	(3)	(4)
IMF program, low range	0.337	0.181	-0.100	-1.782
	(10.60)	(1.81)	(-0.59)	(-5.13)
IMF program, high range			1.009	1.327
			(10.20)	(8.28)
IMF program interacted with:				
EMBI volatility		-2.326		
		(-0.70)		
Export growth volatility		1.725	1.773	2.390
		(2.39)	(2.40)	(3.35)
Low range of Debt/GNP				6.526
				(6.07)
High range of Debt/GNP				-2.448
				(-8.96)
Low range of Reserves/Imports			-0.155	
			(-1.03)	
High range of Reserves/Imports			-0.223	
			(-8.28)	

Note: Regressions have the controls specified in the full regression presented in Appendix V. z-statistics, based on robust standard errors, are in parentheses.

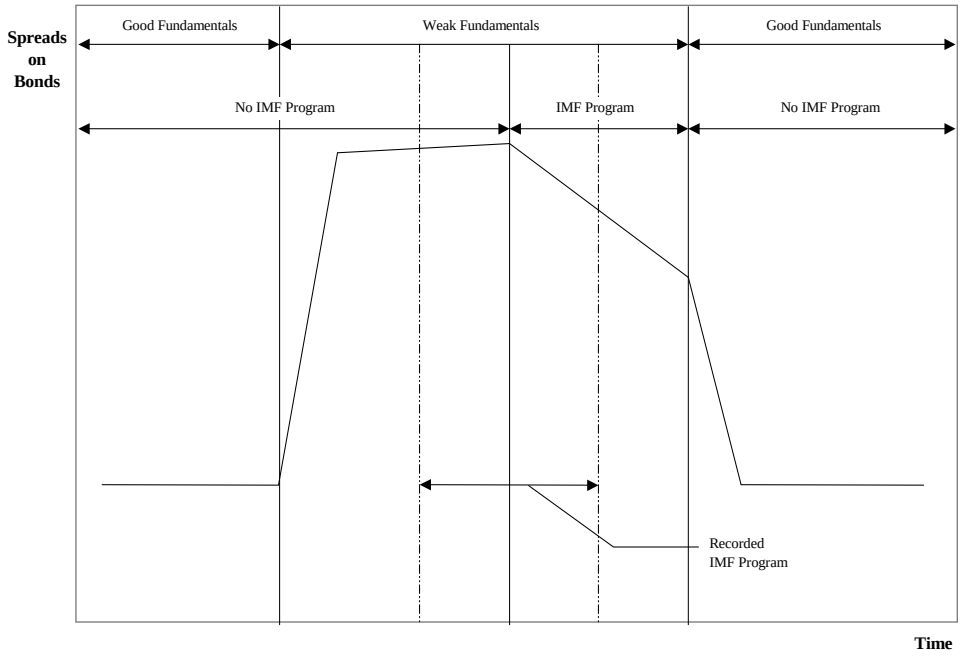
Table 2.4: Influence of Program Features on Bond Market Spreads and Issuance

	Log of Spreads at Time of Issue				
	(1)	(2)	(3)	(4)	(5)
IMF amount/debt	-1.290	-0.825	-0.554		-1.328
	(-3.62)	(-2.38)	(-1.55)		(-3.61)
Precautionary program:					
Outset		0.021	0.001	-0.019	
		(0.38)	(0.01)	(-0.34)	
Turned		-0.139	-0.091	-0.101	
		(-3.58)	(-2.13)	(-2.34)	
Supplemental Reserve Facility			-0.119	-0.161	
			(-1.98)	(-2.73)	
Number of months in					-0.029
IMF program, 1987-1990					(-5.92)
Square of Number of months					0.001
in IMF program, 1987-1990					(5.92)

	Probability of Issuance				
	(1)	(2)	(3)	(4)	(5)
IMF amount/debt	5.659	4.940	3.623		5.945
	(16.57)	(13.02)	(8.56)		(16.48)
Precautionary program:					
Outset		-0.091	-0.053	0.002	
		(-1.40)	(-0.83)	(0.04)	
Turned		0.253	0.145	0.211	
		(5.24)	(2.44)	(3.51)	
Supplemental Reserve Facility			0.464	0.818	
			(5.57)	(10.55)	
Number of months in					0.065
IMF program, 1987-1990					(16.94)
Square of Number of months					-0.002
in IMF program, 1987-1990					(-15.40)

Note: Regressions have the controls specified in the full regression presented in Appendix V. z-statistics, based on robust standard errors, are in parentheses.

Figure 2.1: Econometric Implications of Timing of IMF Programs



Chapter A

Appendices

A.1 Proof of Lemma 1

From zero expected profit condition we write the implicit function

$$Q(\rho, r_1) \equiv 1 - \frac{1}{1+\rho}\int_0^{Min(\lambda^1,\lambda^0)} \frac{\lambda f(k_0)}{k_0} dF(\lambda) - \frac{1}{\rho}\int_{Min(\lambda^0,\lambda^*)}^{\lambda^*} \left[\frac{\lambda f(k_0)}{k_0} - \frac{D_0}{k_0}\right] dF(\lambda) - \\ - \int_{Min[\lambda^1,\lambda^*]}^{\bar{\lambda}} r_1 dF(\lambda) = 0$$

First consider the case where $\lambda^0 < \lambda^*$; applying the implicit function theorem we have that $\frac{\partial r_1}{\partial \rho} = -\frac{\frac{\partial Q(.)}{\partial \rho}}{\frac{\partial Q(.)}{\partial r_1}}$

$$\frac{\partial Q(.)}{\partial \rho} = \frac{1}{(1+\rho)^2}\int_0^{\lambda^0} \lambda \frac{f(k_0)}{k_0} dF(\lambda) + \frac{1}{\rho^2}\int_{\lambda^0}^{\lambda^*} \left[\lambda \frac{f(k_0)}{k_0} - \frac{D_0}{k_0}\right] dF(\lambda) + \\ + \left[\frac{\lambda^0 f(k_0)}{\rho k_0} - \frac{D_0}{\rho k_0} - \frac{1}{1+\rho}\frac{\lambda^0 f(k_0)}{k_0}\right] F'(\lambda^0)\frac{\partial \lambda^0}{\partial \rho} + \left[r_1 - \frac{\lambda^* f(k_0)}{\rho k_0} + \frac{D_0}{\rho k_0}\right] F'(\lambda^*)\frac{\partial \lambda^*}{\partial \rho}$$

Taking into account that $\lambda^0 = \frac{(1+\rho)D_0}{f(k_0)}$ and that $\lambda^* = \frac{D_0+D_1}{f(k_0)}$ we have that the last two terms are both equal to zero. Thus, $\frac{\partial Q(.)}{\partial \rho} > 0$. Moreover,

$$\frac{\partial Q(.)}{\partial r_1} = -\int_{\lambda^*}^{\bar{\lambda}} r_1 dF(\lambda) < 0.$$

Thus, $\frac{\partial r_1}{\partial \rho} > 0$.

Proceeding in the same way we can show that this is also the case when $\lambda^1 < \lambda^*$.

A.2 Proof of Lemma 3

To simplify the exposition of this proof consider the special case when $\lambda^0 = \lambda^1 = \lambda^*$. Without seniority, the interest rate is pinned down by:

$$\int_{\lambda^*}^{\bar{\lambda}} r_1 dF(\lambda) + \left[\frac{1}{L_0 + L_1}\right] \int_0^{\lambda^*} \lambda f(k_0) dF(\lambda) = 1$$

and with seniority by

$$\int_{\hat{\lambda}}^{\bar{\lambda}} r_1^s dF(\lambda) + \left[\frac{1}{L_1^s}\right] \int_0^{\hat{\lambda}} \lambda f(k_0) dF(\lambda) = 1$$

The proof proceeds by contradiction. Assume that r_1=r_1^s. This implies that R_1^s=R_1 since $L_1^s = L_1$, and this implies that $\hat{\lambda} < \lambda^*$ for sure. Splitting the integral limits and equating both expressions:

$$\int_{\lambda^*}^{\bar{\lambda}} r_1 dF(\lambda) + \left[\frac{1}{L_0 + L_1}\right] \left[\int_0^{\hat{\lambda}} \lambda f(k_0) dF(\lambda) + \int_{\hat{\lambda}}^{\lambda^*} \lambda f(k_0) dF(\lambda)\right] =$$

$$= \int_{\hat{\lambda}}^{\lambda^*} r_1^s dF(\lambda) + \int_{\lambda^*}^{\bar{\lambda}} r_1^s dF(\lambda) + \left[\frac{1}{L_1^s}\right] \int_0^{\hat{\lambda}} \lambda f(k_0) dF(\lambda)$$

Rearranging we get:

$$\begin{aligned} \int_{\lambda^*}^{\bar{\lambda}} (r_1 - r_1^s)\, dF(\lambda) \;=\; & \int_{\hat{\lambda}}^{\lambda^*} r_1^s dF(\lambda) + \int_0^{\hat{\lambda}} \lambda f(k_0) \left[\frac{1}{L_1^s} - \frac{1}{L_0 + L_1}\right] dF(\lambda) - \\ & - \left[\frac{1}{L_0 + L_1}\right] \int_{\hat{\lambda}}^{\lambda^*} \lambda f(k_0) dF(\lambda) \end{aligned}$$

The second term of the right hand side is positive and the first term is greater than the third one under the assumption that $r_1^s = r_1$. So the right hand side is unambiguously positive. So, the left hand side should be positive and not zero as it is under our original assumption.

There is a contradiction.

Now we have to show that r_1^s cannot be greater than r_1. Again we proceed by contradiction. Assume $r_1^s > r_1$, which implies that $R_1^s > R_1$. There are two possible cases: $\hat{\lambda} < \lambda^*$ and $\hat{\lambda} > \lambda^*$. In the first case the proof is the same as before. In the second case, split the integral limits as above, but now with $\hat{\lambda} > \lambda^*$.We get

$$\int_{\hat{\lambda}}^{\bar{\lambda}} (r_1 - r_1^s)\, dF(\lambda) = \left[\frac{1}{L_1} - \frac{1}{L_0 + L_1}\right] \int_0^{\lambda^*} \lambda f(k_0) dF(\lambda) + \int_{\lambda^*}^{\hat{\lambda}} [\lambda f(k_0) - r_1]\, dF(\lambda)$$

The second term of the right hand side is positive under our assumption that $\hat{\lambda} > \lambda^*$. Conditional on λ being greater than λ^* and lower than $\hat{\lambda}$ output is greater than r_1. This is because output is higher than the necessary to totally repay the contractual interest rate r_1 (i.e. $\lambda > \lambda^*$). So, the left hand side is unambiguously positive and so should be the left hand side. But this contradicts our initial assumption.We conclude that r_1^s must be lower than r_1.

A.3 Proof that $\frac{\partial \hat{\rho}}{\partial k_0} < 0$

From equation (1.8), define the function $F(k_0, \hat{\rho})$:

$$F(k_0,\hat{\rho}) \equiv \hat{\rho} - \frac{\hat{\rho}}{1+\hat{\rho}} \int_0^{\bar{\lambda}} \lambda \underbrace{\frac{f(k_0)}{k_0}}_{A} dF(\lambda) -$$

$$- \int_{Min[\lambda^0,\bar{\lambda}]}^{\bar{\lambda}} \left[\left(\frac{1}{1+\hat{\rho}} \right) \lambda \underbrace{\frac{f(k_0)}{k_0}}_{A} - \underbrace{\frac{D_0}{k_0}}_{B} \right] dF(\lambda) = 0$$

Applying the implicit function theorem to this expression:

$$\frac{\partial \hat{\rho}}{\partial k_0} = -\frac{\frac{\partial F(.)}{\partial k_0}}{\frac{\partial F(.)}{\partial \hat{\rho}}}$$

$$\frac{\partial F(.)}{\partial k_0} = -\frac{\hat{\rho}}{1+\hat{\rho}} E(\lambda) \frac{\partial A}{\partial k_0} - \int_{Min[\lambda^0,\bar{\lambda}]}^{\bar{\lambda}} \left[\left(\frac{1}{1+\hat{\rho}} \right) \lambda \frac{\partial A}{\partial k_0} - \frac{\partial B}{\partial k_0} \right] dF(\lambda) > 0$$

Since A is a concave function and B is a convex function (analogous to Lemma 1), this expression is greater than zero.

$$\frac{\partial F(.)}{\partial \hat{\rho}} = 1 - \frac{1}{(1+\hat{\rho})^2} E(\lambda) \frac{f(k_0)}{k_0} + \int_{Min[\lambda^0,\bar{\lambda}]}^{\bar{\lambda}} \frac{1}{(1+\hat{\rho})^2} \lambda \frac{f(k_0)}{k_0} dF(\lambda)$$

This expression will have the same sign as:

$$(1+\hat{\rho}) - \frac{1}{(1+\hat{\rho})} E(\lambda) \frac{f(k_0)}{k_0} + \int_{Min[\lambda^0,\bar{\lambda}]}^{\bar{\lambda}} \frac{1}{(1+\hat{\rho})} \lambda \frac{f(k_0)}{k_0} dF(\lambda),$$

from the definition of $\hat{\rho}$ (equation (1.8)) we have that:

$$\frac{1}{1+\hat{\rho}} E(\lambda) \frac{f(k_0)}{k_0} < 1$$

so that,

$$\frac{\partial F(.)}{\partial \hat{\rho}} > 0$$

These imply that $\frac{\partial \hat{\rho}}{\partial k_0} < 0$.

A.4 Data Sources and Construction of Variables

Bond characteristics

The bond dataset, obtained from Bondware, supplemented by the former Emerging Markets Division of the International Monetary Fund for the early 1990s, covers the period 1991 to 1999 and includes: (1) launch spreads over risk free rates (in basis points, where one basis point is one-hundredth of a percentage point); (2) the amount of the issue (millions of dollars); (3) the maturity in years; (4) whether the borrower was a sovereign, other public sector entity, or private debtor; (5) currency of issue; (6) whether the bond had a fixed or floating rate; and (7)the borrower's industrial sector: manufacturing, financial services, utility or infrastructure, other services, or government (where government, in this case, refers to subsovereign entities and central banks, which could not be classified in the other four industrial sectors). Global variables included the United States industrial production growth rate, constructed as average month-month growth rate over a quarter; the United States ten-year swap spread; and the quarterly standard deviation of log differences of daily spreads of the Emerging Market Bond Index.

Global variables

United States industrial production growth rate: average of month-month growth rate over a quarter.

United States ten-year swap spread.

Emerging Market Bond Index: standard deviation of difference in log of daily spreads.

Table 5: Country Characteristics

Variable	(Billions)	Periodicity	Source
Total external debt (EDT)	US$	Annual	WEO
Gross national product (GNP, current prices)	US$	Annual	WEO
Gross domestic product (GDPNC, current prices)	National	Annual	WEO
Gross domestic product (GDP90, 1990 prices)	National	Annual	WEO
Total debt service (TDS)	US$	Annual	WEO
Exports (XGS)	US$	Annual	WEO
Exports (X)	US$	Monthly	IFS
Reserves (RESIMF)	US$	Quarterly	IFS
Imports (IMP)	US$	Quarterly	IFS
Domestic bank credit (CLM_PVT)[1]	National	Quarterly	IFS
Short term bank debt (BISSHT)[2]	US$	semi-annual	BIS
Total bank debt (BISTOT)[3]	US$	semi-annual	BIS
Credit rating (CRTG)	Scale	semi-annual	Institutional Investor
Debt rescheduling (DRES)[4]	Indicator	Annual	WDT/GDF

Table 5 (Continued). Country Characteristics
Constructed Variables

Debt/GNP	EDT/GNP
Debt service/exports	TDS/XGS
GDP/growth	0.25 * ln[GDP90_t/GDP90_t-1]
Reserves/imports	RESIMF/IMP
Reserves/GNP	RESIMF/GNP
Reserves/short-term debt	RESIMF/BISSHT
Short-term debt/total debt	BISSHT/BISTOT
Domestic credit/GDP	CLM_PVT/(GDPNC/4)

Sources: International Monetary Fund's World Economic Outlook (WEO) and International Financial Statistics (IFS); IMF program data from the IMF's Executive Board Documents and Staff Estimates; World Bank's World Debt Tables (WDT) and Global Development Finance (GDF); Bank of International Settlements, The Maturity, Sectoral, and Nationality Distribution of International Bank Lending. Credit ratings were obtained from Institutional Investor's Country Credit Ratings. Missing data for some countries was completed using the US State Department's Annual Country reports on Economic Policy and Trade Practices (which are available on the internet from http:www.state.gov/www/issues/economic/trade_reports/). U.S. industrial production, Federal Reserve Swap rates and EMBI data are taken from Bloomberg.

[1] Credit to private sector.
[2] Cross-border bank claims in all currencies and local claims in nonlocal currencies of maturity up to and including one year.
[3] Total consolidated cross-border claims in all currencies and local claims in nonlocal currencies.
[4] Indicator variable, which is equal to one if a debt rescheduling took place in the previous year and zero otherwise.

A.5 Base Regression

In this appendix we present the full details of the base regression, which corresponds to Column 1 of Table 2.3. As noted, in Tables 2.3 and 2.4 of the main text we present only the variables of direct interest to this paper. The signs and significance of the controls variables presented here remain very similar across the various variations in Tables 2.3 and 2.4. The first two columns of the table in this appendix present the coefficient and z-statistic for the variables in the selection equation; and the next two columns refer to the spreads equation.

While much of the table is self-explanatory, a few comments are in order. In earlier work [e.g., Eichengreen and Mody, 2001], we used the United States' 10-year treasury rate as one of the "global" variables. That variable gave ambiguous signs. In ongoing work, we find that the U.S. industrial growth rate gives a consistent sign and also has an intuitive explanation in terms of U.S. higher growth improving credit quality for emerging market borrowers. Thus, higher U.S. growth is associated with lower spreads and more frequent bond issuance, as if the demand for emerging market bonds shifts to the right when the United States grows more rapidly. Another new variable used in this analysis is the quarterly standard deviation of the daily log change of the EMBI index. A higher standard deviation implies greater market uncertainty with respect to pricing of bonds. We find that such uncertainty reduces bond issuance significantly and raises spreads (that the effect on spreads is not always significant at the 5 percent level).

Table 6: Base Regression Results

	Probability of Bond Issunace		Log of Spread at Time of Issue	
	Coefficient	z-statistic	Coefficient	z-statistic
Bond Characteristics				
Log amount			-0.031	(-2.14)
Maturity			0.010	(4.98)
Yen			-0.321	(-6.97)
Deutsche Mark			-0.091	(-2.09)
Euro			-0.058	(-1.24)
Other currencies			-0.190	(-4.39)
Fixed rate			0.366	(11.04)
Global Variables				
U.S. growth rate	52.908	(10.90)	-25.052	(-5.25)
Log swap rate	-0.319	(-8.28)	0.460	(11.61)
EMBI volatility	-17.359	(-11.15)	6.059	(4.27)
Country Characteristics				
Credit rating	0.033	(29.79)	-0.044	(-26.70)
Debt/GNP	-1.264	(-15.61)	0.970	(10.77)
Debt service/exports	1.281	(24.87)		
Debt restructured dummy	1.058	(15.15)	-0.450	(-9.72)
GDP growth	0.994	(0.93)	-9.372	(-6.58)
Short-term debt/total debt	-0.674	(-8.91)	0.841	(7.42)
Export growth volatility	-2.118	(-5.71)	0.666	(3.10)
Reserves/imports	0.073	(8.22)	-0.006	(-0.52)
Bank credit stock/GDP	-0.000	(-0.51)	0.000	(1.37)
Sector				
Public	0.024	(0.61)	0.033	(0.54)
Finance			-0.127	(-1.96)
Services			0.506	(3.23)
Utilities			-0.085	(-1.26)
Private	0.639	(25.19)	0.083	(1.75)
Finance			-0.199	(-6.18)
Services			0.129	(2.32)
Utilities			0.021	(0.63)
Latin America dummy			0.021	(0.63)
IMF program dummy	0.337	(10.60)	-0.089	(-3.06)
Constant	-0.249	(-1.41)	5.238	(28.02)
Lambda			-0.520	(-11.55)
Number of observations			7882	
Number of Bonds			2990	

Note: z-statistics, based on robust standard errors, are presented in parentheses.

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