Bonds or Loans? On the Choice of International Debt Instrument by Emerging Market Borrowers

Galina Hale*

UC Berkeley

This version: November 14, 2001

Abstract

This paper analyzes the access of emerging market borrowers to international debt markets and specifically their decision of whether to borrow from banks or on the bond market (a decision that does not appear to have been analyzed in the literature before). This choice is modeled using a framework that focuses on the implications of asymmetric information. In this model, monitoring by banks can attenuate moral hazard. But monitoring has costs, which cause the bank loan market to dry up faster than the bond market as risk and interest rates rise (reflecting the presence of adverse selection). These are the factors that drive the borrower's decision between bank loans or bonds and that determine whether high risk borrowers can access international markets at all. The model predicts that borrowers from countries where economic and political risks are highest will not have market access. More substantively, it predicts that borrowers from countries where economic and political risks are somewhat lower will issue junk bonds, while those from countries where risks are still lower will borrow from banks, and that borrowers from the lowest risk countries will issue high-quality ("investment grade") bonds. A censored regression model with random effects, estimated using simulated maximum likelihood, supports these predictions and reveals the variables that affect the choice of debt instrument at each end of the risk spectrum.

JEL classification: C34, F34

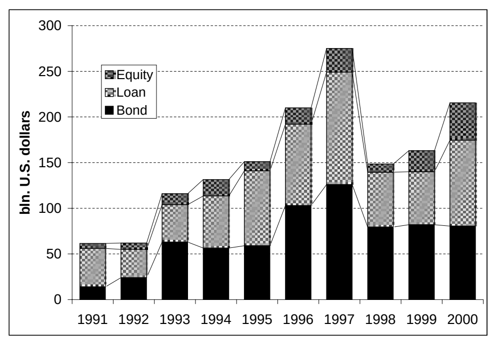
Key words: emerging markets, international debt, censored regression

*Department of Economics, UC Berkeley. Contact: galina@econ.berkeley.edu. 549 Evans Hall #3880, Berkeley, CA 94720. I am grateful to Barry Eichengreen for guidance and encouragement, to James Powell and Paul Ruud for help with econometrics. Bronwyn Hall, Chad Jones, Richard Lyons, Maury Obstfeld, David Romer, Mark Seasholes, Kenneth Train and Macroeconomics and Econometrics seminar participants at UC Berkeley provided helpful comments. Ashoka Mody, Himmat Khalsi and E.J. Kim helped with obtaining data. All errors are mine.

1 Introduction

The explosive growth of capital flows to emerging markets was one of the dominant features of the 1990s. In particular, the rapid growth of bond issuance as a source of emerging–market finance, from a standing start at the beginning of the nineties, was one of the most widely remarked upon international financial developments of the decade.[1] At the same time, the role of banks in mediating capital flows to emerging markets, the credit channel that was heavily dominant in the 1970s, did not go away. To the contrary, the Asian countries that borrowed so heavily in the period leading up to the 1997-1998 crisis relied heavily on syndicated bank loans.[2] Figure 1 displays the channels of portfolio capital flows to emerging markets since the end of the 1980s and includes borrowing by both private and public agents. It shows that the share of bonds rose from essentially zero at the start of the period to a roughly half of total portfolio capital flows to emerging markets in the mid-1990s.

Figure 1: Emerging market financing.



Clearly, bonds and loans compete in the marketplace. But why some issuers float international bonds while others borrow from international banks has received little if any systematic attention. Although both the bond market and the syndicated loan market have been treated in isolation,[3] there has been little analysis of the choice of debt instrument — of the choice between bonds and loans — and no systematic attempt to analyze the two markets in an integrated fashion.

This issue is important for a number of reasons. For one thing, it is necessary to understand the current determinants of borrowers' choice between bonds and loans in order to make educated

[1]See for example Global Development Finance (2000).

[2]See for example Goldstein (1998).

[3]On the pricing of international bonds, the literature goes as far back as Edwards (1996). On pricing and availability of international bank loans, see Eichengreen and Mody (2000).

guesses about the future importance of bank and bond finance, something that matters for planning by lenders and borrowers alike. From the point of view of policy, international capital flows mediated by banks and by the bond market pose different systemic risks. Foreign bank loans are easily liquidated; the banks extending them can cancel their loans on short notice. Hence, countries that rely on them for external finance face a greater risk of liquidity crises. Bonds, while having a longer tenor, are harder to restructure (as Argentina is finding at the time of writing), both because the number of holders of a bond issue is much larger than the number of banks in a loan syndicate, and because bonds do not typically include the sharing clauses that feature prominently in syndicated loan agreements.

To analyze these issues, I apply a theory of the firm's choice of debt instrument from the corporate finance literature to the case of emerging market debt. The model suggests that the choice of debt instrument is a function of a country's creditworthiness. In particular, as creditworthiness improves, borrowers are likely to switch from junk bonds (bonds that are associated with a high level of risk and therefore bear high risk premia) to bank loans. As creditworthiness improves further, borrowers then switch back to the bond market, this time issuing investment grade bonds, reflecting the now lower level of risk. Empirical analysis supports these predictions. In most cases, I find that changes in fundamentals that reduce a country's ability to service foreign debts lead to a larger share of junk bonds, whereas changes in fundamentals that signal overall improvement in the country's economic situation shift borrowers' preferences from bank loans to investment grade bonds.

The intuition for these results lies in the different characteristics of bonds and bank loans. Bank syndicates have a lead manager who monitors the borrower (reducing moral hazard) and takes the lead in (re–)negotiations with the borrower. Bank loans can be canceled at relatively low cost, which represents a credible threat to a borrower and therefore makes monitoring efficient. In contrast, after the launch of an international bond, bondholders have little control over the issuer's actions, since a bond issue cannot be reversed before it matures. In addition, the majority of international bonds bear a fixed interest rate, while the rates on loans are floating; and international bonds tend to bear longer maturities than syndicated bank loans. These facts suggest that banks can limit the risk of their loans and, hence, offer funds at a lower rate.

However, these advantages come at a cost. Banks bear costs not borne by bond holders. These costs include reserve and capital requirements, operating and monitoring costs. Banks pass these costs through to their borrowers. Hence, borrowers face a trade–off between lower risk premium and additional costs of bank loans as compared to bonds.

This trade–off is resolved differently for different borrowers. At the low end of the risk spectrum, borrowers do not need to be monitored. For these borrowers, the costs of financial intermediation outweigh its benefits and they choose to use the bond market, which is able to provide funds at a lower cost than banks. For moderate–risk borrowers, monitoring can be efficient in reducing the risk of a loan. The costs of financial intermediation are then outweighed by the reduction in the risk premium, which makes bank loans cheaper than bonds. For high risk borrowers, adverse selection is important. If the bank cannot significantly reduce the risk of a loan, as will be the case with the most risky borrowers, it will charge higher rates than the bond market, due to its additional costs. In a situation of asymmetric information rates become too high for the low–risk borrowers, and the market disappears due to adverse selection.[4] Critically, because of the additional costs of banking activity, the market for bank loans disappears at a lower risk level than does the bond market.[5] As a result, we expect the most and least risky borrowers to issue bonds, while those of the moderate riskiness rely primarily on bank loans. The highest risk borrowers are rationed out of the market entirely.

I begin by constructing a simple model of lending. The model describes a market that is subject to moral hazard and adverse selection. It incorporates the possibilities of monitoring and of loan cancellation.[6] The cost of debt is endogenous and depends on the distribution of borrowers' types. I extend the model to introduce the possibility of re–negotiation, and analyze the effects of past default and possible strategic default. The model predicts that the riskiest borrowers will not be able to borrow, and that high– and low–risk borrowers issue bonds while moderate–risk borrowers take out bank loans. It also predicts that the possibility of strategic default reduces total lending,

[4]For a seminal model of asymmetric information and adverse selection in the credit market, see Stiglitz and Weiss (1981).

[5]In other words, safe projects get priced out of the loan market for a larger set of cases then they get priced out of the bond market.

[6]Lenders choose whether to monitor the borrower's project. In practice, when banks do not choose to monitor, bond market can offer a lower rate.

and that the possibility of re–negotiation increases the share of bank loans in lending. The latter happens because bondholders are less well organized and have a weaker bargaining position than banks. The model also predicts that an increase in the risk–free rate reduces total borrowing and increases the share of bank loans.

I test these predictions using a data set that includes all emerging market bonds issued and loans contracted during the 1990s. Since the only borrowers that appear in the data set are those who have chosen the international debt market as a way of meeting their financing needs (as opposed to accessing the equity or domestic capital market), borrower–level analysis is subject to selection bias for which I am not able to correct at a disaggregated level. I therefore aggregate borrowers into groups by industry type, ownership sector, country and quarter. I then reconstruct observations for groups that did not borrow internationally. My dependent variables are the amount of funds raised by each group on the international bond market and the amount of funds borrowed through syndicated bank loans in each quarter, scaled by the number of companies listed in a given country in a given year. My explanatory variables include macroeconomic variables that affect credit ratings, the world risk–free interest rate, variables describing a country's level of financial development, and country–specific control variables.

With 580 groups and 36 quarters, the data are an unbalanced panel. Because the dependent variables are censored at zero, linear estimators are biased and a censored regression has to be estimated by maximum likelihood. Panel estimation of the censored regression requires multidimensional integrals to be computed. For a panel with more than three periods, simulation is necessary because numerical approximation is intractable. Simulated maximum likelihood estimation methods have been developed in the past for censored regressions. To further improve efficiency, I extend a technique proposed by Hajivassiliou and McFadden (1998) to estimate seemingly unrelated censored regressions on panel data.[7]

My main results are consistent with the predictions of the model. Less risky borrowers borrow

[7]Simulated maximum likelihood is not the only available method to estimate a panel–data tobit regressions. Lee (2001), for example, suggests a semi–parametric first–difference approach to estimating a panel censored model. This approach allows for random effects and serial correlation. It would be interesting to compare the results above to those obtained using the approach proposed by Lee. Chay and Powell (2001) suggest a number of semi–parametric techniques designed to estimate censored regression models. The issue of estimating simultaneous tobit equations has also appeared in the literature. See Morizumi (2000) for an example of the model set–up in a cross–section case.

more in total. Fundamentals that indicate potential difficulties in servicing country debt, such as a high ratio of debt service to exports, a low ratio of Central Bank reserves to short–term debt, and high inflation, reduce the share of bank loans in total borrowing. This implies that borrowers from countries with liquidity problems have to issue junk bonds to obtain international financing. An improvement in the fundamentals, such as improved political stability, faster GDP growth, less volatile exports, less foreign debt, leads to a larger share of bonds in total borrowing. This implies that borrowers from countries with improving economic and political situations switch from using the bank loan market to issuing investment grade bonds.

These findings make intuitive sense. The risks involved with lending to borrowers from countries with potentially serious liquidity problems cannot be reduced by banks. Since the risk–premium for such borrowers is high due to high country risk, adverse selection is important. For those who lend to these borrowers, macroeconomic and political stability are of second order importance, as lenders are primarily concerned with borrowers' ability to service current debt. Once liquidity problems are resolved, macroeonomic and political stability play the primary roles.

The paper proceeds as follows. In Part 2, I review the existing theoretical and empirical literature on the choice of debt instrument. Part 3 presents the basic model, several extensions and testable implications. In Part 4, I discuss the data and the empirical methodology. Results are presented in Part 5. Part 6 concludes with policy recommendations and future research.

2 Related literature

Corporate finance theory. Theories of the choice between bonds and loans have been developed in the corporate finance literature. Examples include Berlin and Loeys (1988), Diamond (1991), Bolton and Freixas (1999). The first two of these papers address the choice between bank loans and directly placed debt. They find that borrowers with the lowest credit ratings cannot obtain external financing, while those with slightly higher ratings issue bonds, those with still higher ratings borrow from banks, and those with the highest ratings issue bonds. Their intuition emphasizes a bank's trade–off between the cost of monitoring and its efficiency in reducing moral hazard. Diamond's result hinges on the fact that a good reputation induces borrowers to choose safe projects and thus eliminates the need for monitoring, while a bad reputation makes it impossible to provide incentives to ensure the choice of the safe project. In my modification of Diamond's model I show that even without differentiated reputation costs the same result holds.

Bolton and Freixas (1999) investigate the choice between equity and debt as well as the choice of debt instrument (bonds versus loans). In addressing the latter, they emphasize the greater flexibility of bank debt relative to bonds, the costs associated with banking activity (which they model as costs of raising capital to meet capital requirements), and the seniority[8] of bank loans relative to bonds. They predict that if the supply of loans is large, equity completely disappears and lower–rated firms borrow from banks, while higher–rated firms issue bonds.

Corporate finance empirics. There is a large body of empirical work on the capital structure of firms. Most papers address only the choice between internal and external finance or the choice between equity and debt. Evidence on the choice between bank loans and bonds is sparse.[9] Two papers that address the issue are Helwege and Liang (1994) and Angbazo, Mei and Saunders (1998). Helwege and Liang test a "pecking order" theory of finance on firm–level data from the United States. They find that young firms rely on bank loans and that only profitable firms with good investment opportunities issue bonds. Angbazo, Mei and Saunders study behavior of bank credit spreads. They find that loan spreads are more closely correlated with spreads on investment grade bonds than with those on junk bonds. This can indicate which instruments are relatively close substitutes for one another.

Theory and empirics of emerging market debt. A large body of literature in international finance and development studies emerging market debt. Two papers that specifically address the international bond and loan markets are Folkerts-Landau (1985) and Aerni and Junge (1998). While both offer reasons why bonds or loans dominate in different periods, neither addresses the determinants of the choice between the two debt instruments. A few studies empirically address the financing choice of emerging market borrowers as a function of macroeconomic environment,

[8] In case of bankruptcy or default, senior claimants are paid first out of any remaining firm assets.

[9] I was not able to find a paper that addresses directly the question of the choice between bonds and bank loans as a function of a borrower's creditworthiness.

including Demirguc-Kunt and Maksimovic (1996), Schmukler and Vesperoni (1999), and Domowitz, Glen, and Madhavan (2000). Demirguc-Kunt and Maksimovic analyze effect of the stock market development on the leverage and term structure of firm debt. The remaining two papers focus on the choice between domestic and international financing and the choice between equity and debt, as well as the effect of financial liberalization. Using data on primary market activity for both developed and emerging markets, Domowitz, Glen, and Madhavan show that macroeconomic stability affects financing decisions.

While all of these studies touch on issues related to the concerns of this paper, no paper, to my knowledge, specifically addresses the choice of international debt instrument by emerging market borrowers. This paper seeks to fill that gap.

3 Model

The syndicated loan market differs from the bond market in having a small number of relatively well–coordinated lenders as opposed to a large number of non–coordinated lenders. This has three implications. First, borrowers can be more easily monitored by the banks than by bondholders. Second, loans are more easily renegotiated than bonds. Third, if the borrower reveals that it does not satisfy the lender's criteria, a loan can be more easily canceled. I present a simple model that captures these facts.

3.1 Basic model

Borrowers. The population of risk-neutral borrowers includes three types: G, B and S with the following characteristics:

Type G invests in a safe project that yields gross return G with probability 1.

Type B invests in a risky project that yields gross return B with probability π, and 0 with probability $1 - \pi$.

Type S takes an unobservable action, s. $s = g$ if it invests in a safe project identical to that of type G; $s = b$ if it invests in a risky project identical to that of type B.[10]

Borrower type is not observable. Thus, banks have the same beliefs about all borrowers. The type distribution is publicly known and is given as follows: share f_G of all borrowers are type G, share f_B are type B, and share f_S are type S. f_G, f_B and f_S belong to a simplex. All borrowers are risk-neutral and maximize their expected profit. All borrowers borrow one unit of capital.[11] Borrowers have limited liability and no initial endowment, and are therefore effectively risk–loving.

Lenders. A storage technology that brings a return R with probability 1 is available to lenders. Assume that $B > G > R$ and that risky projects have a negative net present value: $\pi B < R$. For simplicity assume that lenders have abundant funds and are risk–neutral. Therefore, lenders will always accept an expected rate of return equal to R without monitoring and equal to $R + c$ with monitoring, where $c > 0$ is the cost of monitoring. This implies that the supply of funds will be perfectly elastic at the (expected) reservation interest rate, which differs depending on whether there is monitoring.

Monitoring, loan cancellation and default. Since the lender cannot distinguish between different types, it will either monitor all the borrowers or not monitor at all.[12] Monitoring is imperfect. With exogenous probability P,[13] borrowers of type S that choose $s = b$ will be caught and their loans canceled. No action is taken by the other types and therefore monitoring of borrowers of types B and G will be uninformative.[14] With probability $1 - P$, monitoring of borrowers of type S will be uninformative, as if no action were taken. This is equivalent to the results of monitoring types B and G. In the case of loan cancellation, the borrowers' monetary payoff is 0 and the lenders can still use the storage technology or lend to someone else. However, even in the case of loan cancellation, the lenders bear the cost of monitoring. Borrowers bear an exogenous fixed cost L of

[10] For simplicity, I do not consider mixed strategies for borrowers of type S.

[11] Allowing the amount of borrowing to be different across borrowers does not change the results of the model, if this amount is exogenous. Allowing it to be a choice variable is potentially an interesting modification of the model, because it can lead to a separating equilibrium.

[12] To keep the model simple, I do not allow for mixed strategies for lenders.

[13] This probability can be interpreted a measure of monitoring effectiveness.

[14] This implies that a loan to type B borrower cannot be canceled. This assumption is made to capture the fact that borrowers of type B are not subject to moral hazard.

loan cancellation due to reputation deterioration and other losses.

Monitoring occurs for two reasons. First, it can provide an incentive for borrowers of type S to choose $s = g$, which will increase the bank's expected payoff for a given rate. Second, even if it does not provide sufficient incentive, monitoring can still be profitable since the lender can cancel the share P of the risky projects undertaken by borrowers of type S, and thus increase the expected payoff.

If borrowers invest in risky projects and the return is 0, they default on their loans. In this case the monetary payoff to both parties is 0. In addition, borrowers bear an exogenous fixed cost D of default, $D > L$.[15] All variables except for the borrower's type, action, and payoff are common knowledge.

Rates. The timing of actions is as follows. Borrowers offer a take-it-or-leave-it contract that specifies r, the gross return they are willing to pay. Lenders accept or reject the contract and choose whether or not to monitor. Borrowers of type S then choose their action.

Given these assumptions, there is no signaling or other motive for borrowers to offer a rate above the minimum that lenders will accept. Borrowers with safe projects are not able to offer the rate above the maximum profitable rate that the borrowers with risky projects can offer. Thus, borrowers with safe projects are not able to signal their type, because they are not able to separate themselves from the borrowers that have or choose risky projects. Since borrowers with risky projects are not willing to signal their type, all borrowers offer the same rate. If we assume that lenders are rational (i.e., given their information they can infer which action would be chosen by type S), we can derive the minimum gross rates of return that will be accepted by the lenders.[16]

[15] An interpretation of this condition is that in case of loan cancellation, a borrower's reputation worsens within the bank syndicate but not beyond, whereas in case of default a borrower's reputation worsens everywhere. A no-reputation cost interpretation is also possible: in the case of loan cancellation, the cost to a lender is c, which is significantly less then the amount of the loan, and thus the lender's incentive to take "revenge" steps is much smaller then in the case of default, where the cost to a lender is equal to r. An additional constraint on parameters needs to be imposed for risky projects to occur. Namely, the cost of default, D, should not be too high given B and π: $D < \frac{\pi(B-r)}{1-\pi}$.

[16] All formulas are derived in Appendix 1.

	Type S chooses safe project $s = g$	Type S chooses risky project $s = b$
Lender chooses not to monitor	Case 1. $r_1 = \frac{R}{1-(1-\pi)f_B}$	Case 3. $r_3 = \frac{R}{\pi+(1-\pi)f_G}$
Lender chooses to monitor	Case 2. $r_2 = \frac{R+C}{1-(1-\pi)f_B}$	Case 4. $r_4 = \frac{R-PR(1-f_G-f_B)+C}{\pi(1-P)+(1-\pi(1-P))f_G+\pi P f_B}$

If the rate offered by a borrower is higher than G, then lenders can infer that there will be no investment in safe projects. Since we have assumed that $\pi B < R$, no lending will occur. Therefore for lending to take place all rates should not exceed G, which leads to the following set of constraints:

$$f_B \leq \frac{1}{1-\pi}\left(1 - \frac{R}{G}\right) \tag{1}$$

$$f_B \leq \frac{1}{1-\pi}\left(1 - \frac{R+C}{G}\right) \tag{2}$$

$$f_G \geq 1 - \frac{G-R}{(1-\pi)G} \tag{3}$$

$$f_G \geq 1 - \frac{G-R-C}{(1-\pi)G - P(R-\pi G)} + \frac{P(R-\pi G)f_B}{(1-\pi)G - P(R-\pi G)}. \tag{4}$$

Choice of project by the borrowers of type S. Borrowers of type S will prefer $s = g$ to $s = b$ without being monitored if and only if their return from the safe project is at least as high as the expected return from the risky project minus the expected cost of default:

$$(G - r_1) \geq \pi(B - r_1) - (1-\pi)D.$$

We can substitute for r_1 to find that this is equivalent to

$$f_B \leq \frac{1}{1-\pi} - \frac{R}{(1-\pi)D + (G - \pi B)}. \tag{5}$$

This implies that if the share of borrowers of type B is sufficiently low, the interest rate r_1 is low enough for borrowers of type S to prefer safe projects even without monitoring. Since monitoring is costly, it will not occur unless borrowers of type S would choose risky projects in the absence of monitoring. If condition (5) is satisfied and $f_S > 0$, the rate r_1 will be small, and monitoring will never be needed.

Borrowers of type S will choose $s = g$ when monitored if the expected return from the safe project is at least as high as the expected return from the risky project minus the expected cost of default or loan cancellation.

$$(G - r_2) \geq -PL + (1-P)[\pi(B - r_2) - (1-\pi)D],$$

which is equivalent to

$$f_B \leq \frac{1}{1-\pi} - \frac{(1-\pi(1-P))(R+C)}{(1-\pi)[Z + G - \pi(1-P)B]}, \tag{6}$$

where $Z \equiv PL + (1-P)(1-\pi)D$ and can be interpreted as a cost of "failure" in case of monitoring. If the share of borrowers of type B is too high, the lowest rate the bank will accept with monitoring is too high to induce borrowers of type S to prefer the safe project even though they are monitored.

Choice by the lenders whether or not to monitor. For lenders to be willing to monitor, it is necessary that monitoring is needed (condition (5) is violated).[17] Monitoring will then occur in two situations:

A. Monitoring provides incentives for borrowers to choose the safe project that they would not have chosen were they not monitored. In other words, borrowers when monitored choose $s = g$, as

[17] In other words, without monitoring, borrowers of type S would choose risky project.

determined by condition (6). Monitoring will then occur if the expected benefit from monitoring is greater then its cost,[18] which holds if

$$f_G + \frac{R}{R+C} f_B \leq 1 - \frac{C}{(R+C)(1-\pi)}. \tag{7}$$

Intuitively, if the share of type S borrowers is too low, the benefit from monitoring will be small, since there is no benefit from monitoring types G and B. The higher the cost of monitoring, the larger is the share of borrowers of type S needed in order for monitoring to occur.

B. Monitoring does not provide incentives for borrowers to choose safe projects, but lenders can still cancel the loan. Lenders will choose to monitor because this allows them to cancel the share P of risky projects, thus increasing the probability of being repaid. For monitoring to occur it is necessary that the benefit from this increase be higher than the cost of monitoring,

$$f_B \leq 1 - f_G - \frac{C}{RP} - \frac{C}{RP} \frac{\pi}{(1-\pi) f_G}. \tag{8}$$

Again, the share of borrowers of type S must be high enough in order for monitoring to be profitable.

Case 3, when borrowers choose risky projects and lenders choose to not monitor, will occur in two situations: if monitoring is needed and provides incentives for borrowers to choose $s = g$ but is too costly; or if monitoring is needed, does not provide incentives for borrowers, and is too costly (relative to its efficiency P) to be used to increase the repayment probability.

The implications of the model are summarized in the propositions below.

Proposition 1 *Given the distribution of borrower types, monitoring is more likely if:*

- *the difference between the returns, $B - G$, is higher;*
- *the risk–free rate, R, is higher;*
- *the probability of success of the risky project, π, is higher;*
- *the efficiency of monitoring, P, is higher and the cost of monitoring, C, is lower;*

[18] The expected benefit from monitoring is the increase in the probability of being repaid multiplied by the amount to be repaid and is equal to $[(1-(1-\pi)f_B) - (\pi + (1-\pi)f_G)]r$ in this case.

— *the cost of default, D, is lower and the cost of loan cancellation, L, is higher.*

Proof. See Appendix 1.

Proposition 2 *Given the distribution of borrower types, the set of cases in which lending occurs will be larger if:*

— *the difference between the returns, $B - G$, is lower;*

— *the risk–free rate, R, is lower;*

— *the probability of success of the risky project, π, is higher;*

— *the efficiency of monitoring, P, is higher and the cost of monitoring, C, is lower;*

— *the cost of default, D, and the cost of loan cancellation, L, are higher.*

Proof. See Appendix 1.

Intuition. A larger differential between the return on the risky project in the good state and the return on the safe project increases moral hazard for borrowers and thus increases the need for monitoring. At the same time, it reduces the set of borrowers who can borrow, because a higher share of risky projects raises the interest rate, reducing the set of potentially profitable projects.

If the risk–free interest rate rises, the total amount of risky lending falls. Monitoring is more likely if the risk–free rate is high, since r_1 increases and therefore fewer borrowers are willing to choose safe projects without monitoring.

A higher probability of success for risky projects makes lending "safer" and thus increases its total amount. It also increases moral hazard and thus makes monitoring more likely.

An increase in the cost or a decline in the efficiency of monitoring reduces net benefit from monitoring and so monitoring is less likely to occur. As some borrowers can only borrow if they are monitored, the total volume of lending falls.

A higher cost of default makes risky projects less attractive. This reduces the need for monitoring and raises total lending.[19] A higher cost of loan cancellation increases the set of cases in which monitoring provides incentives to borrowers to choose safe projects. This raises the amount of both monitoring and total lending.

Proposition 3 *The distribution of borrower types affects lending and monitoring in the following way:*

— *if the share of borrowers of type B is high, overall lending is less;*
— *monitoring does not occur if the share of borrowers of type B is very high or very low;*
— *monitoring is more likely if the share of type S borrowers is high.*

Proof. See Appendix 1.

If only a few borrowers are subject to moral hazard, there is less benefit from monitoring, and thus monitoring is less likely to occur. At the same time, if there are just a few borrowers of type B, interest rates will be low if borrowers of type S choose safe projects. This too will reduce the need for monitoring.

In contrast, if the share of borrowers of type B is high and the borrowers of type S choose risky projects, interest rates will exceed the return on a safe project and thus no lending will occur.

3.2 Extensions

Lender's monopoly power. The model assumes that lenders are perfectly competitive. This may not capture the reality of the loan market. Introducing a monopolistic lender will change the model's basic results, since a monopolist would be able to offer a menu of contracts to borrowers and thus potentially learn their types. Two considerations suggest that a competitive framework is a more appropriate way of characterizing lending to emerging markets. First, the share of loans to emerging market borrowers in the total lending of international banks is not very large. In December 2000, the emerging market share of the Bank for International Settlements reporting

[19] This result is consistent with the one found by Dooley (2000). His model, where the default costs are necessary as an incentive for repayment, predicts that lending might in fact be reduced to zero if the cost of default is small.

banks cross–border claims was 8.4%,[20] suggesting that they could increase lending to emerging markets should it become more profitable. Second, international bank lending is syndicated, which means that the lead manager that is negotiating the loan does not disburse the full amount of the loan but involves other banks. Both factors indicate that the banks that lend to emerging markets can increase the amount they lend. As long as the banks do not collude, the funds for international syndicated bank lending to emerging markets are elastic — if some banks try to charge rates that are too high, other banks will be able to switch their assets from other markets and undercut those rates.

Dynamics. The preceding model utilized a simple one–period framework. Dynamics change the implications of the model.[21] Here I limit my discussion to two extensions.

Borrowers who default reveal that they are not of type G.[22] For those borrowers, the model can be applied with $f_G = 0$. It is straightforward to show that the borrowers who have defaulted are more likely to be monitored. Although the set of cases in which no lending occurs is larger for those who have defaulted, not all borrowers that have defaulted will be rationed out of capital markets.[23]

In a dynamic setting, the cost of default is endogenous. In particular, the better is the reputation of the borrower, the more costly default becomes. This consideration can be introduced by assuming, for example, that D is a function of f_B with $D'(f_B) < 0$. This does not affect the propositions formulated above, but does reduce total lending and the amount of monitoring. There is less monitoring because it is almost impossible to provide an incentive for borrowers of type S to choose a safe project if f_B is high, and it is easier for borrowers to choose a safe project even without monitoring if f_B is low. Both of these changes reduce the set of cases in which monitoring occurs.

[20]This amount includes inter–bank loans and loans to businesses other than banks and securities. For each of these categories, the share of emerging markets is about the same. For the data, see BIS Quarterly Review, June 2001, table 2.1, p.13.

[21]The borrowers are able to build reputation over time and thus either the distribution of borrower types changes over time, or the borrowers are heterogeneous, drawn from different distributions. Diamond (1991) largely focuses on the dynamics of the model by endogenizing cost of default and loan cancellation.

[22]The borrowers that had their loans cancelled are revealed to be of type S to the lender. However, while defaults are common knowledge, cancellation of a loan can be a private matter between the lender and the borrower, and so not observed by other market players. Thus, in order to formulate testable predictions of the model, we need to consider the effects of past defaults, but not the effects of past loan cancellations.

[23]One technical question that arises, is how many years are needed for a default to be forgiven. The model implies an indefinite effect of a past default. We know, however, that this is not the case in practice. Empirically determining the time pattern of the effects of the past default is a subject of my future research.

Possibility of re–contracting. If the payoff from the risky project in a bad state of nature is strictly positive (even if very small), there may be gains to both parties from re–contracting.

Suppose that the risky project was financed and has ended in a bad state that brings a return b, $0 < b < r$. Since the cost of default is fixed and does not depend on the size of debt outstanding, there is no incentive for the borrowers to return b and default. Therefore borrowers prefer to keep b and bear the cost of default, leaving lenders with 0. Default, as before, does not reveal the borrower's type, because the above is true for both B and S type borrowers.

If there is a possibility of re–contracting with banks and if b is sufficiently low, borrowers may prefer not to publicize the default, and banks may prefer to receive b rather than 0. Both B and S types have an incentive to re–negotiate; therefore the banks know that the type of borrowers they are dealing with is "not G", which, if revealed to other lenders, is equivalent to default for the borrowers in terms of their reputation. However, if re–contracting can be kept private, borrowers avoid reputation costs.

This possibility increases banks' but not bondholders' expected return and also increases moral hazard for borrowers who borrow from banks. This raises the profitability of monitoring but reduces the set of borrowers for whom monitoring provides incentives. Thus, the possibility of re–contracting increases monitoring and reduces the total amount of lending due to increased moral hazard.

Strategic default. If the reason for default is unobservable, then liquidity default in a bad state of nature and strategic default have the same cost D.[24] Borrowers will then choose to repay their debt if and only if

$$D \geq r_i \ , \ \text{where} \quad i = 1,\ 2,\ 3,\ 4,$$

[24]Liquidity default is due to inability to repay the debt, strategic default occurs when a borrower can repay its debt but chooses not to.

which is equivalent to the following set of constraints:

$$f_B < \frac{1}{1-\pi}\left(1-\frac{R}{D}\right), \tag{9}$$

$$f_G > 1-\frac{D-R}{(1-\pi)D}, \tag{10}$$

$$f_B < \frac{1}{1-\pi}\left(1-\frac{(R+C)}{D}\right), \tag{11}$$

$$f_G < 1-\frac{D-(R+C)}{(1-\pi)D-P(R-\pi D)}+\frac{PR-D\pi P}{(1-\pi)D-P(R-\pi D)}f_B. \tag{12}$$

These constraints bind if $D < \frac{1}{\pi}R$ and $D < G$. These conditions are stronger than conditions (3), (4) and (6), which implies that the set of cases in which lending occurs is smaller if strategic default is allowed. Although the set of constraints that leads to different cases is changed, Propositions 1-3 still hold for the sovereigns as shown in Appendix 1.

There is also a possibility of renegotiation in this case. Banks will accept any payment above 0 in exchange for not announcing a default, while a borrower of any type would be willing to accept any interest rate below D and not default. This will relax constraints (11) and (12) and increase the set of cases in which lending will occur as well as increase the share of bank lending. Monitoring will also be more likely if we assume that monitoring allows lenders to determine the reason for default with some probability and therefore prevent a fraction of strategic defaults.

3.3 Caveats

In the model, I focus on the lender's decision of whether or not to monitor. If monitoring is not profitable, then lending will take the form of bonds: the bond market can offer a lower rate than banks because banks have additional costs.[25] In addition, I model the bank syndicate as a single

[25] These additional costs are referred to as costs of monitoring, but can be interpreted more broadly as including operating costs, costs of raising equity to meet capital requirements, reserve requirements, and so on.

actor. This is justified because the borrower deals with one bank (the lead manager) that monitors and renegotiates, while the other banks in the syndicate only contribute funds.

I assume that there is a fixed distribution of borrower types. This is not true in practice — banks form their beliefs about a borrower's type based on a borrower's reputation and other characteristics. The model can still be applicable, however, if we assume that banks face several sets of borrowers with different type distributions, and, based on signals (such as credit rating or default history) decide what distribution a particular borrower is from. This interpretation allows me to test indirectly the results of Proposition 3.

3.4 Testable implications and explanatory variables

Several testable implications can be derived from the model. If a borrower is drawn from a distribution with lower risk (lower share of type B borrowers), lending is more likely to occur. Borrowers from a very low risk distribution (very low share of type B borrowers) borrow mostly on the bond market. Borrowers from a distribution with moderate risk are more likely to take out loans, while borrowers drawn from a distribution with higher risk are likely to issue junk bonds. The most risky borrowers will not be able to borrow at all. The relationship between the risk level and the debt instrument is illustrated in Figure 2.

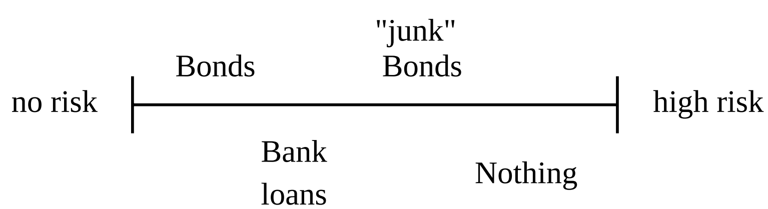


Figure 2: Risk and debt instrument

How risky a borrower is can be measured by, inter alia, its credit rating. But the credit rating is a function of macroeconomic variables that I would like to use as explanatory variables. Since I am interested in the total effect of macroeconomic variables on borrowing decisions, and not just the direct effects for a given credit rating, I use a credit rating residual (purged of the effects of the obvious macroeconomic variables) as an explanatory variable, as described in Appendix 2.[26]

[26]Individual borrowers' credit ratings are available only for a small subset of the borrowers and therefore cannot

There are several additional straightforward empirical implications:

- If a borrower has a history of debt rescheduling, he will borrow less and have larger share of bank debt.[27]
- If a country's banking sector is better developed, making it cheaper for foreign banks to access and monitor borrowers, the "cost of monitoring" will be correspondingly less. I use the ratio of domestic credit to GDP to measure the development of the domestic banking system.
- Strategic default is more likely for sovereigns than private borrowers because of sovereign immunity. As a result, sovereigns are likely to borrow less than private borrowers. To control for this, I include a dummy variable indicating whether the borrower is from the private sector.[28]
- A higher opportunity cost of lending will reduce total lending but raise the share of bank loans. I use the 3-year US Treasury bond rate to proxy for the opportunity cost of lending. Since bank loans and bonds in practice have different maturities, I include the difference between long–term and short–term rates[29] to account for potential differences in the interest rate dynamics between shorter and longer maturities.

In addition, I include a dummy variable for whether a country had Brady–type deals in the past.[30] Brady deals create the infrastructure for international bond issuance; I therefore expect them to increase the share of bonds in total international borrowing.

---

be used — I use each country's credit rating as a proxy. Since additional variance is introduced by using a residual, the standard errors need to be corrected for the variables that affect credit ratings.

[27]Since I do not have data on the history of individual borrowers' defaults, I construct a variable for each country that is equal to one if a country had debt rescheduling in the past, and zero if it never rescheduled. Over the time span of my data, this variable switched from zero to one for some countries.

[28]I also estimate the model separately for different ownership sectors.

[29]I refer to this variable in the rest of the paper as yield curve. It is calculated as a ratio of 10-year to 1-year US Treasury bond rates.

[30]Brady–type deals convert delinquent bank loans into bonds that are collaterized by the US Treasury bonds.

4 Data and Empirical Methodology

4.1 Data

The data consist of the Capital Data Bondware and Loanware data sets combined with the macroeconomic variables from IMF and World Bank publications, credit ratings from Institutional Investor, external debt data from the Bank for International Settlements, Global Financial Data on the size of markets, and daily US interest rate series provided by the Federal Reserve Board. These data span 1991 to 1999 and 75 non-OECD countries.[31] I create the variables for debt rescheduling and Brady deals from IMF publications. The macroeconomic data are quarterly while bond and loan data consist of all primary international bond issues and all international syndicated bank loans during the 1990s.[32]

The bond and loan data are summarized in Tables 1 and 2. Note that East Asian borrowers rely mostly on bank loans, while Latin American borrowers rely primarily on bonds. This is consistent with the model's predictions — East Asian borrowers were viewed by investors as relatively low–risk before the Asian crisis. Note also the increase in the number and volume of bond issues and loan contracts throughout the 1990s and how it was interrupted by the financial crises of 1995 and 1997.

The data set only includes borrowers who have chosen the international debt market (bonds or bank loans) as a way of raising money. Clearly, each borrower faces more choices than are present in my data set — such as issuing equity or borrowing domestically. In addition, some borrowers may not borrow at all in a given period. Figure 3 shows a complete choice set. If these possibilities are left out of the choice set, the estimated coefficients will be biased. In particular, if an explanatory variable that affects choice between a bond and a loan also reduces the probability that the borrower will choose international debt as a way of raising money, the coefficient on this variable in a binary probit model will be biased upwards. Thus, we will not be able to determine reliably whether a variable affects the choice between a bond and a loan.

[31] In most estimations only 58 countries are included as the rest drop out due to missing explanatory variables.

[32] A complete data description is presented in Appendix 3.

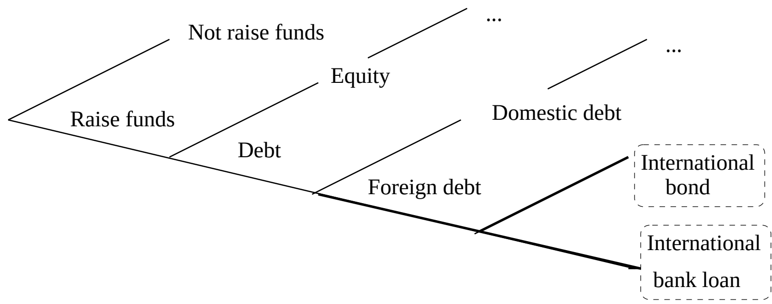


Figure 3: Complete set of borrower's choices

4.2 Data Transformation

Since I do not have information about firms, banks and governments that did not borrow internationally, I am unable to estimate the individual–level determinants of the choice of debt instrument. I therefore aggregate the borrowers into groups by quarter, country, ownership sector, and industry.[33] I then reconstruct observations for groups that did not borrow internationally. This produces a balanced panel of 580 "borrowers" over 36 quarters.[34] As shown on Figure 4, the aggregated data allow us to observe the choices of the aggregated borrowers, and to estimate the effect of group–level determinants of the choice of debt instrument.[35]

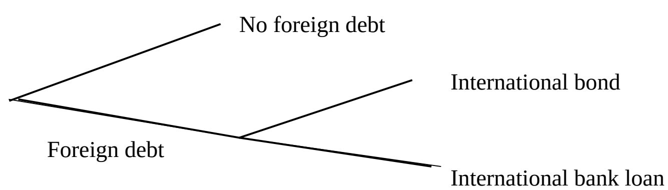


Figure 4: Observed set of borrower's choices

[33]An ownership sector is defined as sovereign, other public, or private; industries are combined into 5 large groups: manufacturing, finance, services, utilities and infrastructure, and government services. Sovereigns only own borrowers in government industry. Borrowers in other industries are either privately or publicly owned, except for the borrowers in government industry; these cannot be private.

[34]By doing this I implicitly assume that lenders view all borrowers from the same country, sector, and industry as indistinguishable.

[35]Since the explanatory variables of interest are country–level, I do not lose much information by aggregating the data.

Aggregating the data at the group rather than country level allows me to include different fixed or random effects for different ownership sectors and industries.

For each group I calculate the total amount borrowed internationally from banks, y_1, and the total amount borrowed internationally on bond markets, y_2. Since the amount borrowed depends on the number of firms in the market, I scale the amount for each group by the number of firms listed in a given country.[36] I estimate the following reduced–form model:

$$y_{1ijkt} = \alpha_{ijk} + \beta x_{it} + \gamma t + \delta_j + \delta_k + \varepsilon_{ijkt},$$

$$y_{2ijkt} = \alpha_{ijk} + \beta x_{it} + \gamma t + \delta_j + \delta_k + \varepsilon_{ijkt},$$

where i is country, j is industry, k is ownership sector and t is time. α_{ijk} is random effect, x_{it} are macroeconomic variables, δ_j and δ_k are industry and ownership sector fixed effects. Appendix 3 lists my 58 countries, the number of observations, loan contracts and bond issues for each country. Due to missing explanatory variables, the estimated panel is unbalanced.

4.3 Estimation methodology

Since both dependent variables are censored at zero, the structure of the model for the cross–section specification is:

$$y_1^* = X\beta_1 + \varepsilon_1,$$

$$y_2^* = X\beta_2 + \varepsilon_2,$$

$$y_1 = \max\{y_1^*, 0\},$$

[36]This choice of scaling takes into account both the size of the country and its exposure to the international capital markets. For example, India is a larger country than Thailand, but is not necessarily a larger borrower. Because the number of companies listed is highly correlated with population size and with GDP expressed in the U.S. dollars, the choice of scaling should not have a large effect on the empirical results.

$$y_2 = \max\{y_2^*, 0\},$$

$$\begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_1^2 & \tau\sigma_1\sigma_2 \\ \tau\sigma_1\sigma_2 & \sigma_2^2 \end{pmatrix}\right].$$

While this system can be estimated simultaneously by maximum likelihood, the estimates will be consistent even if we estimate the two equations separately (imposing that $\tau = 0$). The likelihood function for the single tobit regression in the pooled setting (cross–section) is fairly simple. For each observation i

$$l_i = \mathbf{1}(y_i^* \geq 0)\left[-\frac{1}{2}\left(\ln 2\pi + \ln \sigma^2 + \frac{(y_i - X_i\beta)^2}{\sigma^2}\right)\right] + (1 - \mathbf{1}(y_i^* \geq 0)) \ln\left[1 - \Phi\left(\frac{X_i\beta}{\sigma}\right)\right].$$

The first term is a normal probability density function, while the second term is a normal cumulative distribution function that does not have a closed–form solution, although in the univariate case it can be easily approximated numerically.

Imposing $\tau = 0$ leads to a loss of efficiency and incorrect standard errors. Robust standard errors can be calculated, or the system of equations can be estimated simultaneously to obtain correct standard errors and improve efficiency. The likelihood function above can be rewritten for two equations in the cross–section case. For each observation i, it is

$$\begin{aligned} l_i &= \mathbf{1}(y_{1i}^* \geq 0, y_{2i}^* \geq 0)\left[-\frac{1}{2}(\ln 2\pi + \ln\det(\Omega) + \left(\begin{pmatrix} y_{1i} \\ y_{2i} \end{pmatrix} - \begin{pmatrix} X_i\beta_1 \\ X_i\beta_2 \end{pmatrix}\right)' \Omega^{-1} \left(\begin{pmatrix} y_{1i} \\ y_{2i} \end{pmatrix} - \begin{pmatrix} X_i\beta_1 \\ X_i\beta_2 \end{pmatrix}\right)\right] \\ &+ \mathbf{1}(y_{1i}^* \geq 0, y_{1i}^* < 0)\left[-\frac{1}{2}\left(\ln 2\pi + \ln \sigma_1^2 + \frac{(y_{1i} - X_i\beta_1)^2}{\sigma_1^2}\right) + \ln \Phi\left(\frac{1/\sigma_2(-X_i\beta_2) + \tau/\sigma_1(y_{1i} - X_i\beta_1)}{\sqrt{1-\tau^2}}\right)\right] \\ &+ \mathbf{1}(y_{1i}^* < 0, y_{1i}^* \geq 0)\left[-\frac{1}{2}\left(\ln 2\pi + \ln \sigma_2^2 + \frac{(y_{2i} - X_i\beta_2)^2}{\sigma_2^2}\right) + \ln \Phi\left(\frac{1/\sigma_1(-X_i\beta_1) + \tau/\sigma_2(y_{2i} - X_i\beta_2)}{\sqrt{1-\tau^2}}\right)\right] \\ &+ \mathbf{1}(y_{1i}^* < 0, y_{1i}^* < 0) \ln \Phi_2\left(\frac{-X_i\beta_1}{\sigma_1}, \frac{-X_i\beta_2}{\sigma_2}, \tau\right), \end{aligned}$$

where $\Omega = \begin{pmatrix} \sigma_1^2 & \tau\sigma_1\sigma_2 \\ \tau\sigma_1\sigma_2 & \sigma_2^2 \end{pmatrix}$ and Φ_2 is a bi–variate normal cdf that can be approximated numerically. The second and third terms represent the sum of the the marginal pdf and the conditional cdf.

Efficiency can be further improved if we take into account the panel structure of the data and allow for fixed effects and (potentially) for serial correlation in the errors.

For each equation in the panel setting, each "observation" is a sequence of y_i's over time for each borrower. If we denote the set of times when $y_{it} = 0$ as I and the set of times when $y_{it} > 0$ as J, we can write the likelihood function for each observation as

$$l_i = \ln \int_{y_I^* \leq 0} n(y_I^* - X_I\beta, y_J - X_J\beta, \Omega) dy_I^*,$$

where n is the joint normal density that can be expressed as a product of the marginal and the conditional density in the following way[37]

$$n(y_I^* - X_I\beta, y_J - X_J\beta, \Omega) = n(y_J - X_J\beta, \Omega_{JJ}) n(y_I^* - \mu_I, \tilde{\Omega}_{II}),$$

where

$$\mu_I = E(y_I^*|y_J) = X_I\beta + \Omega_{IJ}\Omega_{JJ}^{-1}(y_J - X_J\beta),$$

and

$$\tilde{\Omega}_{II} = \Omega_{II} - \Omega_{IJ}\Omega_{JJ}^{-1}\Omega_{IJ}'.$$

The integral can then be split into two parts, the first of which integrates out as a joint normal pdf and can be calculated analytically, and the second of which is the joint probability that all components of y_I^* are non-positive. The second component (a multinomial analogue to the conditional cdf in the bi–variate case described above) cannot be calculated analytically or numerically for $T > 3$ and therefore has to be simulated as described below.

The full matrix Ω cannot be identified. I therefore parameterize Ω to allow for random effects with

[37] This follows closely Hajivassiliou and McFadden (1998).

AR(1),

$$\Omega = \sigma_a^2 J_T + \underbrace{\begin{pmatrix} 1 & \rho & \rho^2 & \dots & \rho^{T-1} \\ \rho & 1 & \dots & \dots & \dots \\ \vdots & & & \ddots & \\ \rho^{T-1} & \dots & \dots & \dots & 1 \end{pmatrix}}_{P_T}(1-\sigma_a^2)$$

where J_T is the $T \times T$ matrix of ones, the AR(1) coefficient $|\rho| < 1$ and the variance of the random effect $0 \leq \sigma_a^2 < 1$.[38] This parameterization allows for random effects and the AR(1) structure of the error term.[39]

A final step to improve efficiency would be to estimate simultaneously two panel tobit regressions. A system of two seemingly unrelated tobit equations[40] can be estimated using an extension to the method described above. For each individual we have $2T$ observations. We are interested in the probability of observing a particular combination of the dependent variables. Technically, this is not different from the single equation panel case.

Suppose the dependent variables for individual i are y_{1it} and y_{2it}, which can be written in vector form as y_{1i} and y_{2i} (each vector is T-dimensional). We can stack those vectors to obtain a single vector y_i of dependent variable for an individual. y_i then has the mean $X_i\beta$:

$$y_i = \begin{pmatrix} y_{1i1} \\ \vdots \\ y_{1iT} \\ y_{2i1} \\ \vdots \\ y_{2iT} \end{pmatrix}; \quad X_i\beta = \begin{pmatrix} x_{i1}\beta_1 \\ \vdots \\ x_{iT}\beta_1 \\ x_{i1}\beta_2 \\ \vdots \\ x_{iT}\beta_2 \end{pmatrix},$$

where $X_i\beta$ is a $2T \times 1$ vector of explanatory variables listed twice and multiplied by the vectors of parameters of two different equations.

Assume that the errors of the two equations are only contemporaneously correlated with correlation

[38] The overall variance and the variance of a random effect cannot both be identified, thus the normalization. See Hajivassiliou and Ruud (1994).

[39] This technique has not been used much in the economics literature. Two papers that I am aware of that apply this methodology are Hajivassiliou (1994) and Dong, Chung, Schmit and Kaiser (2001).

[40] I use this term to describe the model with two tobit equations that are independent with possibly the same set of explanatory variables and with correlated error terms.

coefficient τ. Then the variance-covariance matrix Ω_2 of y_i can be represented by the following partitioned matrix

$$\Omega_2 = \begin{pmatrix} \Omega_{11} & \tau P_T \\ \tau P_T & \Omega_{22} \end{pmatrix},$$

where Ω_{11} and Ω_{22} are the variance–covariance matrixes for each equation with the same AR(1) coefficient but with possibly different variances of the random effect.

Specified in this way, the model can be estimated using the same procedure as the single-equation panel tobit. It can also be extended to more than two seemingly unrelated tobit equations. Notice that this approach does not require a panel–data specification; it can be used for multiple seemingly unrelated tobit regressions in a cross–section setting. (The results of this estimation will be available in forthcoming version of this paper.)

4.4 Simulation

A number of simulators have been developed for multinomial joint probability. Hajivassiliou, McFadden, and Ruud (1996) show that computationally the Geweke-Hajivassiliou-Keane simulator has the best performance for a given number of draws.[41] The GHK simulator allows one to draw from the conditional distribution in a recursive manner, thus avoiding the need for a large number of draws in order to generate an accepted sequence. This property is especially important in a panel data setting with many periods.[42] In addition, GHK is vectorizable and thus can be programmed efficiently in matrix–oriented software like GAUSS.[43] Finally, GHK is a smooth simulator and thus allows for relatively easy convergence of the likelihood function to its maximum.

Since the log–likelihood function is non–linear in simulated probabilities, simulated maximum likelihood estimation introduces a simulation bias that asymptotically disappears as the number of draws increases. Hence, the computational performance of the method is quite important.

[41] A very good presentation of GHK simulator can be found in Hajivassiliou (1994).

[42] See Keane (1994).

[43] I used the GHK simulator provided on the web site econ.lse.ac.uk/∼vassilis. I am grateful to the authors for making the code publicly available.

5 Empirical Results

5.1 Full sample analysis

The results for the full sample are in Tables 3–5. Standard errors are corrected for the use of the credit rating residual. Robust standard errors are calculated.

Most results are consistent with the predictions of the model and are robust across specifications. A couple of results change, however, when I allow for random effects and add a time effect. Since the random–effect specification that also allows for time changes is most likely to be free of spurious correlation, I use the results presented in Table 5 in the discussion that follows. The results are robust to including other fixed effects and other explanatory variables. Using GDP measured in US dollars or population instead of the number of the firms listed does not affect the results. The semi–parametric analysis is still to be conducted. The results of robustness tests are not shown but are available from the author on request.

Creditworthiness, access to capital markets, and the choice of debt instrument. Borrowers from countries that are more risky (as measured by a lower credit rating residual, a lower rate of GDP growth, more variable exports, a higher ratio of foreign debt to GNP, and a higher inflation rate) borrow less. These findings support my emphasis on asymmetric information. In a world with no asymmetric information and risk–neutral lenders, there is no reason for the amount of lending to depend on risk — the risk premium would simply adjust to compensate lenders. Thus, the observed negative correlation between empirical proxies for risk and the amount of lending points to the importance of adverse selection. The market disappears as risk and interest rates rise because low–risk borrowers, who cannot signal their type, are priced out of the market.

The importance of adverse selection is confirmed by another finding. Borrowers from countries with a high debt–service–to–export ratio, high inflation, and a low ratio of reserves to short term debt are more likely to borrow on the bond market. All of these variables are signals of potential liquidity problems. A high ratio of debt service to exports combined with small foreign reserves may make it necessary for a country to keep borrowing in order to service its debt. Indeed, we observe that high debt service and low reserves increase total foreign borrowing. High inflation indicates that the government finds it difficult to borrow domestically or to meet its financial obligations in other ways. Hence, lending to the government or firms of such country is viewed as very risky. In a situation where the liquidity of a country is questionable, banks, even by monitoring individual loans, cannot do much to reduce their risk. The additional costs associated with banking then make it cheaper for the borrowers to borrow on the bond market. Thus, we observe a larger share of bonds.

I also find support for the theoretical prediction that if adverse selection is not an issue, riskier borrowers tend to borrow from banks. Borrowers from countries with more political stability, a higher rates of GDP growth, less volatile exports, and a lower ratios of foreign debt to GDP are more likely to issue bonds. All these variables are signals of economic stability and sustainable economic policies. As these fundamentals improve, the advantages of bank lending relative to bonds diminishes, because lending to the borrowers in these countries becomes less and less risky. Thus, borrowers switch from bank loans to investment grade bonds.

Other results. Several further empirical results are also consistent with the model. Private borrowers borrow more, which supports the conjecture that sovereigns are more prone to strategic default and therefore, other things being equal, have less access to international capital.

Borrowers from countries with better developed financial markets and institutions, as measured by the ratio of domestic credit to GDP, borrow more in total and relatively more from banks. This is expected — as the domestic financial system develops, the costs for banks of lending in such a country decrease. For example, bank syndicates can delegate monitoring to domestic banks, thereby reducing the cost of monitoring.

As expected, having a history of Brady deals increases bond issuance and does not borrowing from the banks. A history of debt rescheduling increases the share of bank loans. This is consistent with the model's predictions. A puzzling result is that a history of default increases total lending.[44]

Finally, a rise in the risk–free rate tends to increase both bond issuance and the amount of bank

[44] Some reverse causality here is possible — those that always borrow more tend to default more.

lending, although the latter to a lesser extent. This is the opposite of what is expected based on the model's predictions and is therefore puzzling. It may be that this result is due to substitution between equity and debt. Bekaert and Harvey (1998) show that as world interest rates decline, equity flows to emerging markets increase and thus the use of both debt instruments declines.

The difference between long–term and short–term interest rates (the yield curve) has been declining throughout the 1990s. Thus, only the results of the regression with time effects represent the true effect of changes in the yield curve and not the spurious correlation due to time trend. A steeper yield curve reduces bank lending and increases bond issuance. This is also a somewhat puzzling result as most loans are of a shorter maturity and thus are likely to be cheaper if interest rates are expected to rise. A more detailed analysis of the relationship between the yield curve and lending to emerging markets is necessary to understand these results.

5.2 Sub–samples by ownership sector

Tables 6 and 7 present the results of the regressions for the ownership sub–samples as robustness checks. The results are largely the same as for the full sample, although a few differences are worth noting.

As expected, a higher ratio of debt service to exports increases sovereign borrowing by more than it increases the borrowing of the other sectors, especially their borrowing on the bond market. This confirms the explanation given in the previous section — when sovereigns have difficulties servicing their debt, they need borrow more, and might not be able to obtain bank loans.

Private borrowers from the countries that rescheduled in the past tend to borrow more from foreign banks, while sovereigns tend to borrow less from foreign banks. This suggests that banks do not punish private borrowers for their governments' defaults, but that they are less willing to lend money to sovereigns that have defaulted in the past. This can be explained by the differences in loan contracts of private and sovereign borrowers. International banks may be able to collect their money from private borrowers rather easily and quickly in case of a country default. However, the restructuring of sovereign debt usually takes a long time and banks frequently end up getting just a fraction of their funds back.

A somewhat puzzling finding is that more rapid GDP growth raises bank lending to sovereigns, but *reduces*, albeit not significantly, bond issuance by sovereigns.[45] Perhaps when the rate of GDP growth is higher, sovereigns may prefer to borrow domestically rather than issue international bonds. If they had been previously borrowing from banks, however, they may wish to maintain their relationships with banks rather than switch to domestic borrowing.

6 Conclusion

This paper contributes to the literature in two ways. First, it analyses the choice of debt instrument, an important issue that had not been addressed in the literature previously. Second, by determining the variables that affect the choice of a debt instrument, it facilitates empirical analysis of emerging market debt and suggests a direction for theories thereof.

The empirical analysis supports the predictions of the model. Not only are borrowers who are viewed as more risky less likely to be able to borrow, but borrowers from countries with potential liquidity problems are more likely to borrow on the bond market. The second result follows from the fact that there are costs associated with banking activity, and from the fact that the market for bank loans consequently disappears (due to adverse selection) at a lower level of risk than does the market for bonds. Borrowers enjoying more stable economic and political situations are more likely to borrow on the bond market, but their issues are investment grade bonds, not junk bonds (as in the case of risky borrowers).

Among the implications of these findings are the following. First, and unsurprisingly, we should expect borrowers from countries with improving macroeconomic and political stability and improving liquidity to be able to borrow more internationally. But in addition, and less obviously, we should expect borrowers from countries that solve their liquidity problems to switch from junk bonds to loans. Third, we should expect borrowers from countries with significantly better economic and political environments to switch from bank loans to investment grade bonds, thus reducing their borrowing costs.[46]

[45] This result holds even if we include regional dummy variables.

[46] In this paper I estimate a reduced form model and hence do not address directly the relationship between

This paper thus opens an avenue for further research on the relative importance of bond market and bank financing to developing countries. While there is a large body of empirical literature on financial contagion, previous studies tend to be limited to either the bond or loan markets. More rigorous study would require simultaneous analysis of both markets due to the possibility of substitution between the two instruments. In particular, I plan to extend the study by Eichengreen, Hale and Mody (2001) on the transmission of contagion through the international debt market. Knowing what determines a borrower's choice between bonds and bank loans will allow me to simultaneously estimate changes in the issuance, maturity, and spreads of both international bonds and international bank loans during periods of financial turmoil. This paper therefore takes the first step towards resolving the question of whether international bonds are safer than international bank loans in times of financial instability.

macroeconomic fundamentals and the cost of foreign debt. The analysis, however, suggests some implications for this relationship. They are formulated and tested in a separate paper that is still in progress, Hale (2001).

References

[1] Aerni, Peter and Georg Junge, "Cross–border Emerging Market Bank Lending," in Levich, Richard M. (ed.), *Emerging Market Capital Flows*, Kluwer, 1998.

[2] Angbazo, Lazarus A., Jianping Mei, and Anthony Saunders, "Credit Spreads in the Market for Highly Leveraged Transaction Loans," *Journal of Banking and Finance*, Vol.22, 1998, pp.1249-1282.

[3] Berlin, Mitchell and Jan Loeys, "Bond Covenants and Delegated Monitoring," *Journal of Finance*, Vol. 43(2), June 1988, pp.397-412.

[4] Bolton, Patrick and Xavier Freixas, "Equity, Bonds and Bank Debt: Capital Structure and Financial Market Equilibrium under Asymmetric Information," mimeo, March 1999.

[5] Chay, Kenneth and James Powell, "Semiparametric Censored Regression Models," mimeo, UC Berkeley, July 2001.

[6] Folkerts-Landau, David, "The Changing Role of International Bank Lending in Development Finance," IMF Staff Papers, Vol.32(2), June 1985, pp. 317-363.

[7] Demirguc-Kunt A. and V. Maksimovic, "Stock Market Development and Financing Choices of Firms," *The World Bank Economic Review*, Vol. 10(2), May 1996, pp.341-369.

[8] Diamond, Douglas W., "Monitoring and Reputation: The Choice between Bank Loans and Directly Placed Debt," *The Journal of Political Economy*, Vol. 99(4), August 1991, pp.689-721.

[9] Domowitz, Ian, Jack Glen and Anqanth Madhavan, "International Evidence on Aggregate Corporate Financing Decisions," January 2000. This paper is available from `http://www.worldbank.org/research/projects/finstructure/papers_22000.htm`

[10] Dong, Diansheng, Chanjin Chung, Todd M.Schmit and Harry M.Kaiser, "Modeling the Household Purchasing Process Using a Panel Data Tobit Model," mimeo, Cornell University, September 2001.

[11] Dooley, Michael, "Can Output Losses Following International Financial Crises be Avoided?" NBER Working Paper 7531, February 2000.

[12] Edwards, Sebastian, "The Pricing of Bonds and Bank Loans in International Markets: An Empirical Analysis of Developing Countries' Foreign Borrowing," *European Economic Review*, Vol.30(3), June 1986, pp.565-589.

[13] Eichengreen, Barry and Ashoka Mody, "Lending Booms, Reserves and Sustainability of Short–Term Debt: Inferences from the Pricing of Syndicated Bank Loans," *Journal of Development Economics*, Vol.63(1), October 2000, pp.5-44.

[14] Eichengreen, Barry, Galina Hale and Ashoka Mody, "Flight to Quality: Investor Risk Tolerance and the Spread of Emerging Market Crises," in S.Classens and K.Forbes (eds.) *International Financial Contagion*, Kluwer, 2001.

[15] Goldstein, Morris, *The Asian Financial Crisis*, Washington, D.C.: Institute of International Economics, 1998.

[16] Hajivassiliou V., "A Simulation Estimation Analysis of the External Debt Crises of Developing Countries," *Journal of Applied Econometrics*, Vol.9(2), 1994, pp. 109-131.

[17] Hajivassiliou V. and D.McFadden, "The Method of Simulated Scores for the Estimation of LDV Models," *Econometrica*, Vol.66(4), 1998, pp. 863-896.

[18] Hajivassiliou V., D. McFadden, and P.Ruud, "Simulation of Multivariate Normal Rectangle Probabilities and their Derivatives: Theoretical and Computational Results," *Journal of Econometrics*, Vol.72(1-2), 1996, pp. 85-134.

[19] Hajivassiliou V. and P.Ruud, "Classical Estimation Methods for LDV Models Using Simulation" in R.F.Eagle and D.L.McFadden eds. *Handbook of Econometrics*, Vol.IV, 1994, pp. 2383-2441.

[20] Hale, Galina B. "Creditworthiness, Macroeconomic Fundamentals and the Cost of Foreign Debt for Emerging Market Borrowers", work in progress, UC Berkeley, 2001.

[21] Harvey, Campbell R. and Geert Bekaert, "Capital Flows and the Behavior of Emerging Market Equity Returns," NBER Working Paper 6669, July 1998.

[22] Helwege, Jean and Nellie Liang, "Is There a Pecking Order? Evidence from a Panel of IPO Firms," Finance and Economics Discussion Paper 94-22, Federal Reserve Board, August 1994.

[23] Keane M., "A Computationally Practical Simulation Estimator for Panel Data", *Econometrica*, Vol.62(1), 1994, pp. 95-116.

[24] Lee M., "First-difference estimator for panel censored-selection models," *Economics Letters*, 70, 2001, pp. 43-49.

[25] Morizumi Y., "Current Wealth, Housing Purchase, and Private Housing Loan Demand in Japan," *Journal of Real Estate and Economics*, Vol.21(1), 2000, pp. 65-86.

[26] Schmukler, Sergio and Esteban Vesperoni, "Does Integration with Global Markets Affect Firms' Financing Choices? Evidence from Emerging Economies," February 2000. This paper is available from `http://www.worldbank.org/research/projects/finstructure/papers_22000.htm`

[27] Stiglitz, Joseph E. and Andrew Weiss, "Credit Rationing in Markets with Imperfect Information," *The American Economics Review*, Vol.71(3), June 1981, pp. 393-410.

Appendix 1. Derivations and proofs

Interest rates. If there is no monitoring, the lender will accept the rate that will give him an expected return equal to R. If type S chooses project g, then the share f_B of borrowers will pay back with probability π, the rest will pay with probability 1. Therefore

$$\begin{aligned} r_1((1-f_B)+\pi f_B) &= R \\ r_1(1-f_B+\pi f_B) &= R \\ r_1 &= \frac{R}{1-(1-\pi)f_B}. \end{aligned}$$

If type S chooses project b, then the share $1-f_G$ of borrowers will pay back with probability π and the rest will pay with probability 1. Therefore,

$$\begin{aligned} r_3(f_G+\pi(1-f_G)) &= R \\ r_3(f_G+\pi-\pi f_G) &= R \\ r_3 &= \frac{R}{\pi+(1-\pi)f_G}. \end{aligned}$$

With monitoring, no matter what the outcome is, the bank bears the cost C of monitoring. Therefore it will not accept the expected rate of return below $R+C$. If monitoring provides incentives, borrowers of type S will choose $a=g$ and therefore

$$\begin{aligned} r_2((1-f_B)+\pi f_B) &= R+C \\ r_2 &= \frac{R+C}{1-(1-\pi)f_B}. \end{aligned}$$

Matters are more complicated if monitoring does not provide incentives. Since type B borrowers do not take any action, their "choice" of risky project cannot be "caught". Therefore, as before, they pay with probability π. Type S borrowers can be "caught" and in this case bank cancels the loan, which means that the total number of loans is smaller by Pf_S, although the cost of monitoring has been already borne. Type S borrowers actually pay the bank with the probability $(1-P)$ that they are not caught multiplied by the probability π that their return is positive. Therefore,

$$
\begin{aligned}
r_4(f_G + (1-P)\pi(1-f_G-f_B) + \pi f_B) &= R(1-P(1-f_G-f_B)) + C \\
r_4(f_G(1-(1-P)\pi) + f_B(\pi-(1-P)\pi) + (1-P)\pi) &= R(1-P(1-f_G-f_B)) + C \\
r_4((1-P)\pi + (1-(1-P)\pi)f_G + \pi P f_B) &= R(1-P(1-f_G-f_B)) + C \\
r_4 &= \frac{R(1-P(1-f_G-f_B)) + C}{(1-P)\pi + (1-(1-P)\pi)f_G + \pi P f_B}.
\end{aligned}
$$

Feasibility constraints: (1) — (4). The feasibility constraints are derived from the following conditions:

$$
\begin{aligned}
r_1 = \frac{R}{1-(1-\pi)f_B} &\leq G \\
r_2 = \frac{R+C}{1-(1-\pi)f_B} &\leq G \\
r_3 = \frac{R}{\pi+(1-\pi)f_G} &\leq G \\
r_4 = \frac{R - RP(1-f_G-f_B) + C}{\pi(1-P) + (1-\pi(1-P))f_G + \pi P f_B} &\leq G.
\end{aligned}
$$

They are then derived straightforwardly except for 4 which is derived below.

$$
\begin{aligned}
f_G &\geq -\frac{(PR - G\pi P)f_B}{PR - G + G\pi - G\pi P} - \frac{R - PR + C - G\pi + G\pi P}{PR - G + G\pi - G\pi P} \\
f_G &\geq 1 - \frac{G-R-C}{(1-\pi)G - P(R-\pi G)} + \frac{P(R-\pi G)f_B}{(1-\pi)G - P(R-\pi G)}.
\end{aligned}
$$

Equations (5) and (6). Safe project without monitoring:

$$
\begin{aligned}
(G - r_1) &\geq \pi(B - r_1) - (1-\pi)D \\
r_1 &\leq \frac{G - \pi B + (1-\pi)D}{1-\pi} \\
r_1 &\leq \frac{G-\pi B}{1-\pi} + D \\
\frac{R}{1-(1-\pi)f_B} &\leq \frac{(G-\pi B) + D(1-\pi)}{(1-\pi)} \\
R(1-\pi) &\leq (G-\pi B) + D(1-\pi) - (1-\pi)(G-\pi B)f_B - D(1-\pi)^2 f_B \\
f_B &\leq \frac{(G-\pi B) + D(1-\pi) - R(1-\pi)}{(1-\pi)(G-\pi B) + D(1-\pi)^2} \\
f_B &\leq \frac{1}{1-\pi} - \frac{R}{(1-\pi)D + (G-\pi B)}
\end{aligned}
$$

Safe project with monitoring:

$$\begin{aligned}
(G - r_2) &\geq P(-L) + (1-P)[\pi(B - r_2) + (1-\pi)(-D)] \\
r_2 &\leq \frac{G + PL - (1-P)\pi B + (1-P)(1-\pi)D}{1-(1-P)\pi} \\
r_2 &\leq \frac{[PL + (1-P)(1-\pi)D] + G - (1-P)\pi B}{1-(1-P)\pi}.
\end{aligned}$$

Denote now $PL + (1-P)(1-\pi)D \equiv Z$. Note that $0 < Z < D$.

$$\begin{aligned}
\frac{R+C}{1-(1-\pi)f_B} &\leq \frac{Z + G - (1-P)\pi B}{1-(1-P)\pi} \\
(R+C)(1-(1-P)\pi) &\leq (Z + G - (1-P)\pi B)\,(1-(1-\pi)f_B) \\
f_B &\leq \frac{(Z + G - (1-P)\pi B) - (R+C)(1-(1-P)\pi)}{(1-\pi)\,(Z + G - (1-P)\pi B)} \\
f_B &\leq \frac{1}{1-\pi} - \frac{(R+C)(1-(1-P)\pi)}{(1-\pi)\,(Z + G - (1-P)\pi B)}.
\end{aligned}$$

Equations (7) and (8). Lenders will choose to monitor given the choice of a safe project by borrowers of type S if:

$$\begin{aligned}
r_2[(1-(1-\pi)f_B) - (\pi + (1-\pi)f_G)] &\geq C \\
\frac{R+C}{1-(1-\pi)f_B}[(1-(1-\pi)f_B) - (\pi + (1-\pi)f_G)] &\geq C \\
R + C - (R+C)\frac{\pi + (1-\pi)f_G}{1-(1-\pi)f_B} &\geq C \\
(R+C)\frac{\pi + (1-\pi)f_G}{1-(1-\pi)f_B} &\leq R \\
\pi + (1-\pi)f_G &\leq \frac{R}{R+C}(1-(1-\pi)f_B) \\
f_G &\leq \left(1 - \frac{C}{(R+C)(1-\pi)}\right) - \frac{R}{R+C}f_B.
\end{aligned}$$

Lenders will choose to monitor given the choice of a risky project by borrowers of type S if:

$$\begin{aligned}
r_4[\pi(1-P) + (1-\pi(1-P))f_G + \pi P f_B] - R + PR(1 - f_G - f_B) - C &\geq r_4[\pi + (1-\pi)f_G] - R \\
\frac{[R - PR(1-f_G-f_B) + C][\pi + (1-\pi)f_G]}{\pi(1-P) + (1-\pi(1-P))f_G + \pi P f_B} &\leq R \\
1 - f_G - \frac{C}{RP} - \frac{C}{RP}\frac{\pi}{(1-\pi)f_G} &\geq f_B.
\end{aligned}$$

Proof of Propositions 1,2,3. The options open for each pair of f_G and f_B are shown on Figure 5. The notation is as follows:

- mn — Monitoring is needed versus Case 1 (equation (5))
- sm — Borrowers choose safe project with monitoring (equation (6))
- ms — Lenders choose to monitor given that borrowers of type S choose safe project (equation (7))
- mr — Lenders choose to monitor given that borrowers of type S choose risky project (equation (8))
- $f4$ — Feasibility constraint for r_4 (equation (4))
- $f3$ — Feasibility constraint for r_3 (equation (3)).

The two remaining feasibility constraints are not binding.

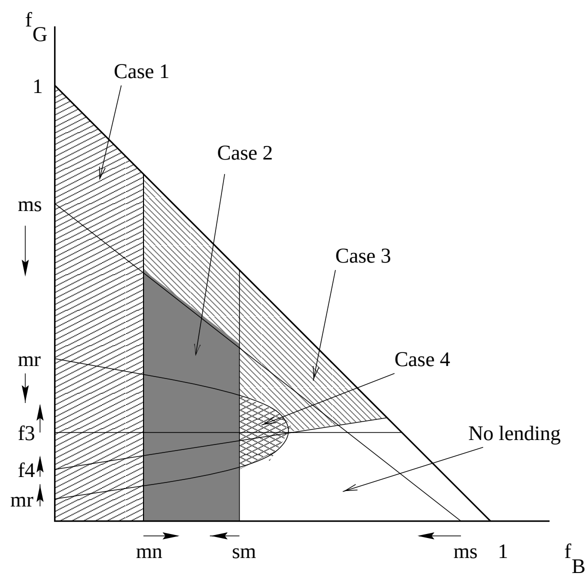


Figure 5: Model predictions

The following can be shown by taking the derivatives of the right hand sides of the conditions depicted:

Increase in G will shift mn right, sm right, $f3$ down
Increase in B will shift mn left, sm left, $f3$ up
Increase in R will shift mn left, sm left, $f3$ up
Increase in π will shift mn left, ms down, $f3$ down
Increase in P will shift sm right
Increase in C will shift sm left
Increase in D will shift mn right, sm right
Increase in L will shift sm right

Propositions 1 and 2 follow directly. Proposition 3 follows immediately from the graph.

Incentive constraints for sovereigns: 9 — 12

$$\begin{aligned} r_1 = \frac{R}{1-(1-\pi)f_B} &\leq D \\ r_2 = \frac{R}{\pi+(1-\pi)f_G} &\leq D \\ r_3 = \frac{R+C}{1-(1-\pi)f_B} &\leq D \\ r_4 = \frac{R-RP(1-f_G-f_B)+C}{\pi(1-P)+(1-\pi(1-P))f_G+\pi P f_B} &\leq D. \end{aligned}$$

Equations (9) — (12) are then derived exactly like feasibility constraints with G replaced by D/x.

Propositions 1-3 hold for sovereigns. Equations (9)—(12) make constraints (3), (4), (7) non-binding. A possible case given the restriction on the parameters is presented on Figure 6. The lines IC_2, IC_3 and IC_4 correspond to constraints (10), (11), (12) respectively.

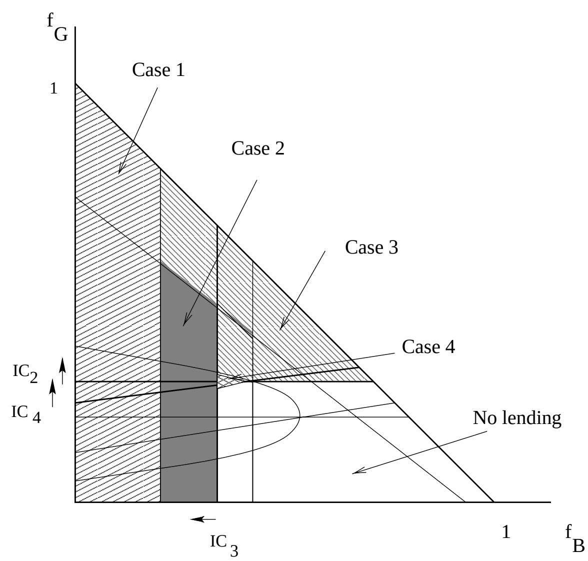


Figure 6: Model predictions for sovereigns

The following can be shown by taking the derivatives of the right hand sides of conditions (10) and (11):

Increase in R will shift IC_2 up, IC_3 left
Increase in π will shift IC_2 down, IC_3 right
Increase in C will shift IC_3 left
Increase in D will shift IC_2 down, IC_3 right.

When IC_2 shifts up, the amount of bond issues decreases, when IC_3 shifts to the left, the amount of loans decreases. Other variables will have the same effects as before. This immediately leads to propositions 1-3.

Appendix 2. Credit rating residual

The credit ratings of sovereigns tend to be constructed by the rating agencies as a function of macroeconomic variables. Variables that are commonly used include the ratio of total debt service to exports (a lower ratio should improve the credit rating), the ratio of total external debt to GNP (a lower ratio should improve the credit rating), the growth rate of real GDP (a higher growth rate should improve the credit rating), the variance of export growth (a lower variance should improve the credit rating), and the inflation rate (a lower inflation rate should improve the credit rating). In addition, debt rescheduling typically worsens a country's credit rating.

I estimated a panel fixed–effects regression of the credit rating given to sovereigns by Institutional Investor on the variables enumerated above. All the coefficients have the expected signs and are statistically significant (with the exception of the GDP growth rate) signs. I used these results to construct the credit rating residual to be used as an additional explanatory variable to proxy for political risk. Credit rating residual is a sum of estimated fixed effect and a true residual:

$$\text{credit rating residual} = \alpha_i + \varepsilon_{it}.$$

	coefficient	standard error
Debt rescheduled in the previous year	-4.21***	0.12
Total debt service / exports	-4.56***	0.33
Total external debt / GNP	-4.56***	0.29
Growth rate of real GDP	5.48	3.38
Variance of export growth	-2.45***	0.27
Log of inflation rate	-2.42***	0.04
Constant	35.47	0.17
Fraction of variance due to α	.90	
Number of observations	18280	
R^2 within	0.33	
R^2 between	0.35	
R^2 overall	0.29	

Note: * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level.

7 Appendix 3. Data description.

Variable	Source	Units	Frequency
US treasury rate	Federal Reserve	annual %	daily
Credit rating	Institutional Investor	0–100 scale	bi-annual
Debt service	IMF IFS	US$	quarterly
Exports	IMF IFS	US$	quarterly, monthly
Debt rescheduled	WB publications	0/1	annual
Real and nom. GDP	IMF IFS	index and n.c.	quarterly
External debt	BIS	US$	bi-annual
Brady deals	WB publications	0/1	annual
Domestic credit	IMF IFS	n.c.	quarterly
C.B.Reserves	IMF IFS	US$	quarterly
Short-term debt	BIS	US$	bi-annual
Inflation rate	IMF IFS	CPI	quarterly
Capital controls		0/1	annual
Bond data	Capital Data		by closing date
Loan data	Capital Data		by signing date
Number of firms listed	Glob. Fin. Data	number	annual

The following table lists the countries by region that participated in the estimations and a number of observations, number of bonds and number of loans for each country. Countries excluded due to missing explanatory variables are Algeria, Angola, Ethiopia, Former Czechoslovakia, Ghana, Iran, Lebanon, Lesotho, Liberia, Mauritius, Moldova, Papua New Guinea, Qatar, Saudi Arabia, Seychelles, United Arab Emirates, and Vietnam.

Country	N.obs.	N.b.	N.l
East Europe and Central Asia			
Bulgaria	130	1	2
Croatia	210	8	34
Czech Rep.	220	59	65
Estonia	120	11	16
Hungary	230	23	61
Kazakhstan	70	2	5
Latvia	200	4	9
Lithuania	220	6	25
Poland	360	17	82
Romania	240	2	38
Russia	220	30	88
Slovak Rep	220	16	44
Slovenia	200	4	31
Ukraine	70	3	5
Middle East			
Bahrain	20	0	1
Egypt	360	1	26
Kuwait	220	0	8
Morocco	270	2	21
Oman	10	0	0
Tunisia	320	7	22
Turkey	360	52	165
East Asia and Pacific			
China	160	38	131
Hong Kong	310	76	165
Indonesia	360	45	168
Korea	280	134	177
Malaysia	350	39	177
Philippines	360	59	97
Singapore	260	20	90
Taiwan	270	37	65
Thailand	330	72	170

Country	N.obs.	N.b.	N.l
Carribean			
Barbados	270	1	2
Dominican Rep	220	2	2
Jamaica	360	4	9
Trinidad & Tobago	350	6	10
Latin America			
Argentina	310	117	105
Bolivia	240	1	5
Brazil	360	130	125
Chile	240	18	89
Colombia	240	25	63
Costa Rica	240	3	4
Ecuador	240	5	5
El Salvador	150	1	8
Guatemala	180	1	4
Mexico	360	148	191
Panama	310	5	19
Paraguay	260	0	3
Peru	360	5	46
Uruguay	350	17	11
Venezuela	320	33	71
South Asia			
Bangaldesh	180	0	2
India	360	36	140
Pakistan	360	6	108
Sri Lanka	360	3	10
Africa			
Kenya	340	0	3
Nigeria	90	0	6
South Africa	350	36	78
Zambia	40	0	1
Zimbabwe	270	0	20

Table 1: Amount of bonds and loans issued by region and year

Region	1991	1992	1993	1994	1995	1996	1997	1998	1999	1991-9
E. Europe	15%	7%	10%	6%	9%	6%	10%	26%	14%	12%
and C.Asia	10%	5%	7%	9%	8%	8%	12%	9%	7%	9%
Middle East	4%	15%	7%	5%	7%	5%	5%	8%	10%	7%
	29%	26%	15%	18%	16%	9%	13%	16%	20%	17%
E. Asia and	34%	29%	35%	52%	42%	41%	34%	16%	29%	34%
Pacific	32%	40%	52%	55%	47%	52%	43%	30%	32%	43%
Carribean	0%	1.4%	0.7%	1.3%	0%	0.5%	0.6%	1.4%	0.5%	0.7%
	0.3%	0.3%	0.1%	0.5%	0.1%	0.2%	1.2%	0%	0.5%	0.4%
Latin America	43%	44%	46%	31%	36%	46%	44%	47%	44%	43%
	18%	17%	17%	11%	15%	21%	24%	37%	32%	22%
South Asia	1.7%	0%	1.0%	2.0%	1.4%	1.3%	2.1%	0.2%	0.1%	1.2%
	2.6%	3.3%	4.3%	4.7%	4.4%	4.8%	3.9%	3.8%	3.4%	4.0%
Africa	2.4%	3.8%	0.9%	3.5%	3.1%	1.2%	4.4%	1.7%	2.2%	2.6%
	8.1%	7.8%	4.0%	2.3%	9.9%	4.1%	2.8%	3.6%	5.7%	5.1%
Total	13.1	21.1	57.5	55.3	58.1	106.5	136.2	80.0	87.6	615.4
(bln U.S.$)	87.5	74.8	83.2	104.4	150.7	161.8	234.7	130.4	120.2	1147.7

Note: First line - bonds, second line - loans. Percent of total.

Table 2: Number of bond issues and loan contracts by region and year

Region	1991	1992	1993	1994	1995	1996	1997	1998	1999	1991-9
E. Europe	11%	7%	6%	6%	11%	7%	12%	20%	15%	10%
and C.Asia	5%	6%	8%	9%	9%	9%	13%	17%	14%	10%
Middle East	2.4%	7%	3%	1.9%	4%	4%	5%	9%	8%	5%
	12%	14%	12%	8%	6%	6%	8%	12%	14%	9%
E. Asia and	45%	29%	35%	52%	53%	50%	42%	16%	39%	42%
Pacific	55%	52%	53%	60%	60%	63%	52%	36%	37%	53%
Carribean	0%	1.5%	0.7%	2.1%	0%	0.9%	1.0%	2.1%	0.5%	1.0%
	1.3%	0.6%	0.5%	0.8%	0.2%	0.3%	0.6%	0%	0.4%	0.5%
Latin America	39%	53%	53%	34%	27%	35%	36%	50%	36%	38%
	15%	18%	16%	11%	13%	12%	17%	26%	26%	17%
South Asia	0.8%	0%	1.4%	2.2%	2.0%	2.3%	3.1%	1.0%	0.2%	1.8%
	3.4%	3.2%	4.3%	7.1%	5.8%	6.7%	6.3%	4.9%	2.9%	5.3%
Africa	2.4%	3.0%	0.7%	1.5%	2.2%	0.9%	1.2%	1.7%	1.4%	1.4%
	8%	6%	6%	3%	4%	4%	3%	4%	5%	5%
Total	127	203	434	481	454	690	669	289	427	3774
	924	1045	1160	1371	1790	1979	2182	1172	1070	12693

Note: First line - bonds, second line - loans.

Table 3: Full sample results. No fixed or time effects.

Dependent variable	One equation, pooled bond	One equation, pooled loan	Two equations, pooled bond	Two equations, pooled loan	One equation, r.e. bond	One equation, r.e. loan
Log of 3-year US treasury rate	0.20 (0.25)	0.10 (0.18)	0.61 (0.41)	-0.16 (2.03)	0.15 (0.23)	0.19 (0.13)
Log of 10 y/1 y US treasury rate	-2.50** (1.21)	-3.87*** (0.85)	-2.57 (1.94)	-4.62 (9.77)	-0.88 (1.18)	0.01 (0.68)
Credit rating residual	0.31*** (0.02)	0.29*** (0.02)	0.17*** (0.03)	0.05 (0.18)	0.30*** (0.03)	0.23*** (0.02)
Total debt service/Exports	12.5*** (1.32)	8.23*** (0.99)	11.3*** (2.45)	8.95 (14.4)	6.70*** (1.87)	2.33* (1.27)
Debt rescheduled in the past	0.21 (0.51)	0.37 (0.35)	0.96 (0.80)	1.90 (4.23)	0.76 (0.81)	1.29** (0.53)
Variance of export growth	-15.0*** (2.50)	-12.4*** (1.56)	-14.5*** (4.20)	-12.4 (18.0)	-7.10*** (2.40)	-2.54** (1.23)
Growth rate of real GDP	80.8*** (21.9)	134.9*** (15.2)	182.0*** (34.1)	327.1** (158.4)	97.3*** (22.3)	62.3*** (12.3)
Total external debt/GNP	-11.2*** (1.09)	-4.96*** (0.72)	-8.43*** (1.84)	-5.89 (10.7)	-11.2*** (2.00)	-2.14** (0.91)
Brady deals in the past	4.08*** (0.55)	-1.00** (0.41)	2.44*** (0.94)	0.92 (4.63)	4.62*** (0.71)	-0.39 (0.46)
Domestic credit /GDP	-0.16 (0.19)	0.09 (0.14)	0.19 (0.30)	1.23 (1.58)	0.90*** (0.21)	0.42*** (0.13)
Reserves/Short term debt	-0.51*** (0.10)	-0.26*** (0.06)	-0.54** (0.22)	0.34 (1.06)	-0.23 (0.14)	-0.12* (0.06)
Log domestic inflation rate	0.22 (0.17)	0.53*** (0.13)	-0.17 (0.26)	-0.20 (1.33)	-0.25 (0.18)	-0.43*** (0.12)
Private borrower	2.74*** (0.39)	4.49*** (0.28)	1.72*** (0.60)	1.59 (2.85)	5.17*** (0.68)	4.01*** (0.48)
Constant	-17.4***	-11.7***	-14.8***	-11.9	-23.0***	-14.8***
Standard error	12.3***	11.4***	15.5***	20.66***	8.78***	7.16***
R.e.standard error					10.6***	6.57***
Mean log lik.	-0.52	-1.04	-1.17		-0.45	-0.96

Note: * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level. Robust standard errors (corrected for the first–stage) are in parentheses. Number of observations 14660. Number of bonds 1371. Number of loans 3128.

Table 4: Full sample results. Time effects. No random effects.

	One equation		One equation		One equation	
Dependant variable	bond	loan	bond	loan	bond	loan
Log of 3-year US treasury rate	1.31***	0.51**	1.31***	0.50**	1.30***	0.46*
	(0.32)	(0.23)	(0.32)	(0.23)	(0.32)	(0.23)
Log of 10 y/1 y US treasury rate	8.45***	-0.06	8.51***	-0.00	8.24***	-0.44
	(2.29)	(1.63)	(2.26)	(1.64)	(2.26)	(1.64)
Credit rating residual	0.32***	0.29***	0.32***	0.30***	0.27***	0.23***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Total debt service/Exports	12.9***	8.37***	13.2***	8.35***	15.8***	12.3***
	(1.32)	(0.99)	(1.31)	(0.99)	(1.47)	(1.09)
Debt rescheduled in the past	-0.05	0.30	-0.09	0.27	0.43	1.15***
	(0.51)	(0.35)	(0.51)	(0.35)	(0.54)	(0.37)
Variance of export growth	-13.9***	-11.9***	-14.0***	-11.9***	-12.2***	-9.83***
	(2.49)	(1.56)	(2.48)	(1.56)	(2.44)	(1.54)
Growth rate of real GDP	86.8***	137.8***	92.0***	138.6***	72.2***	132.9***
	(22.1)	(15.2)	(21.9)	(15.2)	(22.4)	(15.5)
Total external debt/GNP	-11.5***	-4.98***	-11.5***	-4.92***	-13.3***	-7.26***
	(1.10)	(0.72)	(1.09)	(0.72)	(1.16)	(0.77)
Brady deals in the past	4.00***	-1.05**	4.03***	-1.10***	3.50***	-1.24***
	(0.55)	(0.41)	(0.55)	(0.41)	(0.60)	(0.45)
Domestic credit /GDP	-0.13	0.11	-0.05	0.12	-0.55***	-0.45***
	(0.19)	(0.14)	(0.18)	(0.14)	(0.20)	(0.15)
Reserves/Short term debt	-0.54***	-0.27***	-0.54***	-0.27***	-0.44***	-0.22***
	(0.11)	(0.06)	(0.10)	(0.06)	(0.10)	(0.06)
Log domestic inflation rate	0.40**	0.59***	0.38**	0.59***	0.55***	0.82***
	(0.17)	(0.13)	(0.17)	(0.13)	(0.17)	(0.13)
Private borrower	2.74***	4.48***	5.68***	3.64***	5.67***	3.62***
	(0.39)	(0.28)	(0.47)	(0.31)	(0.47)	(0.31)
Industry effects	NO	NO	YES	YES	YES	YES
Region effects	NO	NO	NO	NO	YES	YES
Constant	-30.8***	-16.5***	-26.6***	-18.6***	-27.0***	-18.9***
Standard error	12.3***	11.4***	11.7***	11.3***	11.7***	11.3***
Mean log lik.	-0.52	-1.04	-0.51	-10.3	-0.51	-1.03

Note: * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level. Robust standard errors (corrected for the first–stage) are in parentheses. Number of observations 14660. Number of bonds 1371. Number of loans 3128.

Table 5: Full sample results. Time, fixed and random effects.

Dependant variable	bond	loan	bond	loan	bond	loan
Log of 3-year US treasury rate	1.20*** (0.28)	0.21 (0.16)	1.29*** (0.31)	0.18 (0.16)	1.23*** (0.28)	0.18 (0.16)
Log of 10 y/1 y US treasury rate	10.01*** (1.99)	0.18 (1.14)	8.34*** (2.20)	-0.07 (1.14)	10.19*** (2.02)	-0.06 (1.15)
Credit rating residual	0.28*** (0.03)	0.23*** (0.02)	0.31*** (0.02)	0.20*** (0.02)	0.29*** (0.03)	0.19*** (0.02)
Total debt service/Exports	5.52*** (1.53)	2.36* (1.28)	12.9*** (1.28)	4.10*** (1.05)	8.67*** (1.68)	3.30*** (1.15)
Debt rescheduled in the past	-0.87 (0.77)	1.27** (0.53)	-0.09 (0.50)	0.94* (0.50)	-1.20 (0.74)	1.78*** (0.60)
Variance of export growth	-5.91** (2.35)	-2.52** (1.23)	-13.5*** (2.42)	-2.75** (1.24)	-6.05** (2.42)	-2.08* (1.23)
Growth rate of real GDP	117.7*** (21.4)	62.4*** (12.3)	90.4*** (21.4)	68.9*** (12.3)	111.5*** (22.7)	65.6*** (12.6)
Total external debt/GNP	-6.60*** (1.41)	-2.17** (0.92)	-11.2*** (1.07)	-2.75*** (0.91)	-8.82*** (1.40)	-2.63** (1.13)
Brady deals in the past	4.47*** (0.88)	-0.40 (0.47)	3.93*** (0.54)	-0.61 (0.50)	4.22*** (0.72)	-0.49 (0.55)
Domestic credit /GDP	0.93*** (0.20)	0.42*** (0.13)	-0.03 (0.18)	0.27** (0.13)	0.49** (0.21)	0.31** (0.14)
Reserves/Short term debt	-0.10 (0.11)	-0.12* (0.06)	-0.52*** (0.10)	-0.13** (0.07)	-0.03 (0.09)	-0.13* (0.08)
Log inflation rate	0.09 (0.17)	-0.43*** (0.13)	0.38** (0.16)	-0.38*** (0.12)	0.40** (0.17)	-0.36*** (0.13)
Private borrower	0.83 (0.52)	4.06*** (0.48)	5.54*** (0.46)	2.56*** (0.502)	7.98*** (0.79)	4.27*** (0.57)
Industry effects	NO	NO	YES	YES	YES	YES
Region effects	NO	NO	NO	NO	YES	YES
Constant	-36.3***	-15.0***	-26.1***	-16.0***	-33.4***	-15.8***
Standard error	8.62***	7.16***	11.4***	7.15***	8.66***	7.16***
R.E.Standard error	10.6***	6.57***	0.43	6.11***	9.59***	6.07***
Mean log lik.	-0.45	-0.96	-0.51	-0.95	-0.44	-0.95

Note: * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level. Robust standard errors (corrected for the first–stage) are in parentheses. Number of observations 14660. Number of bonds 1371. Number of loans 3128.

Table 6: Sovereign borrowers only.

Dependant variable	No effects bond	No effects loan	R.e. bond	R.e. loan	Time and reg. eff. bond	Time and reg. eff. loan
Log of 3-year US treasury rate	-0.76	-1.17**	-0.64	-1.17**	1.68	-1.50**
	(1.00)	(0.57)	(0.91)	(0.57)	(1.28)	(0.76)
Log of 10 y/1 y US treasury rate	-10.6**	-2.31	-6.34	-2.31	13.8	-5.08
	(4.84)	(2.63)	(4.47)	(2.63)	(9.16)	(5.27)
Credit rating residual	0.37***	0.15***	0.16	0.15***	0.42***	0.12**
	(0.09)	(0.05)	(0.11)	(0.05)	(0.09)	(0.06)
Total debt service/Exports	25.58***	9.85***	9.64*	9.85***	26.6***	12.4***
	(5.12)	(3.15)	(5.35)	(3.15)	(5.74)	(3.44)
Debt rescheduled in the past	0.48	-2.96***	-0.41	-2.96***	0.28	-2.18*
	(1.88)	(1.12)	(2.12)	(1.12)	(1.95)	(1.18)
Variance of export growth	-4.81	-6.02	4.20	-6.02	-3.50	-5.11
	(7.10)	(4.50)	(7.16)	(4.50)	(7.16)	(4.49)
Growth rate of real GDP	-134.9	237.5***	46.0	237.5***	-109.4	242.2***
	(82.0)	(48.9)	(80.2)	(48.9)	(83.5)	(49.6)
Total external debt/GNP	-16.5***	2.53	-3.53	2.53	-17.0***	0.62
	(4.07)	(2.19)	(5.43)	(2.19)	(4.39)	(2.37)
Brady deals in the past	5.46***	-0.72	19.13***	-0.72	6.74***	0.14
	(2.07)	(1.27)	(2.75)	(1.27)	(2.35)	(1.43)
Domestic credit /GDP	-3.62***	-1.85***	-1.72*	-1.85***	-2.66***	-2.09***
	(0.95)	(0.62)	(1.01)	(0.62)	(1.00)	(0.67)
Reserves/Short term debt	-0.33	-0.37	-0.27	-0.37	-0.39	-0.37*
	(0.29)	(0.22)	(0.30)	(0.22)	(0.31)	(0.22)
Log inflation rate	-0.20	0.39	-1.52**	0.39	0.23	0.56
	(0.68)	(0.40)	(0.68)	(0.40)	(0.70)	(0.42)
Constant	-7.60	-5.68	-29.0***	-5.68	-36.6***	-1.79
Standard error	20.0***	9.42***	15.3***	9.42***	19.9***	9.43***
R.e.Standard error			19.1***	0.00		
Mean log lik.	-1.04	-0.52	-0.94	-0.53	-1.03	-0.53

Note: * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level. Robust standard errors (corrected for the first–stage) are in parentheses. Number of observations 1466. Number of bonds 264. Number of loans 143.

Table 7: Private borrowers only.

Dependant variable	No effects bond	No effects loan	R.e. bond	R.e. loan	Time and reg. eff. bond	Time and reg. eff. loan
Log of 3-year US treasury rate	0.35*	0.03	0.17	0.03	1.00***	0.40**
	(0.20)	(0.16)	(0.20)	(0.16)	(0.26)	(0.20)
Log of 10 y/1 y US treasury rate	-1.54	-4.50***	-1.87*	-4.35***	4.73***	-1.08
	(0.99)	(0.77)	(1.02)	(0.75)	(1.83)	(1.44)
Credit rating residual	0.23***	0.28***	0.24***	0.27***	0.19***	0.23***
	(0.03)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)
Total debt service/Exports	7.03***	5.14***	4.27***	5.00***	8.51***	5.89***
	(1.07)	(0.88)	(1.34)	(0.87)	(1.19)	(0.95)
Debt rescheduled in the past	0.92**	2.40***	-0.41	2.38***	0.89*	2.30***
	(0.42)	(0.32)	(0.56)	(0.32)	(0.46)	(0.33)
Variance of export growth	-14.9***	-7.94***	-9.91***	-7.42***	-12.7***	-6.35***
	(2.42)	(1.38)	(2.42)	(1.34)	(2.33)	(1.36)
Growth rate of real GDP	93.0***	84.2***	105.5***	79.9***	78.7***	67.6***
	(18.1)	(13.7)	(20.1)	(13.4)	(18.6)	(13.9)
Total external debt/GNP	-6.58***	-3.82***	-5.91***	-3.87***	-7.84***	-4.55***
	(0.88)	(0.64)	(1.41)	(0.64)	(0.94)	(0.67)
Brady deals in the past	2.79***	-1.10***	1.61***	-1.08***	1.89***	-2.33***
	(0.45)	(0.36)	(0.57)	(0.36)	(0.48)	(0.39)
Domestic credit /GDP	0.04	-0.16	0.69***	-0.14	-0.36**	-0.63***
	(0.15)	(0.12)	(0.18)	(0.12)	(0.16)	(0.13)
Reserves/Short term debt	-0.44***	-0.31***	0.01	-0.29***	-0.34***	-0.21***
	(0.09)	(0.06)	(0.07)	(0.06)	(0.09)	(0.06)
Log inflation rate	0.12	0.007	-0.14	-0.01	0.25*	0.12
	(0.13)	(0.11)	(0.16)	(0.11)	(0.14)	(0.12)
Constant	-9.48***	-4.43***	-12.5***	-4.38***	-19.1***	-8.71***
Standard error	6.65***	7.05***	5.48***	6.80***	6.36***	6.87***
R.e.Standard error			5.59***	0.50		
Mean log lik.	-0.60	-1.27	-0.54	-1.26	-0.58	-1.25

Note: * = significant at 10% level, ** = significant at 5% level, *** = significant at 1% level. Robust standard errors (corrected for the first–stage) are in parentheses. Number of observations 5864. Number of bonds 767. Number of loans 1814.