Mixed Signals: Crisis Lending and Capital Markets*

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Abstract

How do geopolitical forces influence international capital markets? In particular, do market actors condition their responses to crisis lending initiatives on the political incentives of major lenders? We analyze a formal model which demonstrates that the effect of crisis lending announcements on international investment flows is conditional on how market actors interpret the political and economic motivations behind lending decisions on the part of the lender and borrower. If investors believe the decision to accept crisis lending is a sign of economic weakness and lending decisions are influenced by the political interests of the major donor countries, then crisis lending may not reduce borrowing costs or quell fears of international investors. On the other hand, if market actors believe that crisis lending programs, and attendant austerity conditions, will significantly reduce the risk of a financial crisis, they may respond with increased private investment, creating a "catalytic effect." In our model, the political biases of key lending countries can affect the inferences market actors draw, because some sovereign lenders have strategic interests in ensuring that certain borrowing countries do not collapse under the strain of economic crisis. Although our theory applies to multiple types of crisis lending, it helps explain discrepant empirical findings about market reactions to IMF programs. We test the implications of our theory by examining how sovereign bond yields are affected by IMF program announcements, loan size, the scope of conditions attached to loans, and measures of the geopolitical interests of the United States, a key IMF principal.

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1. Introduction

Does geopolitics influence market reactions to crisis lending? In particular, when market actors place bets on the quality of different investment environments, do they consider how the geopolitical incentives facing lenders of last resort shape loan programs? If so, does geopolitical interest make crisis lending more or less effective at quelling investor fears?

Crisis lending is intended to restore confidence in capital markets. For instance, efforts to shore up the Eurozone focus on conditional lending to reassure investors in sovereign bonds. Similarly, the International Monetary Fund has long claimed that its lending acts as a "seal of approval" on national economic policies, which catalyzes private capital flows. Yet the empirical evidence is mixed.[1] One potential reason for this mixed evidence is that quantitative studies of market reactions to crisis lending have rarely incorporated political dynamics. International lending is a political decision that results from bargaining between the borrower and the lender. The terms of crisis lending depend on the relative bargaining power of the lender and the borrower and the quality of the relationship between them. Furthermore, the inferences that private investors draw from observing crisis lending depend on what new information it reveals, which in turn depends on this bargaining process.

Crisis lending can influence investor confidence through several channels. First, creditors are concerned that a liquidity crisis will drive a debtor into involuntary default, and the probability that this occurs in the near future is reduced by the scale of lending. Second, creditors are reassured to the extent that countries receiving loans commit themselves to policies that are likely to increase their ability to repay their debts in the future, so the nature of policy conditionality contained in the deal affects its impact. Third, investors form expectations about how the terms of the bargain are likely to be implemented in the future. This is a concern about moral hazard: if the lender is not able to credibly enforce the terms of the agreement, investors should be wary. Fourth, the fact that the government is willing to accept a particular deal resolves some of the investors' uncertainty about the

[1] Indeed, Rodrik (1995) argues that a central function of multilateral lending is informational: since the quality of investment environments varies and private investors are imperfectly informed, crisis lending from institutions or groups of investors can signal useful information to other private market actors.

government's private information; for any given set of loan terms, a government that was more confident about the future would have rejected the bargain that was offered and held out for more generous terms. In this sense, crisis lending always suffers from the problem of adverse selection.

Each of these channels is affected by bargaining. The scale of the loan and the speed with which it is delivered affect the distribution of risks between the lender and the borrower, and the policy reforms are costly to the borrower—they represent deviations from the status quo, which was presumably an equilibrium result in domestic politics—but are reassuring to the lender. The balance of bargaining power will determine which party bears which risks. Similarly, future implementation of promised reforms will be the outcome of future bargaining. Enforcing the terms of a crisis loan is a recontracting problem: after a borrower reneges on implementing promised policy reforms, the lender has incentives to overlook the lapse and continue lending for the same reasons that led it to extend credit in the previous period. The value of any policy promises the borrower makes, therefore, depend on expectations about the lender's future bargaining power. Since the decision to lend and on what terms depends on the political relationships between countries, private investors must take these political relationships into account. Indeed, comparing two similar cases of lending in which the political relationships between the lenders and borrowers differ, market actors may draw different inferences about the likely effects of loans that are otherwise observationally equivalent.

The recent debt crisis in the Eurozone countries illustrates the possible countervailing effects of crisis lending. On the one hand, the decision of a country like Greece to seek a bailout from fellow European Union member countries signals that crisis and imminent collapse of the Greek economy are strong possibilities. Indeed, the more disadvantageous the terms of the deal, the greater investor concern is likely to be on this score. On the other hand, the announcement that a deal has been reached, backed by a fiscally strong Germany, might quell investors' fears that involuntary default is imminent, and this may lead to a resumption of private capital flows to Greece. Yet not all debt deals are the same. German and EU lending to Greece reflects multiple political and economic concerns, most notably the interest of Germany in maintaining political and economic union in Europe. On the one hand, the bailout might be substantially larger for Greece than for less important countries facing similar circumstances, making imminent collapse less likely; on the other hand, the conditions attached to the loan might be less severe than necessary for a more important country, because the creditors are anxious to reach an agreement. For the same reason, future enforcement of those conditions may prove to be lax, which may make imminent collapse or future profligacy more likely. Thus, politics may influence the terms of loan packages in several ways that can have countervailing effects on the reaction of the capital market actors observing the process from the outside.

We build on these insights by developing a game-theoretic model of interactions between a "lender of last resort," a developing country government, and a private market actor. Our model introduces three theoretical innovations. First, it models bargaining over the terms of a loan program, implementation and enforcement of conditionality, and the reactions of market actors, allowing these three processes that are generally modeled in isolation to affect one other.[2] Second, it introduces private information on the part of the government of the borrowing country, which makes possible bargaining failure and adverse selection. Both the market actor and the lender lack complete information about the underlying state of the developing country's economy.[3] Third, we model the probability of a financial crisis as a function of market interest rates, which in turn depend upon the probability of a crisis, allowing for the possibility of self-fulfilling expectations. The interest rate is determined competitively, so market actors price their capital to offset risk, and the price of capital is itself a component of a country risk profile. This setup allows us to examine how market actors might make inferences about the likelihood of a crisis and factor these considerations into their investment decisions, which in turn determine interest rates.

Our theoretical analysis suggests that the effect of crisis lending on market expectations

[2]We assume that market actors are informed about the conditions attached to loans. Data on IMF conditionality were not publicly released until recently, but a determined observer has always been able to obtain this information.

[3]As Blustein (2001) documents, even multilateral financial institutions like the IMF have often been as much "in the dark" as market actors regarding detailed information about a country's Central Bank reserves and liabilities and about the solvency of the banking sector.

depends on contextual factors, so we are unlikely to observe a straightforward "catalytic" effect. When drawing inferences about investment environments, market actors consider the observable characteristics of loan programs, what loan announcements reveal about the underlying state of the economy, and how future bargaining will be affected by the political bias of the lender. Indeed, because of adverse selection, we expect the effect of new lending announcements to be harmful to the investment climate, once we control for the salutary effects of liquidity and conditionality. Furthermore, because of moral hazard, we expect lending to have less beneficial effects in countries that are especially favored by lenders of last resort. On the other hand, liquidity and conditionality should improve the investment climate and lower interest rates—and countries that are the favorites of lenders should receive more of the former and less of the latter. The net effects of crisis lending should depend on the various elasticities involved, but the mechanisms predicted by the model are straightforward and amenable to quantitative testing. We test these hypotheses using data from the IMF's Monitoring of Agreements (MONA) database for the period 1992-2002, and we find support for the predictions of the model. Our central finding is that geopolitically important countries are offered larger loans, on softer terms, and with less rigorous enforcement of conditionality, and the perverse effect is that crisis lending is least effective in the countries of greatest importance to the lender. This suggests that design features of IOs that may be necessary to secure the "buy in" of major powers, such as the IMF governance structure that allows key shareholders to exert informal influence over lending decisions, can have unintended consequences that undermine their effectiveness (Stone 2011).

2. Market Reactions to Crisis Lending

Sovereign crisis lending initiatives aim to provide immediate liquidity and signal confidence to market actors who may panic in the face of increased risk, seeking returns elsewhere or otherwise raising the costs of their services for governments in crisis. The lender of last resort may be an individual government, a "pivotal" or critical member of an international financial institution, or the median member of a coalition of lending countries, or even a large financial institution with incentives for defensive lending in the face of a crisis. Although we focus our empirical analysis on IMF programs, our theoretical analysis holds insights for a number of crisis lending relationships. For instance, in the interwar period the banker J.P. Morgan offered a crisis loan to Great Britain, but Britain rejected the conditionality attached to the loan and was subsequently compelled to go off of the Gold Standard. The Bank of International Settlements extended credit to Austria and Germany in an effort to stem a spreading banking crisis, and demanded far-reaching policy changes in return. In more recent times, the U.S. government engaged in defensive lending to Mexico in 1982 and again in 1995. The Paris Club and London Club have engaged in debt rescheduling to alleviate financial crises and restore investor confidence, and, as noted above, the European Central Bank and European Commission have taken on a crisis lending role in the current European financial crisis. In each of these cases, a lender with significant economic or political interest in an country in crisis extended a loan, typically with reforms attached, in an effort to forestall a deepening economic crisis and restore investor confidence.

The effectiveness of IMF programs in catalyzing private capital flows has received considerable attention in the economics literature (Bird and Rowlands 2002; Brune et al. 2004; Edwards 2005; Mody and Saravia 2003; Eichengreen et al. 2007).[4] Restoring investor confidence is a key element of the IMF mission and a critical component in evaluating whether IMF programs are "good" for participating countries. Yet empirical research on the catalytic effect displays mixed findings. For instance, correcting for selection, Edwards (2006) finds that IMF programs generate net outflows of portfolio investment, and Jensen (2004) finds a similar effect for foreign direct investment. Mody and Saravia (2003) find a positive effect of IMF programs only in cases of intermediate financial risk, which the authors characterize as instances when IMF programs are viewed as joint commitments between a government and the IMF. Eichengreen and Mody (2000) find evidence that IMF lending decreases bond spreads, while Cottarelli and Giannini (2002) find little evidence that IMF interventions catalyze investment. It is clear that catalytic effects vary considerably across types of countries, but there is little consensus about the systematic sources of this variation. Unfortunately, the question of how IMF programs influence international markets has not been studied with

[4]See Steinwand and Stone 2008 for a review.

sensitivity to fundamental political factors.

In our view, the emphasis in the existing empirical research on finding *average* catalytic effects is misplaced. As we discussed above, there are several factors that influence market actors' investment decisions. An agreement with a crisis lender suggests that a principal with significant means is committed to helping an economy get back on its feet, which should send a positive signal to capital markets. On the other hand, the fact that a country needs a rescue package suggests that there may be problems with the country's economic fundamentals, which can make private capital market actors balk at lending to the government. These two opposing effects of crisis lending may explain the mixed findings, including the finding that IMF programs may actually lead to capital flight. We go one step further, noting that the fact that crisis lending decisions are also subject to the political biases of the major principals further complicates the inferences that market actors can draw from observing an agreement.

Recent cross-national empirical evidence confirms that geopolitical interests matter in multilateral lending decisions. For instance, the interests of the United States have been shown to exert a broad influence over IMF lending, including the likelihood of receiving an IMF program (Thacker 1999), loan size and conditions (Stone 2008, 2011, Copelovitch 2010), and the credibility of IMF conditions (Stone 2002, 2004, 2011, Dreher et al. 2009b). Similarly, temporary membership in the UN Security Council or significance to U.S. foreign policy can affect the disbursement of World Bank Loans (Dreher et al. 2009a, Kilby 2009). Extant work has not examined whether this influence affects the behavior of private capital markets, however, so it is not surprising that previous studies have not reached consensus on a general pattern of catalytic effects. Our theoretical analysis provides a detailed explanation for this lack of consensus. The catalytic effect of lending programs is conditional on a number of factors. Market actors may condition their response on expectations of the importance of countries to key principals, in addition to observable factors, such as the scale of financing and the stringency of the associated conditionality.

First, we show that crisis lending programs are heterogeneous treatments. Our bargainingtheoretic framework generates the expectation that different countries will receive programs that contain more or less stringent conditions for policy reform, on one hand, and will receive more or less generous financing, on the other. If this is the case, empirical studies that estimate a uniform effect of such diverse treatments will be misspecified; in principle, the effect of crisis lending programs should be conditional on their terms. Consequently, we investigate the effects of conditionality and the scale of financing on the cost of borrowing, and we control for conditionality and financing when we investigate the effect of program participation. Second, the effects of lending programs are local treatment effects. In general, there is no reason to suppose that even similarly designed loan programs have uniform effects on dissimilar countries. Furthermore, the theoretical literature provides reason to expect that influential borrowers will be less likely to fully implement the contracted conditions because they anticipate that rigorous enforcement is not credible. Consequently, our model investigates how borrower influence alters the effects of these programs, and we control for this influence in our empirical work.

The model that follows is an infinitely repeated game between a lender of last resort, a government of an economy under stress, and a market actor. In each period, the lender may offer a loan and a package of associated policy commitments to be implemented by the borrower, and the government may accept or reject the package. The government is free to renege on its policy commitments, so the model captures the borrower's time-inconsistency problem. A financial crisis may occur stochastically in any period, with a probability that is a function of the market interest rate, in addition to crisis financing, conditionality, the state of the economy, and the government's implementation of conditionality. In the equilibrium that we study, the lender punishes defection by denying the government access to its funds in the future; however, it readmits the country to good standing if the government "corrects" its defection in some period by implementing the required reforms. The market actor invests only if the bond yield is high enough to compensate for sovereign risk, so in equilibrium market expectations set the interest rate. We allow the lender to place different weights on outcomes in different countries, and we examine the implications of this bias for the reactions of the capital market to an loan agreement.

3. Model

In this section we develop an infinitely repeated game to analyze the strategic interactions between a government (G), a lender of last resort (L), and the international capital market (M). Let G denote a government, L the lender, and M a representative market actor. The state of the economy in period t is a random variable, $\theta \in \{\theta_1, \theta_2\}$, where θ measures G's financing gap, which must be financed in order to overcome a potential crisis. Let $\theta_1 < \theta_2$. For convenience, we will sometimes refer to θ_1 as a good economy, and θ_2 as a bad economy. Furthermore, let $\{\theta^t\}_{t=0}^{\infty}$ be independent and identically distributed (i.i.d.) random variables.

At the beginning of a period (or the stage game), nature draws the state of the economy, $\theta = \theta_i$ for $i \in \{1, 2\}$, from the time invariant distribution $\pi = (\pi_1, \pi_2)$. G learns the true value, but neither L nor M does. Then, L moves first and offers a new loan agreement to G to close the gap, θ. The offer is a take-it-or-leave-it offer, (s, x), where $s \in [0, \bar{s}]$ is the size of the loan with a budget constraint at $\bar{s}$, and $x \in [0, \bar{x}]$ is the level of reforms (i.e., conditionality) required in exchange for the loan.

After receiving a proposal (s, x) from L, G decides whether to accept or reject the offer. For notational convenience, let $(d_x, d_s) \in \{0, 1\} \times \{0, 1\}$ denote the decisions of G on x and s, where 1 represents acceptance, and 0 rejection. If G rejects the offer, this means that G rejects both x and s, i.e., $d_x = 0$ and $d_s = 0$. If G takes the offer, then G has three potential further responses. (i) G accepts both x and s, i.e. $d_x = 1$ and $d_s = 1$. This is a case where G fully complies with the terms of the agreement. (ii) G rejects x but accepts s, i.e. $d_x = 0$ and $d_s = 1$. In this case G accepts s but fails to carry out the conditionality. (iii) G accepts x but rejects s, i.e. $d_x = 1$ and $d_s = 0$. This case captures a scenario where G willingly implements reforms without much incentive provided by L. Let x_G and s_G denote the actual level of reforms and loan size. It is easy to see that $s_G = d_s s$ and $x_G = d_x x$. Moreover, to capture the idea that L cannot fully predict G's decision in each period, we introduce a vector of *i.i.d* choice-specific shocks, $\epsilon = [\epsilon(0,0), \epsilon(0,1), \epsilon(1,0), \epsilon(1,1)]$, to G's utility function. G observes the realization of ϵ and chooses its optimal response (d_x, d_s) by taking into account $\epsilon(d_x, d_s)$. L only knows the distribution of ϵ, so from L's perspective,

G's choice of (d_x, d_s) is probabilistic.

Next, M sets a competitive interest rate, r, having observed the bargaining outcome between L and G. That is, the equilibrium yield makes a representative agent indifferent between buying and selling bonds, given the available information. At the end of the period, nature moves again and reveals whether there is an economic crisis as a function of the state of the economy, θ, an exogenous shock to G's revenue, ϕ, and the choices that the actors have made. The stage game is repeated infinitely, with G and L discounting their future payoffs by δ_G and δ_L, respectively.

Now we elaborate on the probability of crisis at the end of each period. Let the probability be $p(s_G, x_G, r; \theta) \in (0, 1)$. That is, the probability of crisis is a function of the scale of the financing received from L, the actual reforms that the government implemented, the market interest rate on government bonds, and the initial state of the economy. Assume that $p(s_G, x_G, r; \theta_1) < p(s_G, x_G, r; \theta_2)$, $p_{x_G} < 0$, and $p_r > 0$. That is, all else equal, the probability of crisis is smaller when the state of the economy is more favorable, decreases in the amount of reforms implemented, and increases in the interest rate. Further, the economy will experience a crisis if G cannot meet its obligations. Specifically, the condition for there to be a crisis is $r\mathbb{I}(\theta - (1 + x_G)s_G) - \phi_\theta \geq 0$, where $\theta - (1 + x_G)s_G$ is the difference between the country's financing gap and the size of the loan augmented by the reforms implemented by G, and ϕ_θ a stochastic shock to G's revenue that will be realized at the end of a period. Since a good economy is more likely to receive a higher revenue, we assume ϕ_{θ_1} has first-order stochastic dominance over ϕ_{θ_2}.[5] The term, $(1 + x_G)s_G$, implies that the reform (x_G) helps a country utilize the financing (s_G) more effectively. Finally, $r\mathbb{I}(\theta - (1 + x_G)s_G)$ is the interest payment that G owes the private market for the remaining financing gap, and the truncation function, $\mathbb{I}(\theta - (1 + x_G)s_G)$, ensures that the amount is well-behaved.[6] Let $F_{\phi_\theta}(\cdot)$ be the cumulative distribution function of ϕ_θ. It then follows $p(s_G, x_G, r; \theta) = F_{\phi_\theta}[r\mathbb{I}(\theta - (1 + x_G)s_G)]$.

A representative international actor, M, observes the remaining financing gap, $K = \theta - (1 + x_G)s_G$, as well as the outcomes from the bargaining phase, s_G and x_G. M uses these

[5] That is, $Pr(\phi_{\theta_1} \geq a) \geq Pr(\phi_{\theta_2} \geq a)$ for any $a \geq 0$. The distribution of ϕ_θ is publicly known.

[6] That is, $\mathbb{I}(\theta - (1 + x_G)s_G) = \theta - (1 + x_G)s_G$ if $(1 + x_G)s_G \leq \theta$, and $\mathbb{I}(\theta - (1 + x_G)s_G) = 0$ otherwise.

signals to draw inferences about G's true type as well as the crisis probability. Finally, M sets the interest rate, r, in a competitive market based on the probability of G experiencing a crisis.

We now proceed to specify the actors' payoffs. G's utility function for each period is a function of its observables, $-bx_G - p(s_G, x_G, r; \theta)$, and unobservables, $\epsilon(d_x, d_s)$:

$$u_G(\theta, \epsilon; d_x, d_s; s, x, r) \quad = \quad -bx_G - p(s_G, x_G, r; \theta) + \epsilon(d_x, d_s). \tag{1}$$

where b is a constant that weights the cost to G of implementing reforms relative to its expected loss due to a crisis. Note that θ and ϵ are the state variables, (d_x, d_s) are G's choice variables that determine s_G and x_G, and s, x and r are choice variables of L and M that enter G's utility function as parameters.

We allow L's lending decision to be influenced by its geopolitical interests in the country. Let $\beta \in [0, \bar{\beta}]$ capture this bias. Then, L's utility function for each period is:

$$u_L(s, x; d_x, d_s, r; \beta, \theta) = -c(1-\beta)s_G - (1+\beta)p(s_G, x_G, r; \theta). \tag{2}$$

where c is a constant that measures the unit opportunity cost of s_G for L. The geopolitical importance of G influences L's lending decision in two ways: it gives L a direct incentive to lend more to an "important" G, and it amplifies the negative effect if a crisis occurs under such a government, thus giving L an indirect incentive to lend more to G.

Lastly, let M be a representative agent in a competitive market, so that the price of debt exactly offsets the risk of default. M is risk neutral so that its utility function is the same as its expected profit:

$$u_M(r; s_G, x_G, \theta, \underline{v}) = \{[1 - p(s_G, x_G, r; \theta)]r - p(s_G, x_G, r; \theta) - \underline{v}\}[\theta - (1 + x_G)s_G], \tag{3}$$

where $\underline{v}$ is the transaction cost in percentage, and as mentioned before, $\theta - (1 + x_G)s_G$ is the scale of the financing that G needs to borrow from M.

This is a game of incomplete information and we solve for a perfect Bayesian equilibrium (PBE).[7]

[7] For technical details, see the appendix.

4. Equilibrium Results

As is generally true for infinitely repeated games, this game has multiple equilibria. Based on our substantive interests, we focus on a particular type of equilibrium where G accepts and then complies with agreements most of the time, but sometimes reneges. Moreover, we are interested in how L's political bias towards G may influence its lending decision and how G responds in turn. To facilitate the explanation of the equilibrium results, we define a punishment phase as beginning if G did not comply with its agreement with L in the previous period; otherwise, G is in a bargaining phase, or in good standing, at the beginning of a period. Each phase may include multiple periods.

In our model, G may choose to defect if the cost of implementing the conditionality is very high. It is easy to show that L is better off if G complies with an agreement; therefore, it is in L's interest to adopt a punishment strategy that will minimize G's incentive to defect. We consider the following punishment strategy for L: if G defects, then L withholds any further loan program from G for at least a period. This means that the game enters a punishment phase in which L offers $s = 0$ to G. However, while such a punishment strategy could deter G from defecting, withholding credit for a long period of time also negatively affects L's long-term utility, and this cost is magnified when L faces a high β country. We show that the optimal strategy for L thus is to allow G to come back to good standing by allowing G to implement a modified conditionality schedule after entering a punishment phase. In the following proposition we characterize an equilibrium in which L adopts such a limited punishment strategy, offering two levels of conditionality contingent on G's compliance behavior.[8]

Proposition 1. *If the marginal crisis reducing effect of, s, decreases as s increases, and the unit cost of loan, c, is sufficiently large, then for any β, b, c and $p(s, x; \theta)$, there exists a perfect Bayesian equilibrium to the game with the following equilibrium strategies of the players:*

(1) The game begins in a bargaining phase. If the game is in a bargaining phase, then

[8]The proof of the proposition is in the appendix.

L offers a bundle of loan size and conditionality, $(s_b^*(\beta), x_b^*(\beta))$*, to G; if G defects in any period by choosing* $(d_x, d_s) = (0, 1)$*, then the game enters into a punishment phase where L offers G a bundle* $(0, x_p^*(\beta))$*. The punishment phase lasts until G chooses to implement* $x_p^*(\beta)$ *in some period, in which case the game returns to the bargaining phase. Here,* $s_b^*(\beta)$*,* $x_b^*(\beta)$ *and* $x_p^*(\beta)$ *maximize L's expected lifetime utility on the equilibrium path. Moreover, in any period, if L has not deviated from its strategy in (1), then G chooses* (d_x, d_s) *to optimize its expected lifetime utility given* θ *and* ϵ*.*

(2) If in any period L has deviated from its strategy in (1), then G chooses (d_x, d_s) *that optimizes its one-period expected utility from that period and thereafter, and consequently, L plays* $(s_o, x_o) = (0, 0)$ *from the next period and thereafter.*

(3) In any period, M chooses $r^*(\beta)$ *to clear the current period loan market after observing the outcome of the interaction between L and G.*

Because the number of choice variables makes the model computationally intensive, we present below the numerical results of the equilibrium. Because we are interested in crisis lending, we focus on the results for the case in which G's economy is of type θ_2, that is, the government faces a large financing gap.[9] The parameters of the model are calibrated to match some aspects of the empirical data; however, our model produces significant new predictions.[10] To examine the robustness of the results, we have perturbed the parameters around their benchmark values, and we find that the qualitative relationships do not change. Below we show several findings that center around the relationship between our key parameter β and the choices made by G and L in equilibrium.

(1) Lender's equilibrium strategy

Figure 1 shows the two regimes of optimal loan size as a function of β in Proposition 1. (1) For $\beta \in [0, 0.12]$, s_b^* is an increasing and convex function of β. This means s_b^* increases sharply as β increases in this range until s_b^* reaches the upper bound of available funds. The logic that drives this relationship is that the marginal cost of s for L is decreasing in β,

[9]Similar results can be presented for the less interesting case where the government's type is θ_1.
[10]For technical details of the derivations, see the appendix.

while the marginal benefit of s is increasing in β, so L is increasingly willing to lend to more important countries. (2) For $\beta \in [0.12, 1]$, L cannot increase s_b^* further due to the budget constraint, but is willing to lend the maximum amount.

Figure 2 shows how β affects x_b^*, the equilibrium level of conditionality, and x_p^*, the level of implementation of conditionality required to return to good standing when a country is in punishment status, respectively. Both x_b^* and x_p^* are decreasing in β. To foreshadow the results that we will be presenting in the next section, note that these two variables have countervailing effects on $Pr(d_x = 0 | d_s = 1)$, the probability of defection conditional on accepting s_b^*. On the one hand, x_b^* measures the cost of implementing the conditions tied to L's loan, so less conditionality, or smaller x_b^*, makes it less attractive to defect. On the other hand, a smaller x_p^* reduces the future cost of returning to good standing after reneging, which makes defection a more attractive option in the present for G.

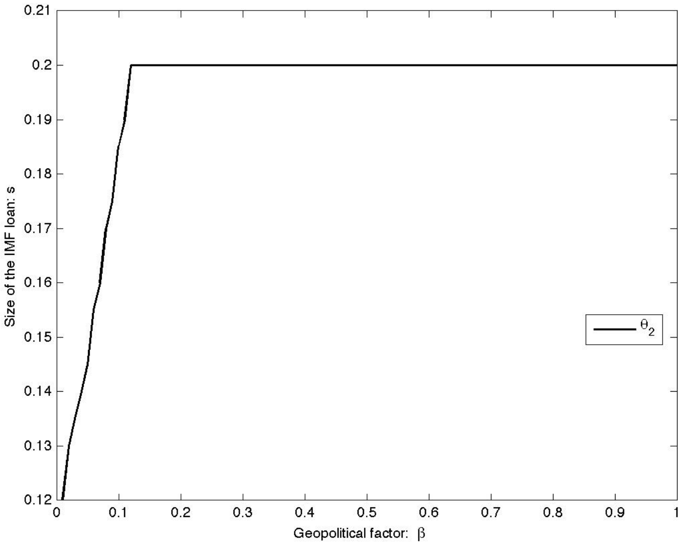

Figure 1: The Effect of Political Bias on the Equilibrium Loan Size

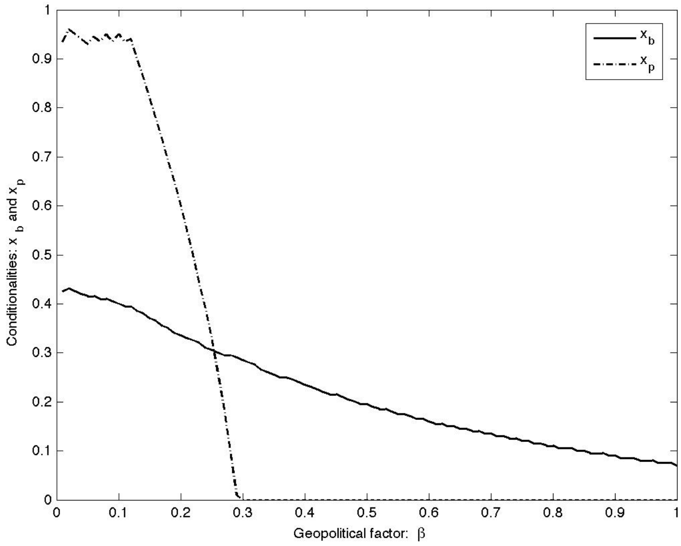

Figure 2: The Effect of Political Bias on the Equilibrium Conditionality x_b and x_p

(2) Government's equilibrium strategy

Figures 3 and 4 show the equilibrium choice probabilities of G in the bargaining phase. Figure 3 shows the relationship between β and $Pr(d_s = 1)$. First, given a value of β, G of θ_2 (bad economy) is more likely to accept an offer because a government facing a severe liquidity crisis has greater need for funds in order to stave off involuntary default. This logic drives the adverse selection effect: countries that accept IMF offers, on average, are worse candidates for investment than countries that reject them. Second, the effect of β has a non-monotonic effect, initially increasing the probability of accepting a loan rapidly, as bias makes the loan terms more attractive. Once the size of the loan hits its upper bound, however, this effect diminishes.

Figure 4 plots the probability of reneging on promises to implement economic reforms after accepting a crisis loan, $Pr(d_x = 0|d_s = 1)$, against β. There are three distinctive regimes. (1) For $\beta \in [0, 0.12]$, the downward slope of $Pr(d_x = 0|d_s = 1)$ is primarily driven by the effect of s_b^* (Figure 1), which increases quickly and reaches its maximum, while x_b^* declines slowly and x_p^* largely remains the same for this range of β (Figure 2). (2) For $\beta \in [0.12, 0.29]$, x_p^* drops quickly to zero, while s_b^* is already at its maximum and x_b^* declines steadily. As a result of the dominant effect of x_p^* in this regime, $Pr(d_x = 0|d_s = 1)$ increases in β. This shows a moral hazard problem for politically influential countries whose incentive to comply with agreements is weaker. For $\beta \in [0.29, 1]$, both s_b^* and x_p^* are bounded, while x_b^* continues to decline; consequently, $Pr(d_x = 0|d_s = 1)$ decreases in β.

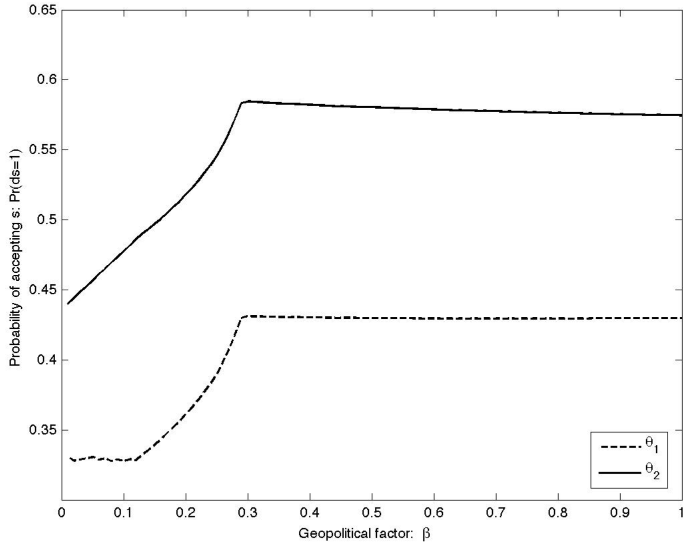

Figure 3: The Effect of Political Bias on $Pr(Acceptance)$ of a Loan Agreement

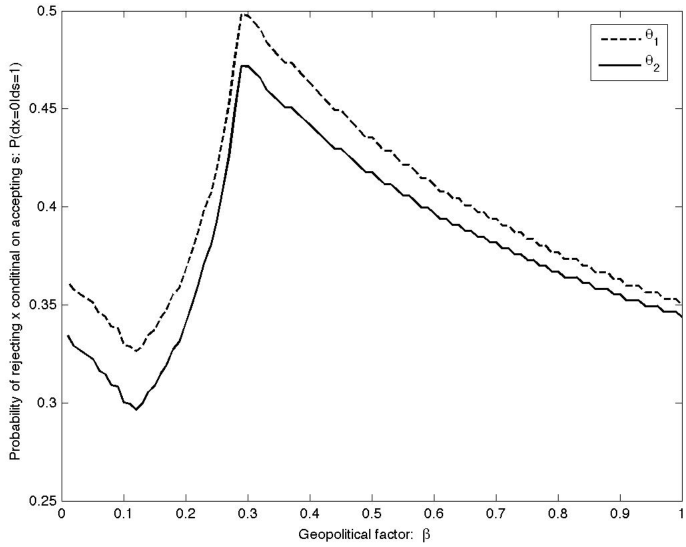

Figure 4: The Effect of Political Bias on $Pr(Defection)$ Conditional on Accepting s

Figure 5 shows that the probability of G carrying out an overdue reform in a punishment phase increases as β increases. This is because the equilibrium conditionality, x_p^*, decreases as β increases, so it is easier for higher β countries to implement the reduced conditionality.

Figure 6 depicts a direct consequence of this result: the expected duration of a punishment phase, $ET(\beta)$, decreases in β. That is, more important countries are punished for shorter time periods than less important countries.

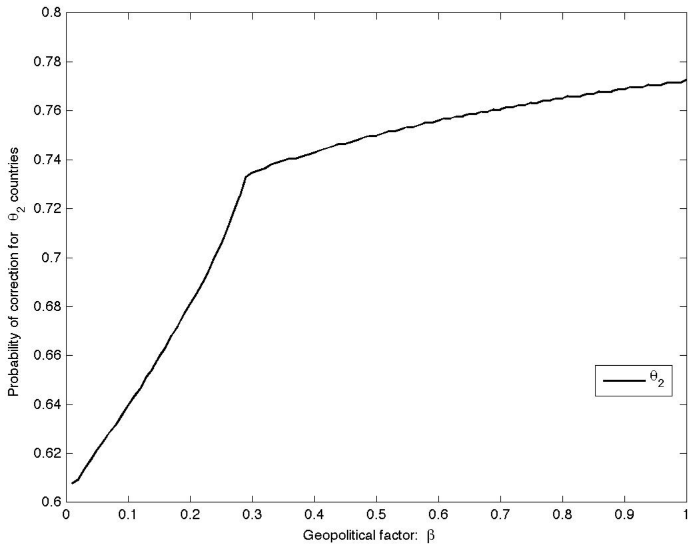

Figure 5: The Probability of Carrying Out an Overdue Reform in a Punishment Phase

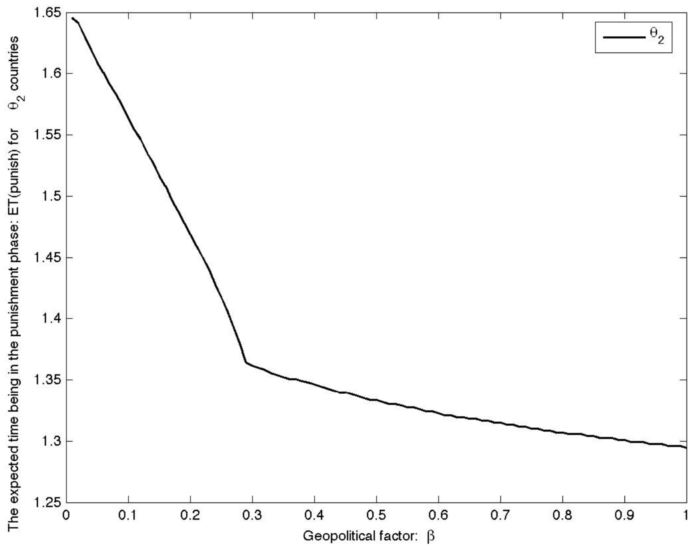

Figure 6: The Expected Duration of Punishment for Defection

(3) Market reaction of the interest rate to x, s and β

Figure 7 shows the relationship between the equilibrium interest rate, r^*, and the political importance of a country when the country accepts an agreement. (Figure 7 plots the equilibrium interest rate, r^*, conditional on accepting s_b^* as a function of β, given $\theta = \theta_2$.) There are three regimes corresponding to those in Figure 4. The increase in liquidity, s_b^*, as a function of political bias drives the downward slope of r^* in regime (1), while the steadily declining x_b^* drives the upward slope of r^* in regime (3). Moreover, the shape of r^* in regime (2) is determined by the net effects of x_b^* and x_p^*. On the one hand, increasing bias causes a drop in x_b^*, which reduces the probability of defection, but increasing bias also causes a decrease in x_p^*, which makes defection more attractive. The net effects of decreasing conditionality and enforcement on the probability of defection, $Pr(d_x = 0|d_s = 1)$, is positive, as illustrated in Figure 4. On the other hand, a drop in x_b^* also raises the crisis probability conditional on accepting both s_b^* and x_b^*. Therefore, we observe a steeper positive slope of r^* in regime (2).

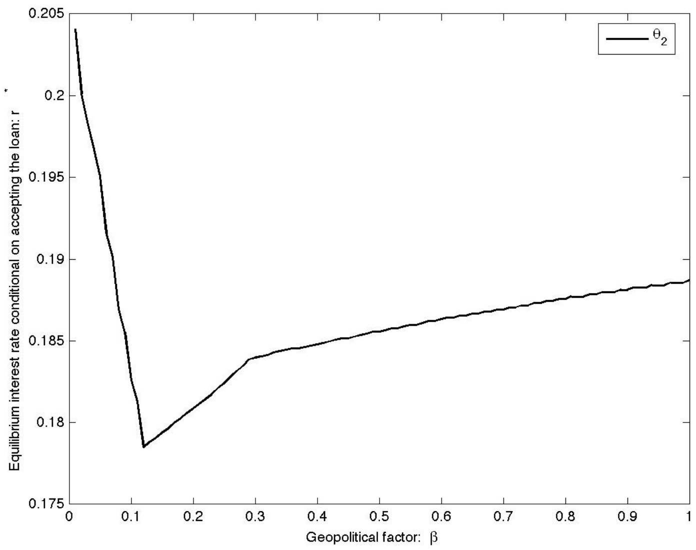

Figure 7: The Total Effect of Political Bias on the Equilibrium Interest Rate with an Agreement

In addition to these relationships, in equilibrium conditionality and loan size both lower bond yields. Below we discuss the empirical implications of these equilibrium dynamics.

5. Empirical Implications

Our theoretical model contains several innovations. Most importantly, it endogenizes the probability of crisis in the borrower country as a function of the interest rates set by a market actor, which themselves are a response to the loan terms negotiated between the lender and the borrower. Building on these innovations, we derive several new hypotheses about the political determinants of loan size and conditions, and the effects of loan size, conditionality and lender bias on equilibrium interest rates. We distinguish between three categories of effects: bargaining, adverse selection, and moral hazard.

Our first set of hypotheses deals with the effect of political bias on loan terms. As Figures 1 and 2 illustrate, the lender's political bias on behalf of the borrower has a monotonically increasing effect on equilibrium loan size, while it has a monotonically decreasing effect on loan conditionality.

H1 (Bargaining and Loan Terms): Political bias is associated with lower conditionality and higher liquidity.

Loan terms, in turn, influence the market interest rate, because they have direct effects on the probability of a financial crisis. Increased liquidity—an expanded crisis loan—decreases the probability of a crisis, all else equal, so it decreases the interest premium due to political risk. Similarly, increased conditionality reduces the probability of a crisis, because implementing economic reforms reduces the size of the financing gap that must be filled by the private sector. Consequently, conditionality reduces the equilibrium market interest rate. Our model predicts that more conditionality and larger loans will depress interest rates.

H2 (Loan size and interest rates): Larger crisis loans are associated with lower interest rates.

H3 (Conditionality and interest rates): Conditionality is associated with lower interest rates.

Crisis lending is not randomly distributed, so the class of countries that negotiate crisis lending deals differs systematically from the population of non-participants (Vreeland 2003).

In our model, governments have private information about the health of their economies, which influences the return to participation in a crisis bailout. Specifically, governments that face weaker economic fundamentals have stronger incentives to accept a loan, so countries that accept lending packages reveal themselves to be in worse circumstances than the average country without a loan, and thus, on average, more prone to subsequent crisis. Therefore, after controlling for the effects of loan size and conditionality, we expect the onset of a loan to generate increased interest rates.

H4 (Adverse selection): Crisis lending announcements are associated with higher interest rates, controlling for conditionality and amount of financing.

Our model assumes that it is more costly for lenders to deny support to politically influential borrowers, which reduces the sanctions that influential borrowers face when they renege on their commitments to implement reforms. This can be expressed in the expected duration of the punishment phase, which is lower for influential countries, as depicted in Figure 6. This occurs because, as Figure 2 illustrates, the policy reforms that are required to bring their programs back on track are less arduous. As a result, the expected cost of punishment is lower for influential countries, which implies that their incentives to comply with conditionality are weaker, as illustrated by Figure 4. Influential countries implement a lower proportion of their policy commitments, so they are more subject to financial crises, and consequently they pay higher risk premia. In our model, this effect is present only for countries participating in conditional lending programs, because we model capital markets as fully liquid. However, if the model were extended to allow for long-term lending, this effect would be present for influential countries regardless of whether they were currently participating in a conditional lending program. In either case, however, the effect should be strongest for countries that are currently participating, because future participation is discounted and uncertain.

H5 (Moral hazard): Political bias exerts an upward pressure on equilibrium interest rates, and this effect is strongest for countries that are crisis borrowers.

6. Research Design

To capitalize on data availability and a comparable set of cases of lending, we focus on crisis lending by the International Monetary Fund, using data drawn from the IMF's Monitoring of Agreements Database (MONA). The data span the period from 1992 to 2002 and cover the 66 countries that were not members of the OECD and for which data on bond yields were available from IFS. Our dependent variable is the nominal yield of short-term sovereign bonds issued in home country currency and measured at the end of each month. Our quantities of interest are the effect of new program announcements, conditional on measures of U.S. influence over the IMF, the effects of those measures of influence when a new program is announced, and the effects of conditionality and loan size. We treat conditionality and loan size as endogenous. We use a dummy variable for a month in which a new program is announced to capture the short-term effects of new program announcements. Any information contained in the lending decision should be reflected in this short-term effect. To capture conditional effects, we regress interest rates on the new program dummy, influence variables x new program, influence variables x no new program, conditionality and loan size, and controls.[11]

We do not correct for selection bias, for several reasons. Corrections for selection bias, as for example those produced by Heckman-type selection models, attempt to estimate the hypothetical effect that a treatment might have if it were applied randomly. This is not the question that we want to ask, because we are interested in estimating the selection effect. Instead, after controlling for the liquidity and conditionality channels through which IMF programs exercise their treatment effects, we interpret the estimated coefficient on IMF program initiation as due to selection bias. To be precise, our theoretical model predicts adverse selection—worse candidates for programs are those that choose to participate—so we anticipate that program initiation will be associated with increased interest rates, after controlling for financing and policy conditionality. The coefficient, although biased from the

[11]This is mathematically equivalent to the usual practice of including the dummy variable, the interaction term and the uninteracted covariate in the regression, but allows us to report our quantities of interest and the hypothesis tests appropriate for them in Table 1.

point of view of a treatment effects model, is exactly the theoretical quantity that we want to estimate.

The reader might be concerned, however, that failing to control for selection leaves the error term correlated with our regressors, which biases the estimates on our other coefficients. This is a question about whether the assumptions of our empirical model correspond to the assumptions of our theoretical model. The theoretical model presented above assumes that the only private information relevant to the game belongs to the government. The short-term interest rate is determined by market actors after the government decides to accept a loan and before it reveals whether it will implement conditionality, so it can only depend on public information and any private information held by market actors. The terms of the loan offer are set by the lender, so they are not correlated with the government's private information. The lender's bias is assumed to be public knowledge, and is operationalized below in terms of publicly observable variables, so it cannot be correlated with the government's private information. Similarly, our control variables measure publicly observable information. Consequently, none of our estimates will be biased as long as the market actors' private information is uncorrelated with the government's private information, and our theoretical model assumes that this is the case.[12]

Measures of U.S. Influence

Our theory does not provide guidance about what particular interests motivate the United States to interfere in IMF program design, so we take an eclectic approach and allow for a range of variables to exert effects that reflect alternative interests. Following extant studies

[12]In Heckman's model, there is a single player with private information, so that both her decision and the error term are correlated with her private information. In contrast, in our model, the private information determining program participation and the second stage error term belong to two different players, so the independence assumption is much weaker. Our theoretical model could be enriched to allow for insider trading, which would violate the assumption of uncorrelated private information, but in order for the effect to be substantively important it would have to affect the equilibrium interest rate, which implies that the information is no longer private. In any case, we think the assumption of uncorrelated private information is relatively innocuous in our application because the effects of any bias would have to be quite large to overturn the results we report below, and our results rely on models with country fixed effects that capture most of the likely sources of endogeneity. Furthermore, Heckman-type models are inefficient, and our theoretical model rules out all of the candidates for instruments for program participation.

(e.g. Thacker 1999, Stone 2004, Oakley and Yackee 2006), we operationalize U.S. interests in terms of similarity of the borrowing country with the United States in alliance portfolios and UN General Assembly voting patterns, and U.S. bank exposure in recipient countries (Copelovitch 2010, Stone 2011). We also tested for effects of U.S. foreign aid and U.S. exports, but those variables did not yield significant results, so they are not included in the specifications that we report below.

Instrumental Variables

The model indicates that IMF conditionality, loan size, and market responses are endogenous to U.S. interests, so we adopt an instrumental variables approach. The validity of instrumental-variables analysis depends on the strength and exogeneity of the instruments. We use the following instrumental variables, which are correlated with loan size and conditionality, but are not strong correlated with bond yields. More importantly, we have argued that conditionality and loan size are endogenous to our measures of U.S. influence; our theoretical model predicts that countries with a high "β" are more likely to receive loans, and those loans are, on average, larger and have fewer conditions. Therefore, the exogeneity of instruments is important with respect to our measures of U.S. influence. These instruments can be thought of as non-political determinants of IMF program terms, theoretically and empirically separate from the geopolitical concerns in which we are interested.[13]

Number of countries participating: Przeworski and Vreeland (2000, 2001) and Vreeland (2003) argue that the IMF becomes reluctant to lend when its resources are stretched thin because of the need to hold something in reserve for future crises. This might lead the Fund to make smaller loans or extract more extensive conditionality in return for

[13]Empirically, the highest correlation between our instrumental variables and treasury bill rates is $\rho = .17$ for the case of total outstanding commitments, followed by $\rho = .14$ for countries with extended IMF program commitments. More importantly, however, these instruments are not highly correlated with our measures of U.S. influence, which theoretically drive loan size and conditionality. The highest correlation between affinity scores and any instrument is $\rho = .15$ for number of countries participating, which is perhaps the least likely of our instruments to have a causal association with a particular country's affinity score with the U.S. U.S. commercial bank exposure is also not strongly correlated with any of our instruments ($\rho < .02$), with the exception of its moderate correlation of $\rho = .15$ with the ratio of prior IMF commitments to IMF quota. Alliance similarity with the U.S. is not strongly correlated with any instrument. The results that follow are robust to the one-by-one exclusion of each instrument (the results are in the on-line appendix).

scarce funds. Alternatively, the number of countries participating in IMF programs might be an index for systemic vulnerabilities that magnify the risks of contagion. This could lead the IMF to offer more generous lending terms, including larger loans and more limited conditionality. We find that the number of participants increases IMF willingness to extend credit and reduces conditionality.

Ratio of Prior commitments of IMF financing to IMF Quota: The IMF has formal rules about access to credit measured in terms of multiples of a country's contributed quota. These rules can be waived, but the Executive Board is reluctant to extend credit substantially beyond previous precedents, and such decisions lead to extended discussions. To the extent that quotas represent constraints on IMF lending, previous commitments reduce the amount of credit available, and should reduce the size of new lending arrangements. Alternatively, the defensive lending hypothesis holds that countries that owe substantial amounts to the IMF may more easily qualify for additional credits because the Fund seeks to prevent any of its debtors from going into default. We find support for the hypothesis that prior commitments constrain new credits, and not for defensive lending.

Extended program: This is a dummy variable that codes arrangements that are designed to be disbursed over more than one year, including the EFF, ESAF, and PRGF. Such programs are typically intended to follow successful Stand-By arrangements and deepen structural reforms, so they typically involve more extensive conditionality and larger commitments of financing.

Unmet conditions: This is a count of categories of conditions that the borrowing country has failed to implement under an immediately previous IMF program (which may currently be waived, modified, canceled, or delinquent). This is a strong predictor of conditionality in subsequent programs, because IMF staff insist on additional conditionality when a country has had difficulty in implementing previous programs.

The inclusion of these instruments in our instrumental variables regressions below consistently yields first-stage F statistics of over 119 and 611 for our equations predicting loan size and conditionality, which is well over the of 10 suggested by Staiger and Stock (1997), and these variables are statistically significant predictors of loan size and number of conditions.[14]

Control Variables

We use a common set of controls, including our three measures of U.S. influence interacted with a dummy for months in which there is no new program announcement (alliance patterns, UN voting patterns, and U.S. bank exposure). We control for economic variables that are correlated with interest rates and the terms of crisis lending (foreign debt, GDP per capita, reserves as a share of GDP, population). In addition, we control for missing data, which is a measure derived from a principal components analysis of the missingness of 19 time series reported by member countries to the IMF. Countries that fail to report these data are likely to have low administrative capacity, and this is associated with higher conditionality and higher interest rates. IMF standing is a measure of past non-performance of conditionality, which is derived from a 12-month moving average of a dummy variable that measures whether a country has an IMF program that is suspended for non-performance. Past non-performance is associated with additional conditionality and higher interest rates.

Results

The results of three models are presented in Table 1 below. The first model uses OLS to provide a baseline for comparison, and the second and third use instrumental variables (2SLS) to model the endogeneity of conditionality and the size of IMF lending facilities predicted by our model. The second model allows for cross-sectional and time series variation, and the third uses country fixed effects to focus on over-time variation within countries. The results are broadly consistent across the three models, but there are important differences that we highlight below. The coefficient of IMF program initiation is statistically insignificant in the first two models when the three U.S. influence variables take a value of zero, but is significantly associated with higher interest rates in the fixed-effects specification. As we

[14] Neither number of countries currently under IMF programs nor extended commitments is a strong predictor of loan size, though both are strong predictors of number of conditions.

will see below when we interpret the conditional effects, however, IMF program initiation is statistically significant in all three models across most of the range of the U.S. influence variables. Note that this variable measures the short-term effect of initiating a new IMF program, which is our theoretical quantity of interest, not the steady-state effect of having an IMF program.

In the 2SLS estimates we focus on the second stage estimates that predict interest rates, though the first-stage estimates (Presented in Table 3) confirm our theoretical expectation that political importance increases loan size but depresses the number of conditions attached to a loan. IMF credit is measured as the monthly change in aggregate IMF commitments in the month in which a new program is introduced, so it represents a short-term effect. The effect is substantively and statistically insignificant in the baseline OLS model. In the second model, which treats the loan amount as endogenous, however, IMF credit is highly significant, and is estimated to reduce interest rates on average by 16 percentage points. Comparing models 2 and 3 makes it clear that most of this effect is due to cross-sectional variation across countries rather than to within-country variation over time. The coefficient remains highly significant in the fixed-effects specification, but the size of the estimated effect drops to an average of 6.5 percentage points. Nevertheless, the results indicate that even in this conservative specification, particular countries experience greater gains in investor confidence, all else equal, when they receive larger infusions of IMF credit, and the effects can be substantial.

The estimated effect of conditionality on bond yields differs across the three models, but does so in a way that makes us confident in our interpretation of the results. The OLS estimate indicates that conditionality, contrary to theory, increases bond yields. However, when we model the endogeneity of conditionality—countries that have failed to implement conditionality in the past are subject to more conditionality in the present, for example—this effect is reduced by one-third. When we further control for fixed effects that capture a wide range of country-level variables that affect both conditionality and credit-worthiness, the result is reversed. Focusing on the 2SLS results with fixed effects, it is clear that when a particular country is subject to more conditionality, its interest rates are lower, as predicted.

Table 1: Effect of IMF Program Initiation and U.S. Influence on Bond Yields

	OLS		2SLS		2SLS (Fixed Effects)	
	Coefficient (std. error)	p-value	Coefficient (std. error)	p-value	Coefficient (std. error)	p-value
IMF Program Initiation	0.94 (5.80)	0.87	11.90 (7.54)	0.12	11.76 (5.59)	0.04
IMF Credit	1.06 (0.72)	0.14	-0.05 (0.01)	0.00	-0.02 (0.01)	0.00
Number of Conditions	0.68 (0.07)	0.00	0.46 (0.13)	0.00	-0.76 (0.11)	0.00
New IMF Program						
Alliance portfolio	5.17 (12.73)	0.69	3.08 (15.79)	0.20	44.37 (13.09)	0.00
UN Voting	35.22 (6.01)	0.00	30.35 (7.52)	0.00	17.78 (5.67)	0.00
U.S. Bank Exposure	-97.51 (104.86)	0.35	2509.93 (607.38)	0.00	1404.66 (428.67)	0.00
No New Program						
Alliance portfolio	-15.86 (1.15)	0.00	-16.69 (1.44)	0.00	42.86 (5.56)	0.00
UN Voting	5.27 (0.67)	0.00	5.84 (0.84)	0.00	5.17 (0.91)	0.00
U.S. Bank Exposure	7.71 (14.09)	0.59	7.92 (17.55)	0.65	67.00 (26.08)	0.01
Control Variables						
Population	-0.13 (0.01)	0.00	-0.12 (0.01)	0.00	0.26 (0.10)	0.01
Foreign Debt	.33 (0.02)	0.00	0.30 (0.03))	0.00	0.30 (0.08)	0.00
GDP per capita	-0.61 (0.06)	0.00	-0.64 (0.07)	0.00	-1.13 (0.31)	0.00
Reserves/GDP	-24.32 (1.89)	0.00	-24.26 (2.35)	0.00	-47.16 (3.64)	0.00
Missing Data	8.27 (1.57)	0.00	9.25 (1.96)	0.00	8.38 (1.72)	0.00
IMF Standing	2.63 (0.90)	0.00	1.84 (1.43)	0.20	-4.77 (1.13)	0.00
Constant	26.93 (0.74)	0.00	27.78 (0.95)	0.00	-0.11 (3.27)	0.97
Fixed Effects						
F test of fixed effects					49.08	0.00
number of obs	8,373		8,337		8,337	
rho (variance due to fixed effects)					0.64	

The results indicate that conditionality has a substantial depressing effect on bond yields. Conditionality is measured as a count of types of conditions contained in a particular program review, ranging from 0 to 19 and averaging almost 6, so conditionality is estimated to depress bond yields under IMF programs by 4.6 percentage points on average. A one standard-deviation increase in conditionality, or 3.6 more conditions, is sufficient to depress interest rates by another 2.7 percentage points.

The results for our three measures of U.S. influence generally support the model's prediction that bias increases bond yields. The results strengthen when we control for endogeneity and become uniformly significant across measures of of influence when we also control for country fixed effects. The similarity in alliance portfolios has a consistently positive coefficient, but is only significant when we control for fixed effects. This suggests that the variation in alliance commitments that is important is taking place within countries over time, for example, as East European countries dropped out of the Warsaw Pact and joined NATO. In the fixed-effects specification, increasing alliance similarity with the United States by one standard deviation is estimated to increase interest rates by 8.4 percent in the month of a new IMF program announcement. To put this result in context, the alliance similarity between the United States and Poland increased by 65 percent of one standard deviation in this sample between 1990 and 2000. UN voting similarity also has consistently positive coefficients, which are significant in the OLS, 2SLS, and 2SLS with fixed effects specifications. The estimated marginal effect of increasing voting similarity with the United States by one standard deviation is to increase interest rates by 11.2 percent in the month of a program announcement. Comparing the results with and without fixed effects, it appears that almost 60 percent of this effect is due to over-time variation in voting similarity within countries.

The exposure of U.S. banks to particular countries tells a similar story. The OLS coefficient is negative. However, modeling the endogeneity of conditionality and IMF credit reverses the effect, and shows that countries that are important to U.S. banks pay much higher interest rates when they receive new IMF programs. Examining the results of the reduced-form equations makes clear why endogeneity plays an important role in the interpretation of these effects. (See Table 3.) The exposure of U.S. banks plays a major role in explaining the size of IMF loans to particular countries, and IMF credit in turn reduces interest rates. When we take into account this important indirect effect of bank exposure that operates through IMF credit, we find that the direct effect of U.S. bank exposure (which our model attributes to the moral hazard effect) is to substantially increase interest rates. On average, this effect increases interest rates by 12.9 percent, which negates about 80 percent of the average effect of increasing IMF credit. Increasing the exposure of U.S. banks by one standard deviation increases interest rates by an estimated 26.4 percent. Comparing the results with and without fixed effects indicates that 56 percent of this effect is attributable to over-time variation in U.S. bank exposure to particular countries rather than to cross-national variation.

Our model does not make predictions about the effect of U.S. influence variables when no new program has been announced, because the model includes the simplifying assumption that interest rates are recontracted every period. We include these variables as controls, in order to isolate the short-term effects of the same variables during new program initiation months. However, we conjecture that a richer model that allowed bonds to have longer maturities would generate expectations for these variables that are similar to the ones our model generates during announcement months, but that the effects should be smaller. Our intuition is that variations in IMF credibility should affect borrowers with on-going programs and non-borrowers as well as new borrowers, because resorting to IMF financing is always part of the game tree for developing countries and emerging markets. The effects should be smaller, however, because future program participation would be uncertain and discounted for current non-participants. Four of the six hypothesis tests that we perform with models that account for endogeneity support this hypothesis. Similarity of alliance portfolios with the United States has essentially the same effect when there is no new program as when there is a new program announcement in the two-stage least squares specification with fixed effects. Similarity of UN voting records has significant effects that raise bond yields, although the effects when a country does not have a new program announcement are only 20 to 30 percent as large as when a new program is announced.[15] Bank exposure has statistically

[15]The difference in coefficients is not statistically significant.

significant effects that are five percent as large when there is no new program as when there is a program announcement. These results broadly support our conjecture.

Our control variables have the expected effects. Foreign debt increases bond yields, richer countries pay lower interest rates, central bank reserves lower interest rates, missing data increases interest rates, and poor standing with the IMF increases interest rates.

Because the interpretation of interaction effects is not straightforward, Table 2 presents the conditional effects of announcing a new IMF program with U.S. influence measures fixed at their means and at one standard deviation above their means. [Table 2 about here] The effect of initiating a new IMF program is highly significant in the 2SLS equations when all three U.S. influence measures are fixed at their mean, and extracts a risk premium of 28.1 percentage points (the 95% confidence interval of the effect runs from 18.4 to 37.9 percentage points). Comparing across the columns reveals that the effects are weaker in the fixed effects specification, but 58 percent of the effect of IMF program announcements is attributable to over-time variation in interest rates within countries, rather than to contemporaneous comparisons of countries with and without new program announcements. The effects become stronger when the U.S. influence measures are increased. Increasing alliance similarity with the United States is associated with only a slight change in interest rates, but the effect of a new program is approximately 30 percent greater in countries that vote in alignment with the United States in the UN to a degree that puts them one standard deviation above the mean.

The most dramatic estimated effects of U.S. influence occur in countries that are important to U.S. banks. Controlling for endogeneity and allowing for cross-sectional effects, equation 2 finds that the effect of a new program announcement is to increase bond yields by nearly 64 percentage points in countries that are one-standard-deviation more important to U.S. banks than average. One standard deviation is a bit under 2 percent of total U.S. foreign bank assets, so it is not near the high water mark set by Mexico in 1995 of 18 percent. This is approximately the level reached by Colombia in the early 1990s, and Greece, the Philippines, South Korea, South Africa and Venezuela in the late 1990s. This effect is

Table 2: Conditional Effects of New IMF Program Announcements

	OLS		2SLS		2SLS (Fixed Effects)	
	Coefficient (std. error)	p-value	Coefficient (std. error)	p-value	Coefficient (std. error)	p-value
All variables at their means	-0.02 (1.87)	0.99	28.12 (4.96)	0.00	16.29 (3.45)	0.00
Alliance S-score 1 std. dev. above mean	0.96 (3.25)	0.77	31.90 (5.93)	0.00	16.57 (4.23)	0.00
UN Voting S-score 1 std. dev. above mean	12.98 (2.94)	0.00	37.19 (5.40)	0.00	20.94 (3.83)	0.00
US Bank exposure 1 std. dev. above mean	-1.41 (2.37)	0.55	63.79 (13.19)	0.00	35.35 (9.07)	0.00

weaker in the model with fixed effects, indicating that a substantial portion of the effect is due to cross-country comparisons. However, 55 percent of the effect is attributable to over-time variation within particular countries.

What is the total effect of political influence on bond yields for IMF program participants? In other words, what is the cumulative effect of our measures of U.S. influence on bond yields, both operating directly and indirectly through IMF credit and conditionality? Table 3 displays the results of model 3, but now with first stage estimates reported. Consider the loan the IMF extended to Russia to counter a crisis of confidence in the sovereign bond market in July 1998. At the time, Russia's alliance profile and UN voting profiles vis-a-vis the United States were close to their average levels, so they are estimated to have had no substantial effects on the terms of the loan, but Russia's share of U.S. bank lending had risen over the previous two years to almost five percent of total foreign assets. Under U.S. pressure, the IMF scrambled to assemble its largest loan to Russia, activating its General Arrangements to Borrow in order to secure the necessary resources. This in turn required U.S. Congressional action, prompting Treasury Secretary Robert Rubin to write to House

Speaker Newt Gingrich, "Our interest in successful political and economic reform in Russia is compelling. A collapse of the ruble would undoubtedly strengthen Russian opponents of reform, who include ultra-nationalists and Communists."[16] According to model 3, the scale of U.S. bank exposure is estimated to have boosted the size of the IMF loan to Russia by 3.15 billion SDRs, or approximately 50 percent of the 6.3 billion SDRs that the IMF committed.[17] The large size of the loan, in turn, is estimated to have depressed bond yields by 63.6 percentage points. On the other hand, the large scale of U.S. bank exposure is estimated to have had a direct effect of raising Russian bond yields by 78.2 percentage points, which is attributable to moral hazard. In addition, program initiation is estimated to have raised the premium on Russian bonds by another 11.8 percentage points, which is attributable to adverse selection. The net estimated effect of IMF lending to Russia in this case is an increase in interest rates of 25.8 percent.

Capital markets initially reacted to the loan announcement with some optimism, and Russian bond yields declined in anticipation of the loan package announcement. Yet shortly after the announcement, bond yields began to rise to crisis levels, reaching 75 percent by early August—25 points above the Russian average treasury bill rate for the sample—and soared to 150 percent by the middle of August as it became clear that the Russian government was considering default (Sturzenegger and Zettelmeyer 2006, 98). Amid increasing market panic, Russia defaulted on some obligations, suspended inter-bank payments and devalued the ruble in late August. The dynamics driving investor expectations during the crisis were complex, but our theoretical model suggests that the terms of the bailout may have signaled that first, the extent of the Russian crisis was larger than anticipated, and second, the importance of the Russian economy to IMF principals was such that it could acquire bailout funding without implementing the longer-term structural reforms necessary to return to fiscal solvency. Indeed, although the July program included a far-reaching set of reforms intended to restore fiscal solvency, signals began to leak out within days of signing the accord that the Russian government did not seriously intend to implement them. As Blustein puts it, "during

[16]Cited in Stone (2002), 155.

[17]The 17.1 billion dollar headline figure announced at the time included loans from the World Bank and Japan.

Table 3: Fixed Effects IV Regression

Variable	IMF Credit	Conditions	Bond Yields
IMF Program Initiation	158.26 (89.31)	3.05** (0.60)	11.76* (5.59)
IMF Credit	–	–	-0.02** (0.01)
Number of Conditions	–	–	-.76** (.11)
New IMF Program			
Alliance Portfolio	-11.66 (220.62)	-1.20 (1.47)	44.37** (13.09)
UN Voting Affinity	-101.44 (93.0)	-2.33** (0.62)	17.78** (5.67)
US Bank Exposure	54918.33** (1517.64)	17.80 (10.12)	1404.66** (428.67)
No New IMF Program			
Alliance Portfolio	-46.19 (100.24)	-0.38 (0.67)	42.86** 5.56)
UN Voting Affinity	0.44 (15.23)	0.04 (0.10)	5.17** (0.91)
US Bank Exposure	1220.51 (401.60)	-12.11** (2.68)	67.00** (26.08)
Control Variables			
Population	1.44 (1.61)	0.09** (0.01)	0.26** (0.10)
Foreign Debt	0.98 (1.38)	0.01** (0.00)	0.30** (.08)
GDP per Capita	2.77 (5.38)	-0.11** (0.04)	-1.13** (0.31)
Reserves/GDP	-36.40 (62.11)	-0.85* (0.41)	-47.16** (3.64)
Missing Data	21.83 (28.51)	-0.09 (0.19)	8.38** (1.72)
IMF Standing	-64.60** (16.10)	0.90** (0.11)	-4.77** (1.13)
Instruments			
Number of countries	-0.18 (0.31)	0.01** (0.00)	–
Extended Program	41.09** (11.89)	3.91** (0.08)	–
Unmet Conditions	2.77 (2.03)	0.57** (.01)	–
Commitments/ Quota	-49.61** (6.32)	0.41** (0.02)	–
Constant	-5.80 (58.11)	-1.51** (0.39)	-0.11 (3.27)
n = 8337			
F	119.67**	611.58**	–
χ^2			902.9**

**Signficant at the .01 level. *Significant at the .05 level. Standard errors in parentheses.

the 1990s, the Russians had usually heard 'yes' when it came to seeking aid from the IMF, to the point that the mantra 'too big and too nuclear to fail' pervaded attitudes of many market participants about the country" (2001, 238). Russia's geopolitical and economic importance created a perception that it would continue to receive IMF funding, making the ultimate decision of the IMF to allow default a surprise for many. At the same time, however. perceptions of geopolitical importance created concerns about the underlying state of the Russian economy and fears about future crises. These concerns created a self-fulfilling prophecy as the combination of rising bond yields, capital flight, and bank runs drove the economy into collapse. Blustein concludes that "it is reasonable to wonder whether Russia was set up for the colossal letdown of 1998 because it had been told 'yes' too many times in the past" (2001, 239).

In summary, we find several pieces of evidence that support our model. We find that conditionality decreases and the scale of financing increases with some of our measures of IMF influence, as hypothesized. We also find that conditionality and liquidity exert strong depressing effects on bond yields. We find robust direct effects of measures of U.S. influence—alliances, UN voting patterns, and U.S. bank exposure—on the yields of sovereign bonds, which are consistent with the moral hazard hypothesis that countries that enjoy privileged access to U.S. decision makers pay additional risk premia. We find that the initiation of new IMF programs is associated with an increase in the risk premium, controlling for conditionality and loan size, and that the risk premium increases more sharply in the presence of U.S. influence. These results hold in models that treat conditionality and loan size as endogenous variables, as the theory specifies is appropriate, and are robust in a model with fixed effects.

7. Conclusion

We have investigated the theoretical and empirical linkages between IMF programs, loan size, conditionality, informal political influence and the responses of international financial markets. Our formal model extends the model in Stone (2002) in three important ways. It incorporates bargaining over the terms of IMF programs, it allows the government to have an information advantage about the state of its finances, and it treats the probability of a crisis and the equilibrium interest rate as mutually endogenous. This richer model allows us to make predictions about the relationship between IMF bias—which we interpret as pressure to lend to countries that are important to the IMF's leading shareholder, the United States—and the scale of financing, the associated conditionality, the enforcement of conditionality, the probability of a financial crisis, and equilibrium exchange rates. The model's results suggest that IMF lending can catalyze private capital flows under some circumstances, but that catalytic effects are highly contextual. This may account for the fact that empirical studies of catalytic effects have reached every possible conclusion. The results indicate that the informal influence that biases IMF lending has similarly complex and contradictory effects on capital markets: influence decreases conditionality but increases liquidity, exacerbates moral hazard problems but ameliorates adverse selection. The net effect on capital flows depends on the various elasticities involved, so it is theoretically ambiguous. However, the mechanisms posited in the model are amenable to empirical testing, and the empirical findings support them unambiguously. Our empirical results indicate that the net effect of IMF lending depends on the borrower's access to U.S. influence, and that the greater the access, the worse the consequences.

Our empirical results can be read as qualified support for the practice of conditional lending, since we find that increasing the scope of conditionality reduces the yield on government bonds. This indicates that market actors believe that the reforms promoted by the IMF improve the probability that they will be repaid. Since the success of the Fund at managing financial crises and limiting international contagion depends upon the perception that its programs are successful, this suggests that rather than implementing plans to streamline conditionality, it might better serve its purposes by expanding it. In addition, we find that larger IMF loans are more effective at stemming capital flight than smaller ones, all else equal. On the other hand, we find evidence that the net effect of announcing a new program, controlling for the effects of liquidity and conditionality, is to raise the cost of borrowing. This indicates that program announcements do not serve as seals of approval, but rather reveal that the government's financial situation is insecure. Furthermore, we find that the negative effect of announcing a program on market confidence increases when the borrowing country is important to U.S. foreign policy. This is consistent with the finding of our model that enforcement of conditionality is less rigorous for influential borrowers, which consequently are less likely to implement conditionality, and more likely to suffer a financial crisis. This interpretation, furthermore, is consistent with the finding that measures of U.S. interest in potential borrowing countries are directly associated with higher bond yields, and that these effects are greatest when a new program is announced. Borrowing from the IMF is always a potential future strategy, so the IMF's lack of credibility with influential countries affects their policies when they do not have active IMF programs, as well as when they do. The effect is strongest, however, when a new program is announced.

In combination, the theoretical model and the empirical estimates provide a clear picture of the effects of informal influence on capital markets. When borrowing countries are able to draw on U.S. influence, conditionality is reduced but liquidity is increased. Meanwhile, the moral hazard effect overwhelms the adverse selection effect, so that the net effect of U.S. intervention is to dampen any positive influence on capital markets that the IMF may be able to exert. When informal influence is at its peak, it causes the announcement of a new IMF program to lead to capital flight. This analysis therefore provides an example of the broader trade-off involved in governance arrangements that allow powerful countries to exert informal influence in exchange for "buy-in" to multilateral institutions. Such arrangements exacerbate the time consistency problems that powerful states face, frequently leading to unintended policy outcomes. In this case, it is precisely the countries that the United States most wants to help to avoid financial crises that are able to derive the least benefit from IMF involvement.

Appendix

The appendix is organized as follows. **A1** provides a partial equilibrium analysis. Specifically, we first show that M's optimization problem can be reduced to a simple substitution of the equilibrium interest rate into the crisis probability. We then show that G's optimization problem can be seen as solving an infinite horizon Markov Decision Process (MDP) on the equilibrium path, and a static MDP off the equilibrium path. **A2** proves Proposition 1.

A1. Partial Equilibrium Analysis

In our model, the three players play an infinitely repeated game, where L, G and M move sequentially in each period. Because we assume a competitive international loan market, M's problem is to choose an interest rate that satisfies the following condition:

$$[1 - p(s_G, x_G, r; \theta)]r - p(s_G, x_G, r; \theta) - \underline{v} = 0, \tag{4}$$

which implies that $r = r(s_G, x_G, \theta, \underline{v})$ is an implicit function of s_G, x_G, θ and $\underline{v}$. Computationally, then, we can solve M's problem first and substitute $r = r(s_G, x_G, \theta, \underline{v})$ into $p(s_G, x_G, r; \theta)$, which enters into L's and G's utility functions. For simplicity, we rewrite the crisis probability as $p(s_G, x_G; \theta)$.

In contrast, L and G face dynamic problems. Their actions today affect their value functions (or continuation values). We now show that G solves an infinite horizon Markov Decision Process (MDP) on the equilibrium path, and a static MDP off the equilibrium path. In doing so, we also derive L's calculation of G's choice probabilities both on and off the equilibrium path, which will be useful for the proofs of Lemma 1 and Proposition 1.

(1) G's strategy on the equilbrium path

On the equilibrium path, L offers a time invariant plan (s_b, x_b) and $(0, x_p)$, and G maximizes its expected value function by choosing (d_x, d_s) in each period. Thus, G solves a recursive dynamic programming problem on the equilibrium path. Moreover, since G's current choice determines the phase (state) of the next period game, which in turn defines its next period action space, G's problem is one of Markov Decision Process (Rust 1994).

Because G has complete information about the shock to its economy, ϵ, it makes a deterministic decision about (d_x, d_s) in equilibrium. On the other hand, L does not know ϵ, therefore, L derives a system of conditional choice probabilities regarding G's decision. We now show how G makes the optimal choice given ϵ, and how L calculates G's choice probabilities without knowing the realization of ϵ.

Let $I_p \in \{0, 1\}$ be an indicator of the phase of the current phase of the game, where 0 represents the bargaining phase, and 1 the punishment phase. Define $\mathcal{A}_G(I_p)$ as the set of available actions of G in phase I_p, where $\mathcal{A}_G(0) = \{(0,0),(0,1),(1,0),(1,1)\}$ and $\mathcal{A}_G(1) = \{(0,0),(1,0)\}$. In addition, given ϵ, define G's value function, $V_G(.)$, and choice-specific value function, $v_G(.)$, as:[18]

$$V_G(I_p, \theta, \epsilon) = \max_{(d_x,d_s)\in\mathcal{A}_G(I_p)} [v_G(I_p, \theta; d_x, d_s) + \epsilon(d_x, d_s)], \tag{5}$$

and

$$v_G(I_p, \theta; d_x, d_s) = \bar{u}_G(I_p, \theta; d_x, d_s) + \delta_G \sum_{\theta'} \sum_{I_p'} [\int V_G(I_p', \theta', \epsilon')\phi(\epsilon')d\epsilon'] Pr(I_p'|I_p; d_x, d_s) Pr(\theta'). \tag{6}$$

Here, $\bar{u}_G(\theta; d_x, d_s)$ is an abbreviation for $\bar{u}_G(\theta; d_x, d_s; s_b \times I_p, x_b \times (1 - I_p) + x_p \times I_p, r)$ and the superscript on the right hand side (RHS) denotes the next period.

Equations (5) and (6) define a contraction mapping operator (Rust 1994); therefore, the choice-specific value function, $v_G(I_p, \theta; d_x, d_s)$, can be solved by value function iteration. This is means G's optimal choice on the equilibrium path can be expressed as:

$$(d_x^{on}, d_s^{on}) = \arg \max_{(d_x,d_s)\in\mathcal{A}_G(I_p)} [v_G(I_p, \theta; d_x, d_s) + \epsilon(d_x, d_s)]. \tag{7}$$

To calculate L's conditional choice probabilities regarding G's decision, we assume that ϵ (a vector) has a multivariate extreme-value distribution, which leads to a conditional

[18]Note that although (s_b, x_b, x_p) are the state variables in G's problem, we suppress the notations in the equations because they are parameters for the analysis of G's equilibrium strategy.

multinomial logit representation of the choice probabilities:

$$
\begin{aligned}
& Pr(d_x, d_s|I_p, \theta) \\
= \; & Pr\{v_G(I_p, \theta; d_x, d_s) + \epsilon(d_x, d_s) \geq v_G(I_p, \theta; \tilde{d}_x, \tilde{d}_s) + \epsilon(\tilde{d}_x, \tilde{d}_s), \forall(\tilde{d}_x, \tilde{d}_s) \in \mathcal{A}_G(I_p)|I_p, \theta\} \\
= \; & \frac{\exp[v_G(I_p, \theta; d_x, d_s)]}{\sum_{(\tilde{d}_x, \tilde{d}_s) \in \mathcal{A}_G(I_p)} \exp[v_G(I_p, \theta; \tilde{d}_x, \tilde{d}_s)]} \qquad (8)
\end{aligned}
$$

That is, from L's perspective, given state (I_p, θ), G will choose the action (d_x, d_s) with probability $Pr(d_x, d_s|I_p, \theta)$. Furthermore, L can derive G's choice probabilities conditional only on I_p, $Pr(d_x, d_s|I_p)$, by integrating out θ in $Pr(d_x, d_s|I_p, \theta)$. Using the probabilities L can calculate its expected utility from offering an arbitrary pair of (s, x) to G, and therefore be able to choose the pair that gives it the highest expected utility in equilibrium.

(2) Off the equilibrium path

Off the equilibrium path, L makes an offer, (s_o, x_o), which is independent of history, and G chooses (d_x, d_s) to maximize its one-period utility. Therefore, G's optimal decision off the equilibrium path is reduced to a static MDP, for which there exists an analytical solution. Given an arbitrary (s_o, x_o) off the equilibrium path, G's optimal choice off the equilibrium path and the conditional choice probabilities from L's perspective can be obtained by replacing $v_G(.)$ in eq(5) by $\bar{u}_G(.)$. Specifically,

$$(d_x^{off}, d_s^{off}) = \arg \max_{(d_x, d_s) \in \mathcal{A}_G(I_p)} [\bar{u}_G(\theta; d_x, d_s) + \epsilon(d_x, d_s)], \qquad (9)$$

and

$$Pr(d_x, d_s|\theta) = \frac{\exp[\bar{u}_G(\theta; d_x, d_s)]}{\sum_{(\tilde{d}_x, \tilde{d}_s) \in \mathcal{A}_G(I_p)} \exp[\bar{u}_G(\theta; \tilde{d}_x, \tilde{d}_s)]} \qquad (10)$$

A2. Proof of Proposition 1

We first prove Lemma 1, which shows that given G's equilibrium strategy L has no incentive to deviate from the equilibrium path. In addition, it shows how L will behave off the equilbrium path, given G's equilibrium strategy.

Assumption 1: $-\frac{\partial^2 p(s,x;\theta)}{\partial s^2} \leq 0$ for all $x \in [0, \bar{x}]$, $s \in [0, \bar{s}]$, and $\theta \in \{\theta_1, \theta_2\}$. That is, the marginal crisis reducing effect of s decreases as s increases.

Assumption 2: $c \geq \frac{1+\beta}{1-\beta}(1+\frac{\tilde{x}}{1+e^{b\tilde{x}}})\left(-\frac{\partial p(s,0;\theta)}{\partial s}|_{s=0}\right)$ for all $\beta \in [0,\bar{\beta}]$ and $\theta \in \{\theta_1, \theta_2\}$, where $\tilde{x} = \arg\max\{\frac{x}{e^{bx}+1}\}$. That is, the unit cost of loan, c, is sufficiently large.

Lemma 1. *Suppose assumptions 1 and 2 are sastisfied, and b is sufficiently large. Then, given G's off-the-equilibrium strategy, offering $(s_o, x_o) = (0,0)$ weakly dominates all other offers off the equilibrium path for L.*

Proof. Let $Eu_L(s,x;\theta) = \sum_{(d'_x,d'_s)} Pr(d'_x, d'_s|s,x;\theta)u_L(d'_x x, d'_s s;\theta)$ be L's expected one-period utility conditional on θ, and $Eu_L(s,x) = \sum_{\theta\in\{\theta_1,\theta_2\}} \pi(\theta)Eu_L(s,x;\theta)$ be L's unconditional utility . To show L's optimal strategy is to offer $(s,x) = (0,0)$ off the equilibrium path, it suffices to verify that, under the two assumptions $Eu_L(s,x;\theta)$ is decreasing in s for any $x \in [0,\bar{x}]$ and $\theta \in \{\theta_1,\theta_2\}$.

First, fix x and θ, and evaluate the expectation with respect to G's choice probabilities conditional on θ. Consider a change from $(0,x)$ to (s,x), where $s > 0$, we want to show $Eu_L(0,x;\theta) - Eu_L(s,x;\theta) \geq 0$.

$$
\begin{aligned}
& Eu_L(0,x;\theta) - Eu_L(s,x;\theta) \\
= \; & [Pr(0,0|0,x,\theta)u_L(0,0;\theta) - Pr(0,0|s,x,\theta)u_L(0,0;\theta)] \\
& +[Pr(1,0|0,x,\theta)u_L(0,0;\theta) - Pr(1,0|s,x,\theta)u_L(0,x;\theta)] \\
& +[Pr(0,1|0,x,\theta)u_L(0,0;\theta) - Pr(0,1|s,x,\theta)u_L(s,0;\theta)] \\
& +[Pr(1,1|0,x,\theta)u_L(0,0;\theta) - Pr(1,1|s,x,\theta)u_L(s,x;\theta)]
\end{aligned}
$$

Using $u_L(0,x;\theta) = u_L(0,0;\theta)$ and eq(10) to simplify the above equation, we have

$$
\begin{aligned}
& Eu_L(0,x;\theta) - Eu_L(s,x;\theta) \\
= \; & Pr(0,1|s,x,\theta)[u_L(0,0;\theta) - u_L(s,0;\theta)] - Pr(1,1|s,x,\theta)[u_L(s,x;\theta) - u_L(0,0;\theta)] \\
= \; & \beta\frac{e^{-p(s,0;\theta)}[-p(0,0,\theta) + \bar{c}s + p(s,0;\theta)] - e^{-bx-p(s,x;\theta)}[-\bar{c}s - p(s,x;\theta) + p(0,0;\theta)]}{e^{-p(0,0;\theta)} + e^{-p(s,0;\theta)} + e^{-bx-p(0,x;\theta)} + e^{-bx-p(s,x;\theta)}},
\end{aligned}
$$

where $\bar{c} = \frac{(1-\beta)c}{1+\beta}$.

Since the denominator in the above equality is strictly positive, to show $Eu_L(0,x;\theta) - Eu_L(s,x;\theta) \geq 0$, we only need to show

$$
e^{-p(s,0;\theta)}[-p(0,0,\theta) + \bar{c} + p(s,0;\theta)] - e^{-bx-p(s,x;\theta)}[-\bar{c}s - p(s,x;\theta) + p(0,0;\theta)] \geq 0,
$$

which is equivalent to

$$\bar{c} \geq \frac{e^{-bx-p(s,x;\theta)}[p(0,0,\theta) - p(s,x;\theta)] + e^{-p(s,0;\theta)}[p(0,0,\theta) - p(s,0,\theta)]}{s[e^{-p(s,0;\theta)} + e^{-bx-p(s,x;\theta)}]} \tag{11}$$

If **Assumption 1** is satisfied and the unit cost of implementation the reforms, b, is sufficiently large, then we can show that the supremum of the RHS of eq(11) is attained as s converges to 0. That is,

$$\begin{aligned}
\sup_{s\in[0,\bar{s}]} \{RHS\ of\ eq(11)\} &= \lim_{s\to 0} \frac{e^{-bx-p(s,x;\theta)}[p(0,0,\theta) - p(s,x;\theta)] + e^{-p(s,0;\theta)}[p(0,0,\theta) - p(s,0,\theta)]}{s[e^{-p(s,0;\theta)} + e^{-bx-p(s,x;\theta)}]} \\
&= \frac{e^{-bx}}{1+e^{-bx}} \left(-\frac{\partial p(s,x;\theta)}{\partial s}|_{s=0} \right) + \frac{1}{1+e^{-bx}} \left(-\frac{\partial p(s,0;\theta)}{\partial s}|_{s=0} \right) \\
&= (1 + \frac{x}{1+e^{bx}}) \left(-\frac{\partial p(s,0;\theta)}{\partial s}|_{s=0} \right), \qquad (12)
\end{aligned}$$

where the second equality is obtained by applying Hopital's rule, and the last equality results from the fact that $\frac{\partial p(s,x;\theta)}{\partial s}|_{s=0} = (1+x)\frac{\partial p(s,0;\theta)}{\partial s}|_{s=0}$.

Now, relax x. Then a sufficient condition for $Eu_L(0,x;\theta) - Eu_L(s,x;\theta) \geq 0$ is

$$c \geq \frac{1+\beta}{1-\beta}(1 + \frac{\tilde{x}}{1+e^{b\tilde{x}}}) \left(-\frac{\partial p(s,0;\theta)}{\partial s}|_{s=0} \right) \tag{13}$$

for all $\beta \in [0, \bar{\beta}]$ and $\theta \in \{\theta_1, \theta_2\}$, where $\tilde{x} = \arg\max\{\frac{x}{e^{bx}+1}\}$. □

Now we turn to the proof of Proposition 1.

Proof. **G's equilibrium strategy**

On the equilibrium path: Because L cannot observe ϵ, it cannot detect whether G deviated from its equilibrium strategy. This in turn means that G cannot influence L's strategy by deviating from the equilibrium path. Consequently, G's can at best optimize its expected value function given L's optimal offer on the equilibrium path.

Off the equilibrium path: Since off the equilibrium path L makes an offer, (s_o, x_o), which is independent of history, it follows that G's choice does not have any inter-temporal effect, thus it is optimal for G to maximize its one-period utility.

L's equilibrium strategy

For this part we first show that L's off-the-equilibrium strategy is the best response to G's off-the-equilibrium strategy. We then show that L has no incentive to deviate from the equilibrium path.[19]

Off the equilibrium path: Given that G switches to a myopia strategy off the equilbrium path by maximizing its one-period utility, L could at best choose an offer (s, x) that maximizes its one-period payoff. Lemma 1 shows that if the unit cost of loan, c, is sufficiently large and the marginal crisis reducing effect of s decreases as s increases, then L's optimal offer in this case is $(s_o, x_o) = (0, 0)$. Note that when L offers $(0, 0)$, it will receive an expected one-period payoff of $\underline{u}_L \equiv \sum_{i=1}^{2} \pi(\theta_i) u_L(s = 0, x = 0; \theta_i)$, which is independent of G's strategy and whether the game is on or off the equilibrium path. We will used the fact in the next part of the proof.

On the equilibrium path: since the option of offering $(0, 0)$ is still available, L can guarantee a payoff of $\underline{u}_L$ defined above in each period by offering $(0, 0)$. It follows that L has no incentive to deviate from the equilibrium path.

Now we show how L determines the optimal offer $(s_b^*(\beta), x_b^*(\beta))$ for the bargaining phase, and $x_p^*(\beta)$ for the punishment phase. Using the conditional choice probabilities of G's decision, $Pr(d_x, d_s|I_p, \theta)$, in eq (8), L maximizes its value function w.r.t. s_b, x_b and x_p. Since G's choice probabilities cannot be expressed as analytical functions of s_b, x_b and x_p, L's expected value function is not a closed form function, either. We therefore use numerical methods to calculate $s_b^*(\beta)$, $x_b^*(\beta)$, and $x_p^*(\beta)$.

Let $V^L(I_p, \theta)$ denote L's value function conditional on the observable state I_p and the unobservable state θ. Since both I_p and θ are binary variables, V^L can be represented by a 4×1 column vector, $V^L = (V_{01}^L, V_{02}^L, V_{11}^L, V_{12}^L)'$, where V_{ij}^L is L's value function when $I_p = i$ and $\theta = \theta_j$ for $i \in \{0, 1\}$, $j \in \{1, 2\}$. Then, by definition, V^L solves the following linear

[19] Note that in this game there is no Bayesian updating for L since θ and ϵ are independently drawn in each period. L calculates its expected utility using the stationary distributions of θ and ϵ.

system of equations:

$$V^L = Eu^L + \delta_L \mathcal{P}^L V^L \tag{14}$$

Here, $\mathcal{P}^L$ is a 4×4 transition probability matrix, where $\mathcal{P}^L_{2i+m,2j+n}$ denotes the probability for G to transit from $I_p = i$ and $\theta = \theta_m$ to $I'_p = j$ and $\theta' = \theta_n$ for $m, n \in \{1, 2\}$. In addition, $Eu^L = (Eu^L_{01}, Eu^L_{02}, Eu^L_{11}, Eu^L_{12})'$ is a column vector of L's current expected utility, where Eu^L_{ij} is L's current period expected utility when $I_p = i$ and $\theta = \theta_j$ for $i \in \{0, 1\}$, $j \in \{1, 2\}$. Accordingly, Eu^L_{ij} is given by:

$$Eu^L_{ij} = \sum_{(\tilde{d}_x, \tilde{d}_s) \in \mathcal{A}_G(I_p = i)} Pr(d_x, d_s | I_p = i, \theta = \theta_j) \times u_L(s, x; d_x, d_s, r; \beta, \theta = \theta_j) \tag{15}$$

Since L cannot observe θ when making an offer, it follows from eq (14) that L's objective function is:

$$\max_{(s_b, x_b, x_p)} \sum_{j \in \{1,2\}} \pi_i V^L_{0j}, \tag{16}$$

where $\pi = (\pi_1, \pi_2)$ is the stationary distribution of θ.

In the second step, we employ numerical methods to find the globally optimal $s^*_b(\beta)$, $x^*_b(\beta)$ and $x^*_p(\beta)$ of eq (16). We then obtain the equilibrium interest rates given by eq (4), and the equilibrium choice probabilities given by eq (8). □

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