Modeling Crisis Lending: A Research Note

June 24, 2017

Abstract

Private financial flows dwarf available sources of official funds, so bilateral and multilateral strategies to deal with sovereign defaults and balance-of-payments crises depend on the ability of publicly-supported bailout packages to catalyze private flows. The empirical literature is skeptical that bailout packages actually have this effect, but public policy continues to rely on it. Can theory help us to reconcile the practice with the data? We analyze a formal model of crisis lending that incorporates bargaining over the terms, adverse selection into programs, implementation and enforcement of those terms, and show that there are two effects at play in equilibrium. On the one hand, crisis lending reduces the risk of a deepening crisis and reduces the risk premium demanded by market actors. On the other hand, the political interests that make lenders willing to lend weaken the credibility of commitments to reform, and the act of accepting an agreement reveals unfavorable information about the state of the borrower's economy. The net effect on the price of private borrowing depends on whether the latter effects dominate the beneficial effects of the liquidity the loan provides. Our theoretical model reconciles existing empirical findings and offers an answer to the puzzle of why borrowers and lenders continue to resort to bailouts when their average treatment effect often appears to be harmful.

1 Introduction

The purpose of lending to a sovereign government during a financial crisis is to restore market confidence. Private flows of capital typically dwarf the public resources that might feasibly be deployed, so the outcome of an intervention depends on success or failure in restoring market confidence. Even when public resources are adequate to the task, official lenders are reluctant to fully fund a debtor's borrowing requirements, so crisis lending is explicitly designed to reassure markets. However, it is not uncommon that sovereign bailouts fail to accomplish the task. Many countries see a deterioration of market confidence following a bailout, lose access to international capital markets for years, or suffer from repeated crises.[1] Indeed, studies of the effects of crisis lending on private markets, sometimes called the "catalytic effect," have found positive, negative, and null effects of IMF lending on capital flows and bond yields.[2] What explains the discrepancy between the practice and data?

We develop a game-theoretic model that reconciles these divergent empirical results and offers an answer to the puzzle of why lenders and borrowers continue to resort to bailouts even when their average treatment effect appears to be harmful. The model depicts the strategic interaction between a lender and a sovereign borrower with a financing gap, and allows the capital market to set the market interest rate by utilizing all of the information revealed in the negotiation of an agreement between them. Specifically, in the two-stage game that we develop, the lender and the government first negotiate the terms of a lending agreement, and then the market reacts; if there is an agreement, in the second stage the government decides whether to comply with the conditionality of the agreement, and then the lender decides whether to disburse the loan. The game ends with nature determining whether a crisis occurs with some probability, which is a function of the country's initial financing gap and the realized loan and conditionality. The model thus incorporates adverse selection into programs, bargaining over the terms of the loan, and implementation and

[1] E.g. See Sturzenegger and Zettelmeyer 2006: 51-52

[2] Bauer, Cruz, and Graham 2012; Bird and Rowlands 2002; Brune, Garrett, and Kogut 2004; Edwards 2005; Gray 2009; Mody and Saravia 2003. See Steinwand and Stone (2008) for a review.

enforcement of those terms.

Previous work suggests that each of the three mechanisms that we model should influence catalytic effects; however, each has been studied in isolation from the others. Modeling them simultaneously reveals why the empirical evidence for catalytic effects is mixed. Official lending provides liquidity, which reduces the probability of financial collapse, and comes with conditionality, which, if implemented, also helps to forestall a crisis. However, the act of accepting a bailout reveals information about the severity of the borrower's financial constraints, which may deter private lenders. Furthermore, the government's commitment to carrying out reform is always in question, and the credibility of international threats to enforce conditionality may vary. Because these factors can have countervailing effects on the risk of a future crisis, there is no simple association between lending and capital market reactions, as represented by a bond yield. Crisis lending can drive bond yields up or down.

This observation makes it possible to bridge the gap between practice and the existing empirical evidence, in the following sense. When lending drives bond yields up, the explanation is adverse selection; the act of accepting the loan reveals adverse information to the market. The authorities that contract for the loan anticipate this market reaction, but agree to the terms nevertheless. Why? Because countries that are desperate enough to accept external support that will tarnish their reputations are more likely to experience a crisis if they do not accept that support than if they do.

Finally, our model incorporates the political dimension of crisis lending. The authorities that provide the financing, whether they be individual countries or intergovernmental organizations, are not indifferent to the borrower's fate. They may be inclined to make a risky loan only because the borrower plays a systemically important role in global finance, is a major trade partner, or is an important ally. Consequently, our model allows lenders to be biased in favor of particular borrowers, which means that they are exposed to externalities if a crisis occurs. Previous theoretical work has shown that bias of this sort undermines the credibility of enforcement,[3] and empirical work has shown that bias reduces conditionality and enforcement.[4] Conditionality and enforcement of conditionality, however, are strategic substitutes, so it is not obvious that bias should drive both in the same direction. A country might accept more conditionality, for example, knowing that conditions could not be effectively enforced. Resolving this issue requires a unified theoretical framework for understanding crisis lending that incorporates both bargaining and enforcement.

The central political insight that the model generates is that bias in favor of the borrower does have both effects: bias decreases conditionality and reduces the credibility of commitments to enforce it in the future. These effects increase the perceived riskiness of the country to capital markets. Consequently, the very strategic interests that make the lender willing to offer support — its economic or geopolitical relationships to the borrower — undermine the prospects that crisis lending will be successful.

2 Strategic Crisis Lending

IMF lending is the most visible form of crisis lending in recent times, but historical crisis lending has also taken the form of bilateral or ad hoc multilateral lending, and private market actors have even engaged in sovereign bailouts. For instance, the United States emerged from World War I as the largest creditor to European allies and engaged in a series of debt relief negotiations over the 1920s and early 1930s, partly as a means of staving off economic collapse and ensuring that the allies would have access to continued credit for economic recovery. Despite some intense domestic debate involving congressional-executive disagreement, debt forgiveness proved crucial as a means to bail out and aid fragile European economies during the 1920s and 1930s.[5] Sovereign lending during this era was also not limited to bilateral, government-to-government exchanges. During early 1924 J.P. Morgan extended a $100 million loan to France, which halted a tailspin of the franc and restored

[3]Stone 2002.

[4]Stone 2004, 2008, 2011; Copelovitch 2010; Dreher and Vaubel 2004.

[5]See Chapman et al. 2013; Rhodes 1969; Leffler 1972.

market confidence.[6]

In more recent times, the United States (with assistance from the IMF and the Bank for International Settlements (BIS) constructed a $50 billion bailout of Mexico in response to the so-called "Tequila Crisis" of 1994-1995 ($20 billion of which came from the U.S. Treasury; $18billion from the IMF; $10 billion from the BIS; $3 billion from private creditors).[7] The bailout was largely deemed a success[8], although it was controversial and raised fears about future moral hazard.[9]

Other cases have seen more mixed results. Russia and Argentina failed repeatedly to implement reforms negotiated with the IMF, received additional credits, and suffered spectacular financial crises. The efforts by the "Troika" of the European Central Bank, the European Commission, and the IMF to stabilize Greece and the larger Eurozone have so far prevented default, but have failed to chart a sustainable path for Greek debt. The IMF's 2013 report on the 2010 loan program judges that despite some successes, "market confidence was not restored," and Greece has required additional bailout packages to stave off recurrent crises.[10] Credibility has been a continuing problem both for the Greek authorities and for their interlocutors, who explicitly raised concerns about moral hazard. The IMF, ECB, and European Commission worry that interdependence among the Eurozone countries creates expectations of future bailouts, which undermines the incentives for Greece to implement fiscal reforms.[11]

Our approach to untangling the strategic interactions involved in crisis lending is to simultaneously model the decision making of all three main participants in such an endeavor: a lender, a government, and market actors. In particular, we allow market actors to set an

[6]Simmons 1994: 155, 162-163.

[7]Musacchio, Aldo. "Mexico's Financial Crisis of 1994-1995." Harvard Business School Working Paper, No. 12, May 2012.

[8]see Rubini and Sester (2004), quoted in Musacchio (2012).

[9]ibid

[10]IMF, *Greece: Ex post evaluation of Exceptional Access under the 2010 Stand-By Agreement*, IMF country report 13/156, June 2013.

[11]See, for instance, "IMF swayed by politics during Eurozone crisis, say inspectors," *Financial Times* 28 July 2016.

interest rate that reflects a risk premium by drawing inferences using all of the available information, including the outcome of the bargaining process and the terms of a lending agreement; this in turn influences the behavior of the government and the lender. Three key factors are incorporated into the model that we present: bargaining; adverse selection; and compliance and enforcement.

First, bailout packages are negotiated between the lender and the recipient, so their terms reflect the underlying bargaining power in the bilateral relationship. Crisis countries find themselves in precarious situations, but there is variation among them in terms of their importance to prospective lenders and in terms of the urgency of their need. In the game-theoretic model that follows, we allow both dimensions to vary: the lender's strategic interests in the borrower's fate, and the severity of the borrower's financing gap. Recipients with greater bargaining leverage may be able to hold out for loans with fewer strings attached, while countries that face severe economic conditions and that are strategically unimportant to the lender are compelled to accept more intrusive conditionality.[12] Markets should take this into account.

Second, borrowers typically have private information about their financial situations, and a consequence of this is the possibility of adverse selection. When adverse selection occurs in equilibrium, the lender makes an offer that only a government under desperate financial conditions would accept. In this case, market actors can infer the poor state of the government's finances from the fact that it accepted an agreement, so they downgrade their expectations about the probability of repayment, and raise the loan premium. Note that in equilibrium, the borrower only accepts loans that improve its utility, so accepting a loan always reduces the probability of a crisis, although it may increase bond yields.[13]

Finally, the effects of bailout packages depend on expectations about future implemen-

[12] cf. Stone 2008; Oatley and Yackee 2004.

[13] In the model presented in the next section, this is true by assumption. In the full model in the online appendix the crisis probability is a function of the equilibrium interest rate, which in turn depends on the crisis probability, so self-fulfilling crisis expectations are possible in equilibrium. Nevertheless, the property still holds that no loan is accepted that does not reduce the probability of a crisis.

tation and enforcement of reform commitments. Crisis lending can create incentives for borrowers to implement reforms, but only if the commitment to enforce conditionality is credible. The determination of the lender to insist upon reforms and withhold funding in the future if the government fails to implement conditionality depends on the cost of enforcement. In the model that follows, we consider two cases, one in which enforcement is credible, and one in which enforcement is non-credible, in order to study how the credibility of enforcement affects interest rates by influencing inferences about the likelihood of future crises. The stimulus effect of crisis lending on international capital flows is undermined when enforcement is not credible.

Our model of crisis lending makes three contributions. First, it provides the first unified model of crisis lending that incorporates bargaining, implementation, enforcement and market expectations. This allows us to explore the logical consistency of various claims that have been made in the literature based on partial models or informal arguments. Second, we are able to reconcile the discrepancy between the practice of crisis lending, which relies on catalytic effects, and the mixed empirical evidence that crisis lending actually produces these effects. Previous theoretical explanations for the effect of crisis lending have focused on one or two features of our model; therefore, we believe the empirical studies that are informed by such theories have looked for relationships that may be offset by other important dynamics that our model illustrates. Our more general model demonstrates how a range of empirical correlations may be observed in different data samples as the net effect of multiple countervailing effects. Third, we explore the effects of the political interests that motivate lenders to extend crisis financing. Lenders that are biased in favor of a particular borrower are likely to offer more generous terms, and are unlikely to enforce loan conditions rigorously. Sophisticated market actors take these political motivations into account when they form their expectations, so they may charge a risk premium for strategic importance.

Model

We consider a one-period game between a government, G, and a lender, L. Suppose the government faces a shortfall in its economy, and the financing need is θ. We analyze two versions of the game that differ only in the assumption about θ: in the baseline, we assume that θ is known to both players, while in the extended game we allow uncertainty about θ on the part of the lender. Specifically, in the extended game, we assume that there are two types of governments with different levels of financing need, $\theta \in \{\theta_1, \theta_2\}$, where $0 \le \theta_1 < \theta_2 \le 1$, and the probability distribution of the two types is $Pr(\theta = \theta_1) = \pi_1$ and $Pr(\theta = \theta_2) = 1 - \pi_1$. In the beginning of the extended game, nature draws G's type, G learns its own type, but L does not. Analyzing the baseline model first allows us to identify several important relationships between variables, which are also central to the more complex case.

The rest of the game is as follows. In the first stage L makes a take-it-or-leave-it loan offer to G, which consists of a predetermined fixed share of G's financing need, $s \in (0,1)$, and a level of conditionality, $x \in [0,1]$, which represents the reforms that L demands from G in exchange for the loan.[14] Then G decides to accept or reject the package. After observing L's offer and G's decision, the market sets the equilibrium interest rate, r, which offsets the risk of sovereign default in a competitive market.

If G accepts the offer, then the game enters stage 2. In stage 2, nature draws an implementation cost, b, from a uniform distribution, $b \sim U[\gamma, \Gamma]$, where $\Gamma > \gamma > \frac{1}{1-s}$, and is common knowledge.[15] G alone observes the realization of b, and then decides whether to implement x. Let $d_x \in \{0,1\}$ denote G's decision: if G implements x, then $d_x = 1$; otherwise, $d_x = 0$. Following G's decision, L decides whether to disburse the loan in the agreement from

[14] The assumption that s is a fixed share of an unknown quantity is made for convenience, but implies substantively that the lender shares risk with the borrower. Repeated interactions between the IMF and borrowers suggest that this is in fact the case.

[15] We can think of $\tilde{x}$ as the size of fiscal consolidation required by the program and b as the size of the recipient country's fiscal multiplier, which is subject to uncertainty. Thus, $b\tilde{x}$ measures the output loss due to consolidation. The condition for the lower bound of b, $\gamma > \frac{1}{1-s}$, will be shown necessary in the next section as we conduct the equilibrium analysis.

stage 1. Let $\delta_s \in \{0,1\}$ denote L's decision: if L disburses, then $\delta_s = 1$; otherwise, $\delta_s = 0$. We further assume that L incurs a reputational cost, $Z(\delta_s, d_x) = Z$, if G reneges but L disburses the loan, or if G implements x but L does not disburse the loan; that is, $Z > 0$ if $\delta_s \neq d_x$, and $Z = 0$ otherwise.[16] After L's move, the game ends with nature determining whether a crisis occurs with probability $p = p(\tilde{s}, \tilde{x}; \theta)$, which is a function of the realized loan size, $\tilde{s} = s\delta_s$, realized conditionality, $\tilde{x} = xd_x$, and the country's financing gap. On the other hand, if G rejects L's offer in stage 1, then there is no stage 2, and a crisis occurs with probability $p = p(0,0;\theta)$.

Now we introduce the actors' utility functions. Define G's utility function as follows, depending on whether G accepts L's offer in stage 1 or not:

$$u_G = \begin{cases} -p(\tilde{s},\tilde{x};\theta) - b\tilde{x} & \text{if G accepts} \\ -p(0,0,\theta) & \text{if G rejects} \end{cases} \tag{1}$$

If G accepts the offer, then G's utility has two components: the probability of experiencing a crisis conditional on realized loan size and reforms, and the cost incurred in implementing the reforms. We can similarly define L's utility function, but with one additional parameter. Let $\beta \in (0,1)$ capture the geopolitical and economic importance of G to L. Then L's utility function can be summarized as follows:

$$u_L = \begin{cases} -(1-\beta)\tilde{s}\theta - \beta p(\tilde{s},\tilde{x};\theta) - Z(\delta_s, d_x) & \text{if G accepts} \\ -\beta p(0,0;\theta) & \text{if G rejects} \end{cases} \tag{2}$$

If G accepts L's offer, then L's utility has three components: the cost of lending (discounted by the importance of the country), a negative utility from the chance that G experiences a crisis even with a lending agreement, and the reputational cost that L may incur if it does not disburse the loan in a manner that is consistent with the agreement. On the other hand, if G rejects L's offer, then L simply draws a negative utility from the probability that G experiences a crisis without a lending agreement.

[16] This reputational cost captures the notion that lenders may be concerned about establishing a "too big to fail" precedent.

Now we give the probability of crisis a functional form so that we can solve for an analytic solution of the game. Let $p(\tilde{s},\tilde{x};\theta) = \theta(1-\tilde{s}) - \tilde{x}$. The probability is an increasing function of the financing gap, θ, and a decreasing function of the realized conditionality, $\tilde{x}$. Moreover, since $p(\tilde{s},\tilde{x};\theta) \geq 0$, we have $x \leq \theta(1-s)$, which means that the largest x that L can demand by offering s is the level of conditionality that can compensate for the remaining financing gap, $\theta(1-s)$, a fairly reasonable assumption. Thus, the feasible range of conditionality is $x \in [0, \theta(1-s)]$.

We use backward induction to solve for the unique perfect Bayesian equilibrium of either the baseline or the extended game. To break the ties when players are indifferent, we assume that when L is indifferent between two actions, $x_1 \leq x_2$, L chooses the smaller x_1, and when G is indifferent between accepting and rejecting an offer, G rejects the offer.[17]

Equilibrium Results

In this section we present three propositions and several secondary results. For the first two propositions we consider the case that L's reputational cost, Z, is sufficiently large that L prefers not to disburse the loan if G reneges. In other words, we assume that L's punishment strategy — withholding a loan if a borrowing country does not implement reforms — is credible. Our third proposition analyzes the case where Z is sufficiently small that L's punishment strategy is not always credible.

Using backward induction, we first solve for G's equilibrium strategy, which is not dependent on the assumption about θ, as G knows its own type. We then solve for L's strategy, which does depend on whether L knows θ.

Consider G's compliance strategy in stage 2 after accepting an offer, x, in stage 1. Intuitively, G's compliance strategy depends on the implementation cost, b, which is a ran-

[17] This is without loss of generality. The case that G is indifferent between accepting and rejecting an offer only arises if G never complies in stage 2, so it seems natural to assume that G rejects an offer when indifferent. L's equilibrium offer does not require G to be indifferent.

dom variable realized in stage 2. Specifically, G will comply in stage 2 if and only if $-\theta(1-s)-x-bx \geq -\theta$, or equivalently,

$$b \leq \frac{s\theta}{x}+1 \equiv b^c(x). \tag{3}$$

Note that the threshold cost for compliance, $b^c(x)$, is a decreasing function of x, which means that G is less likely to comply with higher x. Because $b \in [\gamma,\Gamma]$, we use the inequalities, $\gamma \leq b^c(x) \leq \Gamma$, to solve for two threshold values of L's offer that are relevant for charactering G's compliance behavior. Let $x^* \equiv \frac{s\theta}{\Gamma-1}$ and $x^{**} \equiv \frac{s\theta}{\gamma-1}$.[18] Then we have the following three cases regarding G's compliance behavior: if $x \in (0,x^*]$, then $\Gamma \leq b^c(x)$, which means that eq (3) always holds, therefore G complies with probability 1; if $x \in (x^*,x^{**})$, then $\gamma < b^c(x) < \Gamma$, and G complies with probability $\frac{b^c(x)-\gamma}{\Gamma-\gamma}$; finally, if $x \in [x^{**},\theta(1-s)]$, then $b^c(x) \leq \gamma$, which means that eq (3) never holds, therefore G never complies.

Given G's compliance strategy in stage 2, we can now characterize its equilibrium strategy in both stages as follows:

- If L offers $x \in (0,x^*]$, then G accepts x and complies with probability 1 in stage 2;
- if L offers $x \in (x^*,x^{**})$, then G accepts x and complies if and only if $b \in [\gamma,b^c(x)]$ in stage 2 ;
- if L offers $x \in [x^{**},\theta(1-s)]$, G rejects x in stage 1.[19]

Now we consider L's strategy in stage 1. We first analyze the baseline case where θ is public information, as it clearly illustrates the logic of the equilibrium that is also at play in the more complex case where θ is G's private information.

[18]Given $\gamma > \frac{1}{1-s}$, it is easy to show that $0 < x^* < x^{**} < \theta(1-s)$; that is, the two thresholds fall within the feasible range of L's offer, $[0,\theta(1-s)]$.

[19]Here we utilize the fact that rejecting an offer in stage 1 gives G a pyoff of -θ, which is the same as accepting an offer in stage 1 and then defying it in stage 2, as well as the tie-breaking rule that G rejects when indifferent.

The borrower's financing need (θ) is public information

As we mentioned earlier, L's equilibrium strategy depends on its information about G's financing need, θ. Suppose θ is public information and so L (as well as market actors) can observe its value. An additional factor that plays a role in L's equilibrium strategy is L's economic or geopolitical interest in G, β. Since G has different optimal responses that correspond to three ranges of L's possible offers, we analyze L's optimal offer in each range, and then compare them to find L's overall best strategy.

To begin, if L offers $x \geq x^{**}$, then G rejects the offer, which leads to a payoff of $-\beta p(0,0;\theta)$ for L. The payoff is not a function of x, which means that L is indifferent between offering any $x \geq x^{**}$. Given our tie-breaking rule, L offers $x = x^{**}$ in this range. On the other hand, if L offers $x \leq x^{*}$, then G always accepts and complies with the conditionality. This leads to a payoff of $-(1-\beta)\theta s - \beta p(s,x;\theta)$ for L. Since the probability of crisis, $p(s,x;\theta) = \theta(1-s) - x$, decreases as x increases, L's dominant strategy in this range is $x = x^{*}$. Finally, consider the case $x^{*} < x < x^{**}$. L's maximization problem in this range is:

$$\max_{x^{*} \leq x \leq x^{**}} u_L(x;\theta,\beta) = \frac{b^c(x)-\gamma}{\Gamma-\gamma}[-(1-\beta)\theta s - \beta p(s,x;\theta)] + \frac{\Gamma - b^c(x)}{\Gamma-\gamma}[-\beta p(0,0;\theta)]. \tag{4}$$

We first note that $\frac{\partial u_L}{\partial x} = \frac{\beta}{\Gamma-\gamma}\left[\frac{s^2\theta^2(1/\beta-2)}{x^2} - (\gamma-1)\right] < 0$ if $\beta \geq 1/2$, which means that L's utility is a decreasing function of x in the entire range. Therefore, for $\beta \geq 1/2$, the maximum utility of L is achieved at x^{*}. Next, if $\beta < 1/2$, then the first-order condition w.r.t. x is:

$$\frac{\partial u_L}{\partial x} = \frac{\beta}{\Gamma-\gamma}\left[\frac{s^2\theta^2(1/\beta-2)}{x^2} - (\gamma-1)\right] = 0. \tag{5}$$

Solving the equation we have $x^0(\beta) = s\theta\sqrt{\frac{1/\beta-2}{\gamma-1}}$. For $x^0(\beta)$ to be an interior soluton of the range, it must be the case that $x^0(\beta) \in (x^{*}, x^{**})$, which holds only for some β. Let $\beta^{**} \equiv \left[\frac{1}{\gamma-1}+2\right]^{-1}$ and $\beta^{*} \equiv \left[\frac{\gamma-1}{(\Gamma-1)^2}+2\right]^{-1}$. It is easy to show that for $\beta \in (\beta^{**}, \beta^{*})$, $x^0(\beta) \in (x^{*}, x^{**})$. Moreover, the second order condition $\frac{\partial^2 u_L}{\partial x^2} < 0$ for any $x \in (x^{*}, x^{**})$, therefore, $x^0(\beta)$ is the global maximum in the interval.

By comparing L's utility from offering x^0 with offering x^{*} or x^{**}, we can fully characterize L's equilibrium strategy. Let $x^{opt}(\beta)$ be L's equilibrium offer. If $0 < \beta \leq \beta^{**}$, then $x^{opt}(\beta) = x^{**}$; if $\beta^{**} < \beta < \beta^{*}$, then $x^{opt}(\beta) = x^{0}(\beta) = s\theta\sqrt{\frac{1/\beta-2}{\gamma-1}}$; if $\beta^{*} \leq \beta < 1$, then $x^{opt}(\beta) = x^{*}$. Proposition 1 summarizes our equilibrium analysis so far.

Proposition 1. *The following equilibrium strategies of L and G form the unique perfect Bayesian equilibrium of the game where G's financing need, θ, is publicly known:*

(1) if $0 < \beta \leq \beta^{**}$, then L offers $x^{opt}(\beta) = x^{**} \equiv \frac{s\theta}{\gamma-1}$ and G rejects the offer in stage 1;

(2) if $\beta^{**} < \beta < \beta^{*}$, then L offers $x^{opt}(\beta) = x^{0}(\beta) = s\theta\sqrt{\frac{1/\beta-2}{\gamma-1}}$, G accepts the offer in stage 1, and complies with probability $\frac{b^{c}(x^{opt}(\beta))-\gamma}{\Gamma-\gamma}$ in stage 2;

(3) if $\beta^{*} \leq \beta < 1$, then L offers $x^{opt}(\beta) = x^{*} \equiv \frac{s\theta}{\Gamma-1}$, G accepts the offer in stage 1, and complies with probability 1 in stage 2.

Several substantively important results can be derived from the equilibrium. The first two results pertain to the lender's behavior, while the next three results describe the equilibrium market interest rate in reaction to G and L's bargaining outcome. First, the equilibrium conditionality is an increasing function of G's financing need, θ; that is, L demands more reforms from countries that experience more severe economic crises. Second, as depicted in Figure 1, the equilibrium conditionality, $x^{opt}(\beta)$, is decreasing in the importance of the borrowing country, β; in other words, L lowers its conditionality for geopolitically and economically more significant countries. We summarize these two results in the following corollary.

Corollary 1 (Conditionality with Credible Enforcement). *The equilibrium conditionality increases in θ and decreases in β.*

How does the lending agreement affect a market actor's assessment of the risk involved in bailing out G's economy? In the model, the representative market actor sets the equilibrium interest rate after observing the bargaining between L and G in stage 1. Our third

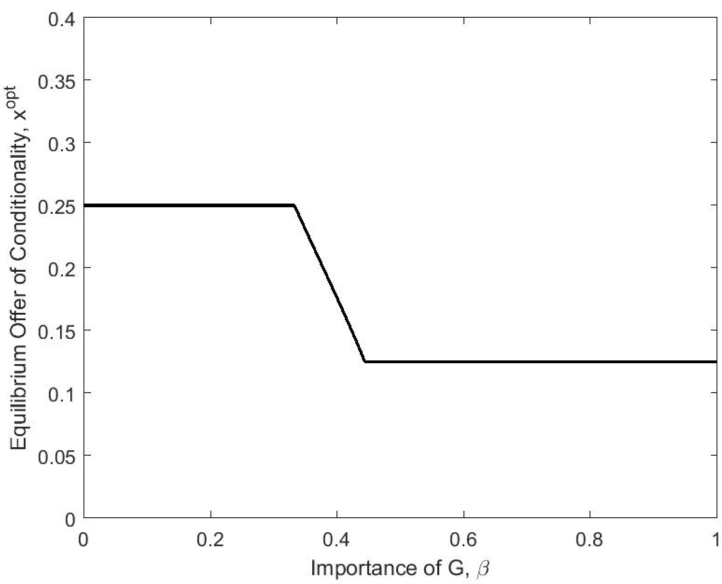

Figure 1: The Effect of Political Bias on the Equilibrium Conditionality

result thus characterizes the equilibrium interest rate when G accepts an offer, $r_a(x)$, where $x \in [x^*, x^{**}]$. We then derive the fourth and fifth results by substituting $x^{opt}(\beta)$ for x in $r_a(x)$, which gives us the equilibrium interest rate as a function of β and θ.

Specifically, because risk-neutral international investors offer short-term loans to G in a competitive market, the equilibrium interest rate leads to zero expected profit, conditional on θ and the outcome of stage 1. That is,

$$\{r[1-p(x,s;\theta)]-p(x,s;\theta)\}\frac{b^c(x)-\gamma}{\Gamma-\gamma}+\{r[1-p(0,0;\theta)]-p(0,0;\theta)\}\frac{\Gamma-b^c(x)}{\Gamma-\gamma}=0. \tag{6}$$

Rearranging the equation, we have:

$$r_a(x)=\frac{p(x,s;\theta)[b^c(x)-\gamma]+p(0,0;\theta)[\Gamma-b^c(x)]}{[1-p(x,s;\theta)][b^c(x)-\gamma]+[1-p(0,0;\theta)][\Gamma-b^c(x)]}. \tag{7}$$

Let $\Delta(x) \equiv p(x,s;\theta)[b^c(x)-\gamma]+p(0,0;\theta)[\Gamma-b^c(x)]$. Then, $r_a(x)=\frac{\Delta(x)}{(\Gamma-\gamma)-\Delta(x)}$. It is straightforward to show that r_a is an increasing function of $\Delta(x)$, or $\frac{\partial r_a}{\partial \Delta(x)}>0$, and furthermore, $\frac{\partial \Delta(x)}{\partial x}=\frac{s^2\theta^2}{x^2}+(\gamma-1)>0$. Therefore, $r_a(x)$ is increasing in x. The intuition for the relationship is as follows: a higher x reduces the probability of crisis conditional on compliance, but it also reduces the probability of compliance. The second effect dominates the first in equilibrium; therefore, investors set a higher market interest rate in equilibrium when they observe a higher x. Combined with Corollary 1, this result implies two additional relationships between the market interest rate and the parameters of the model. First, $r_a(x^{opt}(\beta))$ is a decreasing function of β because, as depicted in Figure 1, a higher β leads to a lower level of equilibrium conditionality. Therefore, risk-neutral investors set a lower market interest rate in equilibrium upon observing a higher β. Second, because the equilibrium conditionality increases in θ, the equilibrium market interest rate increases in θ conditional on G's acceptance of an agreement. This is intuitive: there is a higher risk involved in lending money to countries with higher financing need. These results are summarized in the following corollary:

Corollary 2 (Market Interest Rate with Credible Enforcement). *The equilibrium market interest rate increases in θ, increases in x, and decreases in β.*

The borrower's financing need (θ) is private information

We now consider the more complex case where G's financing need, θ, is unknown to L and the market actor. Recall that $Pr(\theta = \theta_1) = \pi_1$ and $Pr(\theta = \theta_2) = 1 - \pi_1$. In this case L maximizes its expected utility by choosing x subject to its prior belief about $theta$.

The equilibrium strategy for each type of G is the same as in the baseline case, since G knows its own type. Specifically, for θ_1, define the two cutpoints for its equilibrium strategy as $x_1^* \equiv \frac{s\theta_1}{\Gamma-1}$ and $x_1^{**} \equiv \frac{s\theta_1}{\gamma-1}$; for θ_2, define $x_2^* \equiv \frac{s\theta_2}{\Gamma-1}$, and $x_2^{**} \equiv \frac{s\theta_2}{\gamma-1}$. Since $\theta_2 > \theta_1$, $x_2^* > x_1^*$ and $x_2^{**} > x_1^{**}$. Based on the logic of G's equilibrium strategy in the baseline model, it is straightforward to see that there are both pooling and separating equilibria in the incomplete-information case, which we summarize below and illustrate in Figure 2:The figure ideally needs to have 5 cases, corresponding to 5 cases in Proposition 2. But one of the β parameter is difficult to solve.

- Pooling in acceptance: when $x < x_1^{**}$, both types accept the offer in stage 1, and then both comply with a positive probability in stage 2 (possibly with different probabilities);

- Separating in acceptance: when $x_1^{**} \le x \le x_2^{**}$, θ_1 type rejects the offer, while θ_2 type accepts and then complies with a positive probability in stage 2;
- Pooling in rejection: when $x > x_2^{**}$, both types reject the offer.

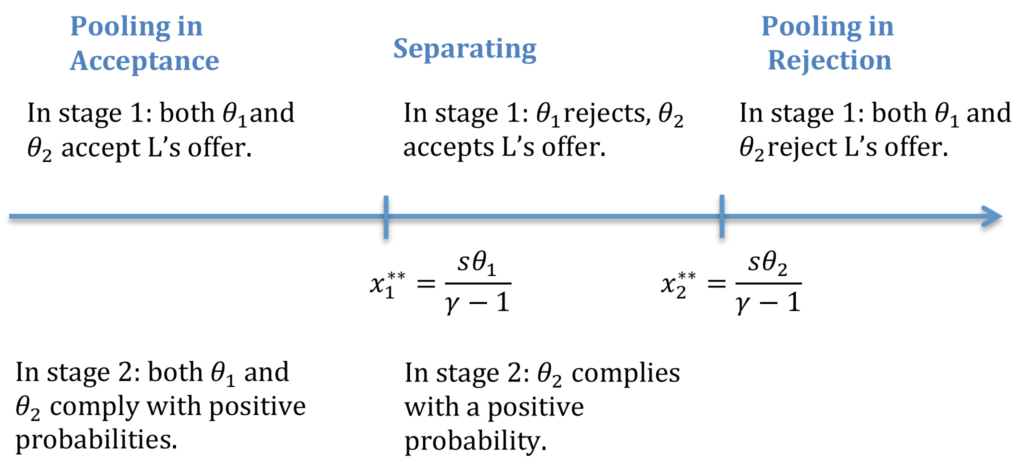

Figure 2: Two Types of G's Equilibrium Strategy

Applying a similar logic to L's optimization problem as in the baseline case, now we can fully characterize the equilibrium for the case that θ is unknown in Proposition 2.[20] Let $b_i^c(x) \equiv \frac{s\theta_i}{x}+1$ $(i=1,2)$, and let $X^{opt}(\beta)$ denote L's equilibrium offer. Define $\tilde{\beta} = \left[\frac{(\gamma-1)\theta_2^2}{(\Gamma-1)^2 E(\theta^2)}+2\right]^{-1}$ and $\tilde{\tilde{\beta}} = \left[\frac{\Gamma-1-\frac{\Gamma-\gamma}{\pi_1}}{(\Gamma-1)^2}+2\right]^{-1}$. Furthermore, assume $\frac{\theta_2}{\theta_1} \ge \sqrt{\frac{(\Gamma-1)\pi_1}{(\Gamma-1)\pi_1-(\Gamma-\gamma)}}$[21] We need another condition here and Xin is working on it.

Proposition 2. *The following equilibrium strategies of L and G form the unique perfect Bayesian equilibrium of the game where G's financing need, θ, is unknown to L:*

(1) if $0 < \beta \le \beta^{**}$, then L offers $X^{opt}(\beta) = x_2^{**} \equiv \frac{s\theta_2}{\gamma-1}$ in stage 1, and both types of G reject the offer.

[20]The proof is in the appendix.

[21]This assumption ensures that $\tilde{\beta} < \beta^* < \tilde{\tilde{\beta}} < 1/2$.

(2) if $\beta^{**} < \beta < \beta^{thr}$, then L offers $x^{opt}(\beta) = s\theta_2\sqrt{\frac{1/\beta-2}{\gamma-1}}$ in stage 1. This leads to a separating scenario. G of type θ_2 accepts the offer in stage 1 and complies with probability $\frac{b_2^c(X^{opt}(\beta))-\gamma}{\Gamma-\gamma}$ in stage 2; G of type θ_1 rejects the offer in stage 1.

(3) if $\beta^{thr} \leq \beta \leq \tilde{\beta}$, then L offers $x^{opt}(\beta) = s\sqrt{\frac{(1/\beta-2)E(\theta^2)}{\gamma-1}}$ in stage 1, and both types of G accept the offer. In stage 2, G of type θ_i complies with probability $\frac{b_i^c(X^{opt}(\beta))-\gamma}{\Gamma-\gamma}$ for $i = 1,2$.

(4) if $\tilde{\beta} < \beta \leq \tilde{\tilde{\beta}}$, then L offers $x^{opt}(\beta) = s\theta_1\sqrt{\frac{1/\beta-2}{\Gamma-1-\frac{\Gamma-\gamma}{\pi_1}}}$ in stage 1, and both types of G accept the offer. In stage 2, G of type θ_2 complies with probability 1 and G of type θ_1 complies with probability $\frac{b_1^c(X^{opt}(\beta))-\gamma}{\Gamma-\gamma}$.

(5) if $\tilde{\tilde{\beta}} < \beta \leq 1$, then L offers $x^{opt}(\beta) = \frac{s\theta_1}{\Gamma-1}$ in stage 1, and both types of G accept the offer. In stage 2, both types of G comply with probability 1.

There are two main findings from the above equilibrium that are similar to those from the baseline model. First, the equilibrium conditionality, $X^{opt}(\beta)$, is a decreasing function of β. This is because L is more generous toward important countries and offers lower x to them. Consequently, high β countries are more likely to accept an offer regardless of their economic conditions. Second, $r_a(\beta)$ is a weakly decreasing function of β. The reasoning is as follows. For the separating equilibrium in Proposition 2, only θ_2 – the type with a higher financing need – accepts the offer; therefore, as in the baseline case, we find a negative relationship between $r_a(\beta)$ and β. Now consider the two types of pooling equilibrium. In such an equilibrium, θ_1 and θ_2 always make the same choice in stage 1, and thus the market actor cannot update its belief about G's type when it sets the interest rate at the end of stage 1. As a result, the market actor cannot set $r_a(\beta)$ as a function of its updated belief about G's type.

There are also new insights. In case (2) of Proposition 2, the two types of G behave differently in stage 1: the type that has a higher financing need, θ_2, accepts an offer, while θ_1 rejects the offer. This is the adverse selection effect, where the economies that are in bigger trouble are more likely to enter a lending agreement. [22] This is summarized in the next corollary.

Corollary 3 (Adverse Selection). *If there is uncertainty about G's financing need, we observe an adverse selection effect where the countries with higher financing needs are more likely to enter a lending agreement.*

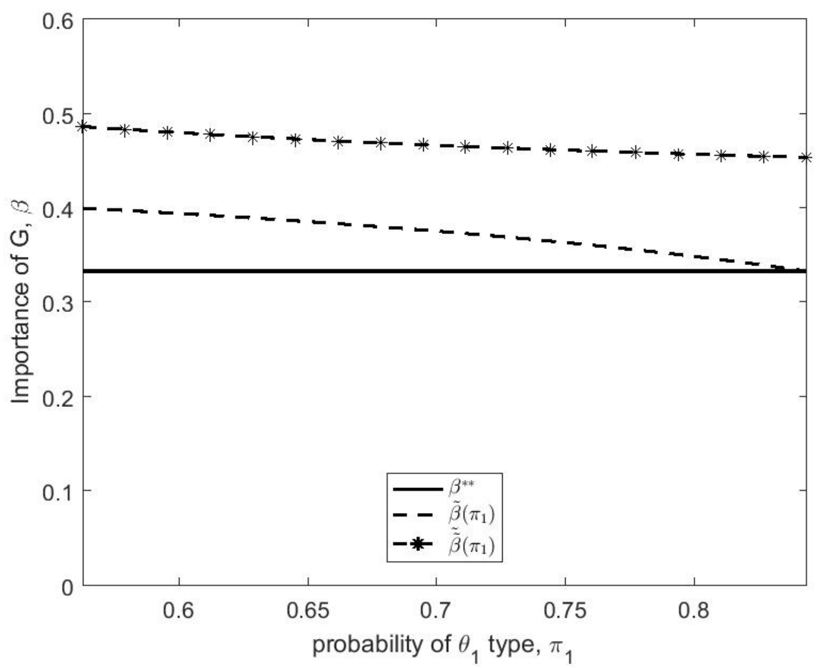

Figure 3: Different Types of Equilibrium in Different Regions of β and π.

Figure 3 illustrates the equilibrium in Proposition 2, showing how different types of equilibrium emerge for different values of β and π. the figure may need to change to have 5 cases. In general, higher β leads to more pooling behavior, both in the acceptance in stage 1 and in the compliance in stage 2. This is because L offers lower level of conditionality for higher β country, and such countries are more likely to accept such an offer and comply with it. Moreover, as the probability of θ_1 (π_1) increases, we are more likely to observe pooling in acceptance in stage 1, and a high level of compliance in in stage 2 (cases (4) and (5)). This is

[22]In a fuller model where we allow the probability of crisis to be endogenous to market interest rate, the lender and the government can take into account of the effect of adverse selection on the market interest rate.

because θ_1 has lower financing need, and so the equilibrium conditionality required by L is lower, which in turn makes it easier for G to accept the offer and also comply with it.

The Enforcement is Not Credible

Our analysis so far assumes that L's reputational cost, Z, is sufficiently large for all β, such that L will not disburse a loan if G does not implement conditionality after accepting an offer. In other word, we have assumed that L's enforcement strategy is credible for all β. Now we consider the case where Z is small, and so it is not credible for L to enforce its conditionality for all cases of β. Below we show that L will always choose to disburse the loan to borrowing countries that are sufficiently important to L. We can solve for a threshold β^0 for a given reputational cost Z, such that L's enforcement is not credible for $\beta > \beta^0$. Consequently, the equilibrium interest rate when G accepts an offer, $r_a(\beta)$, will move upward discontinuously when $\beta > \beta^0$. We solve for the baseline case where θ is known to L and present the equilibrium in Proposition 3.

Proposition 3. *If Z is sufficiently small, then L's enforcement of an agreement is not credible for all countries. The following characterizes the equilibrium, where* $\beta^0 = \frac{1}{2}(1 + \frac{Z}{s\theta})$. *:*

(1) If $0 < \beta \leq \beta^0$*, then L enforces its punishment strategy and the equilibrium is identical to that in the credible case.*

(2) If $\beta^0 < \beta < 1$*, then L makes a non-serious offer* $x^{opt}(\beta)$ *and G accepts the offer in stage 1. In stage 2, G always chooses not to comply (i.e., not comply with probability 1) and L disburses the loan regardless of whether G complies or not.*

The new insight from the case is that it makes no difference for low β countries as the lender does not take exceptions for them. It is the high β countries whose behavior will change as the enforcement becomes non-credible for them. In particular, high β countries will not comply with any conditionality in stage 2 while still receiving the loan. Consequently the specific conditionality that L offers in stage 1 is not consequential.

Discussion and Conclusion

The formal model presented above involves several key modeling innovations. First, it endogenizes conditionality through bargaining between the lender and recipient government. Second, the probability of crisis is endogenously determined by loan size and conditionality, which forces actors to consider the likelihood of future crisis as a direct function of their own strategic decisions, rather than exogenous events. Third, the terms and acceptance of a loan can reveal information about a government's financing need, which influences market conditions. Fourth, the model makes it possible to analyze a case in which future enforcement of conditions is imperfect.

By modeling these dynamics in one model, we are able to move beyond partial equilibrium claims about the effects of crisis lending on capital markets, thereby reconciling seemingly disparate findings that such lending may have a positive, negative, or null effect on capital markets.[23] The equilibrium dynamics also help explain why countries would accept, and lenders extend, loans that might result in a *deterioration* of market conditions. In equilibrium, this occurs when loans reduce the likelihood of crisis even while revealing information about the borrower's underlying economic fragility that drives up interest rates.

Furthermore, we analyze how political dynamics influence the terms of loans and the phenomena of adverse selection and moral hazard. While the latter two problems have received attention in earlier theoretical literature on sovereign lending,[24], this work tended to ignore the influence of international political relationships. Yet as we noted at the outset, a spate of recent empirical research demonstrates that geopolitics systematically influences loan terms and enforcement of those terms. Modeling the bias of the lender reveals that although favored recipients are more likely to receive loans, the loans they receive tend to be less effective, because they include fewer conditions and weaker enforcement. Savvy mar-

[23]This model also provides microfoundations for recent empirical research that attempts to decompose the varying facets of the "catalytic effect" (Chapman et al. 2017).

[24]e.g. Eaton et al. 1986; Atkeson 1991

kets are likely to "price in" these effects, which can undermine the credit market stimulus effects of loan programs.

Previous empirical work has treated the scope of conditionality and enforcement of conditionality independently, and has found effects of geopolitical influences on both dimensions. However, it seems natural to expect conditionality and enforcement to operate as strategic substitutes. For example, lenders might be willing to trade off fewer conditions in exchange for a stronger expectation of being able to enforce those conditions, or borrowers might accept more conditions if they knew they were unenforceable.[25] Our model resolves these difficulties, however, because it shows that politically favored borrowers are less constrained on both dimensions, receiving less conditionality and less rigorous enforcement. For both reasons, the interests that give the lender a stake in the crisis can undermine its ability to restore market confidence.

The net effect of lending on capital market reactions depends on the additive influence of four factors that are co-determined: adverse selection, or the information revealed about a country's financing needs from the successful negotiation of a lending package; liquidity, or the direct injection of capital; the degree of conditionality, which reflects both a lender's interest in a country and the severity of its financing need; and moral hazard, or expectations about the credibility of enforcement for conditionality. These elements are strategically interrelated, and therefore require a unified modeling framework. Our model helps to explain two puzzles about crisis lending: why it produces such mixed effects, and why interested lenders continue to lend even in the face of these mixed results. Like many other examples of the "too big to fail" phenomenon, the very interests that drive lenders to intervene can tragically undermine the effectiveness of their intervention, resulting a "lending trap."

[25]For a related argument on bargaining and enforcement, see Fearon (1998).

Appendix

1. Proof of Proposition 2

To facilitate the exposition, we introduce some notations. We define G's strategy, $\mathscr{G}(x;\theta)$, as follows:

- $\mathscr{G}(x;\theta) \equiv \mathscr{G}_1$: if L offers $x \in (0, x^*]$, then G accepts x and complies with probability 1 in stage 2;
- $\mathscr{G}(x;\theta) \equiv \mathscr{G}_2$: if L offers $x \in (x^*, x^{**})$, then G accepts x and complies if and only if $b \in [\gamma, b^c(x)]$ in stage 2 ;
- $\mathscr{G}(x;\theta) \equiv \mathscr{G}_3$: if L offers $x \in [x^{**}, \theta(1-s)]$, G rejects x in stage 1.

The expected utility of L is given by

$$Eu_L(x;\theta_1,\theta_2,\beta;\mathscr{G}(x;\theta_1),\mathscr{G}(x;\theta_2)) = \pi_1 u_L(x;\theta_1,\beta;\mathscr{G}(x;\theta_1)) + (1-\pi_1)u_L(x;\theta_2,\beta;\mathscr{G}(x;\theta_2)) \quad (8)$$

Here, $\mathscr{G}(x;\theta)$ is embedded in u_L, reflecting that L's utility depends on how G responds to L's offer of x and G's strategy is fully determined by x and its type, θ.

First, we want to show that $Eu_L(x;.)$ is a concave function of x for any given $\beta \in (0,1)$. It is obvious as $Eu_L(x;.)$ is a linear combination of two concave functions, $u_L(x;\theta_1;\mathscr{G}(x;\theta_1))$ and $u_L(x;\theta_2;\mathscr{G}(x;\theta_2))$. Therefore, Eu_L has a global maximum in the entire range of x. Let x^{opt} denote the value at which the maximum of Eu_L is attained. Given θ_1 and θ_2, we will focus on the relationship between x^{opt} and β.

Second, we want to show that $x^{opt}(\beta)$ is a decreasing function of β. Specifically, we can show that [26]

1. If $0 < \beta \le \beta^{**}$, then the global maximum of Eu_L is attained at $X^{opt}(\beta) = x_2^{**} \equiv \frac{s\theta_2}{\gamma-1}$ in stage 1, and both types of G reject the offer. This leads to pooling in rejection. That is, $\mathscr{G}(x;\theta_1) = \mathscr{G}_3$ and $\mathscr{G}(x;\theta_2) = \mathscr{G}_3$.

[26] Please use Figure 2 to guide you through the five cases below (Case 2 includes two subcomponents).

2. If $\beta^{**} < \beta \le \tilde{\beta}$, then there exists a threshold β^{thr} such that:

   (i) If $\beta^{**} < \beta < \beta^{thr}$, then the global maximum of $Eu_L(x;.)$ is attained when x falls into the interval (x_1^{**}, x_2^{**}). As a result, $\mathscr{G}(x;\theta_1) = \mathscr{G}_3$ and $\mathscr{G}(x;\theta_2) = \mathscr{G}_2$. This leads to the separating scenario. In this case, as country of type θ_1 rejects the offer, L only needs to choose an x that maximizes $u_L(x;\theta_2;\mathscr{G}(x;\theta_2))$. It follows that $x^{opt}(\beta) = s\theta_2\sqrt{\frac{1/\beta-2}{\gamma-1}}$.

   (ii) If $\beta^{thr} \le \beta \le \tilde{\beta}$, then the global maximum of $Eu_L(x;.)$ is attained when x falls into the interval $[x_2^{*}, x_1^{**}]$. As a result, $\mathscr{G}(x;\theta_1) = \mathscr{G}_2$ and $\mathscr{G}(x;\theta_2) = \mathscr{G}_2$. This leads to pooling in acceptance. In this case, L offers an x that maximizes $Eu_L(x;.)$. It follows that $x^{opt}(\beta) = s\sqrt{\frac{(1/\beta-2)E(\theta^2)}{\gamma-1}}$.

3. If $\tilde{\beta} < \beta \le \tilde{\tilde{\beta}}$, then the global maximum of $Eu_L(x;.)$ is attained when x falls into the interval $[x_1^{*}, x_2^{*})$. As a result, $\mathscr{G}(x;\theta_1) = \mathscr{G}_2$ and $\mathscr{G}(x;\theta_2) = \mathscr{G}_1$. This leads to pooling in acceptance. In stage 2, G of type θ_2 complies with probability 1 and G of type θ_1 complies with probability $\frac{b_1^c(X^{opt}(\beta))-\gamma}{\Gamma-\gamma}$.

   In this case, L is facing a trade-off when it attempts to further lower x. On the one hand, lowering x will further entice θ_1-type country to comply with a greater probability in stage 2. On the other hand, since x is already small enough to ensure that θ_2-type country will comply with probability 1 in stage 2, a further decline in x will increase the probability of crisis in θ_2-type country given compliance. The additional assumption $\frac{\theta_2}{\theta_1} \ge \sqrt{\frac{(\Gamma-1)\pi_1}{(\Gamma-1)\pi_1-(\Gamma-\gamma)}}$ guarantees that by marginally lowering x, the expected utility gain of L from θ_1-type countries outweights the expected utility loss of L from θ_2-type countries. It follows from L's maximization problem that L offers $x^{opt}(\beta) = s\theta_1\sqrt{\frac{1/\beta-2}{\Gamma-1-\frac{\Gamma-\gamma}{\pi_1}}}$.

   If $\tilde{\tilde{\beta}} < \beta \le 1$, then the global maximum of $Eu_L(x;.)$ is attained when x is equal to x_1^{*}. As a result, $\mathscr{G}(x;\theta_1) = \mathscr{G}_1$ and $\mathscr{G}(x;\theta_2) = \mathscr{G}_1$. This leads to pooling in acceptance. In stage 2, both types of G comply with probability 1.

2. Proof of Proposition 3

Suppose $Z > 0$ but small enough that enforcement is not always credible. We solve the equilibrium for the case where θ is known.

First, suppose G accepts L's offer in stage 1 and does not comply in stage 2, then L needs to decide whether it will punish G or not. If L punishes G (credible enforcement), then $u_L^e = -\beta\theta$. If L does not punish G (non-credible enforcement), then $u_L^{ne} = (2\beta - 1)\theta s - \beta\theta - Z$. Clearly, L will not choose to enforce if and only if, $\beta > \frac{1}{2}(1 + \frac{Z}{s\theta})$. Note that L's equilibrium strategy of enforcement in stage 2 is independent of the level of x that it offers in stage 1.

Second, note that G's per-unit reform implementation cost, b, has a uniform distribution $b \sim U[\gamma, \Gamma]$ with the lower bound of the distribution $\gamma = \frac{1}{1-s}$ greater than one, while G's per-unit benefit of reform implementation is one. It follows that if $\beta > \frac{1}{2}(1 + \frac{Z}{s\theta})$, G will choose not to implement any x as G knows that L will disburse the loan regardless of whether G complies or not. On the other hand, if $\beta \leq \frac{1}{2}(1 + \frac{Z}{s\theta})$, then G will follow the same equilibrium strategy as in the credible enforcement case, as G knows that L will not disburse the loan if it does not implement the reform.

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