Internal Debt Crises and Sovereign Defaults*

Cristina Arellano and Narayana Kocherlakota

Federal Reserve Bank of Minneapolis

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Abstract

Internal and sovereign debt crises occur together and happen more frequently in economies with weak bankruptcy institutions. This paper provides a novel explanation. Internal crises arise because of the inability to liquidate private debtors when many default. In an optimal contract, a successful entrepreneur repays yet an unsuccessful one defaults and liquidates his assets. The bounds on liquidation generate, however, a second equilibrium where domestic borrowers default because others are also defaulting. During these coordinated defaults tax collections fall which increases sovereign default risk. In the model joint debt crises are an optimal response to informational problems in private-sector lending.

Keywords: Default, self-fulfilling debt crisis, optimal contracting

JEL classification: F3, G1

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1 Introduction

Emerging countries experience recurrent financial crises in which private debtors do not pay their private debts and sovereign governments do not pay their international debts. The recent European debt crisis features similar patterns with joint private and sovereign debt crises. This paper provides a novel explanation of these events. The main idea is that crises arise because of the inability to punish private debtors when many of them default at the same time. The crisis is generated by a simple self-fulfilling belief: If all debtors know that all other debtors are going to default, then they all know that they face a small sanction for doing so. During the crisis, government's net tax collections fall which can lead to sovereign default.

The model is motivated by evidence that during financial crises, defaulters' assets are not seized by creditors due to weak bankruptcy institutions. For example, during the Mexican crisis of 1995, the country developed what many Mexicans called the "cultura de no pago" or a culture of non-payment in which few debtors paid their creditors. Creditors were unable to seize the assets of non-performing loans because the courts lacked the capabilities and guidance to manage the systemic bankruptcies effectively.[1,2] Countries in East Asia during the 1997 crisis also exhibited fundamental weaknesses in their bankruptcy mechanisms and their judicial system. For example, initially in Indonesia only courts handled liquidations of failing firms. But as courts quickly became overloaded, the Jakarta Initiative Task Force (JITF) was created as a way to allow for less formal workouts. However, both the court system and the JITF had very limited success in expediting the process of non-performing loans. By October 1998, only 69 cases were settled of the 462 cases filed in courts and JITF.

[1] "Many loans were written off because of issues directly related to the inefficient judicial procedures that involved the recovery of loans from bankrupted companies. The legal framework proved to favor debtors over creditors. Thus, it was not surprising to observe an excessive number of companies filing for bankruptcy, even when they were not in financial distress" (Sidaoui, 2005, Bank of International Settlements p. 278).

[2] Halac and Schmukler (2004) provide evidence of similar situations arising in the crises of Chile in 1981–83, Mexico in 1994–95, Ecuador in 1998–2000, Argentina in 2001–02, and Uruguay in 2002. During these crises large borrowers "quit paying their debts, expecting the government to bear the costs and anticipating no serious consequences for their actions" (Halac and Schmukler, 2004, p. 8). See also Krueger and Tornell (1999) for more details of the crisis in Mexico.

Thus, firms were allowed to run even when they were not paying their debts.[3]

Weak bankruptcy institutions have also played an important role more recently during the European debt crisis. In Ireland, for example, banks suffered large loses due to widespread mortgage defaults. The government then recapitalized the banks with fiscal outlays of about 40% of GDP. However, recent estimates suggest that a substantial portion of these defaults are strategic: homeowners who can pay choose not to pay because they don't think they will get punished and in fact think they might get a write-off from the lenders.[4] Hence, weak bankruptcy mechanisms magnified the internal debt crisis and these events strained the government's ability to service its sovereign debt.

This evidence suggests that an important feature of systemic crises is the inability (or unwillingness) to punish a large number of defaulters. This paper develops a model where the inability to punish a large number of bankrupt debtors is the source of the crisis itself.

Our model has the following elements. There is a benevolent government in a small open economy which borrows from foreign risk-neutral lenders to buy public goods. At the same time, a small number of domestic risk-averse entrepreneurs borrow from domestic risk-averse lenders to buy capital goods for use in a productive investment opportunity. The domestic entrepreneurs' investment returns are a binary random variable that may equal zero with positive probability; returns are, ex-post, known only to the entrepreneur. The government imposes lump-sum taxes on domestic lenders in order to finance its repayments to the foreign lenders.

Liquidation plays a key role in the model. The entrepreneur's capital goods can be liquidated to become consumption goods, but liquidation involves a social loss.[5] The equilibrium

[3]The general sentiment in countries in South East Asia during the 1997 crisis was that "the organizational capacity and human resources of the court appeared insufficient to meet the extraordinary demand for debt settlement posed by massive bankruptcies" (Insolvency Systems in Asia: An Efficiency Perspective, OECD Report, 2001, p. 57).

[4]Recent newspaper headlines in Ireland such as "'Strategic' mortgage defaults rise as borrowers hope for write-down" in *The Independent* and "Strategic arrears - bank-made myth or harsh economic reality?" in *The Irish Times*, report that major mortgage brokers in the country estimate that a quarter of mortgage defaults are strategic.

[5]This approach to designing an optimal loan repayment contract with default is similar to that taken by Diamond (1984) and Rampini (2005).

loan contracts specify repayment/liquidation as a function of the entrepreneurs' declarations of success or failure. In an equilibrium contract, a successful entrepreneur will make a payment to the lender without any liquidation. In contrast, an unsuccessful entrepreneur will liquidate some of his capital, and use that to make a payment to the lender. Thus, equilibrium contracts look like standard debt contracts, with default provisions.

The key assumption of the model is that there is an upper bound on the *total* amount of capital that can be liquidated. Hence, if many entrepreneurs default, the lender can only liquidate a small amount of capital from each of them. If the upper bound on aggregate liquidation is sufficiently tight, then a positive probability non-fundamental shock (a sunspot) can generate a *coordinated default crisis*. In this crisis, domestic entrepreneurs use the non-fundamental shock to coordinate on a default decision, even if they have been successful. During coordinated default crises, successful entrepreneurs default because they know that sanctions will be small given that all other entrepreneurs will also default.

The massive default means that the domestic lenders cannot pay their taxes. Without these tax payments, the sovereign cannot repay the foreign lender in full. Indeed, in these crises, it may well be optimal (for risk-sharing reasons) for the foreign lender to make transfers to the sovereign. The government will then give those transfers to the domestic lenders.

The existence of coordinated default crises in our model is an example of what is called an *implementation problem* in the optimal contracting literature. In our model, an equilibrium contract generates a reporting game between entrepreneurs by specifying repayments and liquidations as a function of the joint reports of the entrepreneurs about their outcomes. In one equilibrium of this game, both entrepreneurs tell the truth, and induce a constrained Pareto optimal allocation of resources. The key property of our model is that, under some parameter settings, the equilibrium contract allows for a second equilibrium in the reporting game in which both lie. The resultant equilibrium outcome is not constrained Pareto optimal.

In our model sovereign and domestic defaults occur simultaneously when the aggregate bound on liquidation is tight. We document that these predictions are borne out in data.

Across countries sovereign defaults are often associated with large numbers of domestic defaults, such as bank insolvencies and non-performing bank loans. Moreover, the incidence of these joint debt crises are systematically correlated with the efficacy of bankruptcy institutions across countries. The efficacy of bankruptcy is measured by the average recovery creditors get during bankruptcy. Empirically, joint crises are more prevalent in countries with low recovery rates. Recoveries explain a considerable fraction of the variation of the the incidence of joint debt crises across countries.

Related Literature

There is a large literature on implementation problems in contractual design. Our paper is most related to the recent contributions of Bassetto and Phelan (2008) and Bond and Hagerty (2007). As in our paper, their implementation problems emerge because society's ability to provide a negative incentive to a given player depends on the number of players who are also supposed to receive such incentives. More concretely, Bassetto and Phelan hypothesize that the probability of any given taxpayer's being audited falls if all taxpayers claim to have low incomes. Under this hypothesis, there is an equilibrium in which all taxpayers choose to default on their tax obligations, regardless of their true incomes. Bond and Hagerty assume that resources for crime enforcement cannot be adjusted in response to the level of crime. Again, this technological restriction generates a second inferior equilibrium with large amounts of crime.

Our paper is also related to the literature that discusses how financial frictions can generate and exacerbate international financial crises. The papers in this literature have modeled a wide variety of financial frictions. Several papers emphasize that, especially in bad times, domestic banks/borrowers may run short on collateral that is acceptable to foreign lenders (Calvo (1998); Caballero and Krishnamurthy (2001); Chang and Velasco (2001)). Without this collateral, domestic agents face what is often termed a *sudden stop* to their borrowing from abroad.

This paper differs from this prior literature on financial frictions in two important respects. First, in these earlier papers, the various crises emerge because some assets, such as non-tradable debt or long-term debt, are illiquid or non-marketable. In many cases, this illiquidity is assumed to exist and is the reason for the crisis. In our paper, crises arise because of limits to provide repayment incentives to borrowers when many are in default at the same time. The "insufficient incentives" mechanism of this paper stands as a stark alternative to the "insufficient liquidity" mechanism emphasized in the literature. This is especially relevant considering the evidence that during emerging markets crises, defaulting borrowers are the ones that gain the most due to weak bankruptcy institutions.

Second, our paper is related to the literature on sovereign default. Although some sovereign default episodes can be rationalized using movements in output or other fundamentals (see Aguiar and Gopinath (2006) and Arellano (2008) for such an account of the recent sovereign default episode in Argentina), it is widely recognized that the connection between sovereign defaults and economic fundamentals is loose.[6] Without a convincing fundamental explanation available, other economists have also turned to a non-fundamental one where debt crises are attributed to *panics* or more general forms of coordination failures among foreign lenders. Cole and T. Kehoe (2000) for example emphasize that sovereign debtors might default when foreign lenders refuse to roll over its debt because they believe other lenders may also refuse to do so.

Finally, the existing literature points to government's bad policies in the form of bailout guarantees as being a source of crises (Eaton (1987); Burnside, Eichenbaum and Rebelo (2004); Schneider and Tornell (2004)). The contractual arrangement of this paper is Pareto optimal, given the upper bound on liquidation. In this environment, government bailout guarantees can be part of an ex-ante optimal arrangement. Intuitively, private agents interact with foreign lenders/insurers only through their government. Because the foreign lenders are risk-neutral, they provide transfers of resources to the home country when the country

[6]For example, Tomz and Wright (2006) document that 38 percent of default episodes since 1820 have occurred when countries had GDP levels above trend.

is doing poorly. These transfers flow through the government to the private sector. They are, in fact, (partial) bailouts. Analyzing debt crises within an optimal contracting structure allows us to pinpoint precisely the source of crises. Within our framework, improving legal institutions domestically to resolve large-scale defaults is the only way to reduce the probability of crises.

2 The Model: Environment and Equilibrium

This section develops a simple model of domestic and foreign lending and characterize equilibrium contracts in this setting.

2.1 Environment

The model consists of a small open economy. Within this country, there is a domestic lender, who is endowed with two units of investment goods in period 1. The domestic lender has a technology that converts these goods into $2R$ units of consumption goods in period 2, where $R > 1$; this technology will serve as the lender's outside option. This domestic lender can be thought as being any agent within the country who contributes resources to investment. In this sense, bank depositors are domestic lenders.

There are also two entrepreneurs. Entrepreneur n has a technology that converts 1 unit of investment goods in period 1 into R_n units of consumption goods in period 2. Here, R_n, $n = 1, 2$, are i.i.d. random variables, with realizations that are determined at the beginning of period 2. With probability $(1 - p)$, R_n equals $R^H > R > 0$ and with probability p, its realization is $R^0 = 0$. There is a key informational restriction in this setting: the realization of R_n is privately known to entrepreneur n, and the entrepreneur has the ability to consume the project return secretly.

Entrepreneurs also have a technology that liquidates invested capital in period 2. If L units of capital are liquidated, then it generates δL units of consumption goods, $0 \leq \delta \leq 1$.

Liquidation is bounded by the entrepreneur's total capital investment such that $0 \leq L \leq 1$. Entrepreneurs, but not lenders, derive consumption benefits from the $(1 - L)$ units of unliquidated capital. Those consumption benefits equal $B_E(1 - L)$ units of consumption.

The domestic lender has a utility function u_L over consumption goods. The utility functions u_L and u_E satisfy the properties $u'_L, u'_E, -u''_L, -u''_E > 0$, and $u_L(0) = u_E(0) = 0$. Both functions exhibit non-increasing absolute risk aversion. The consumptions of the lender and entrepreneurs of every good are restricted to be non-negative.

In addition to the three agents, there is a government. The government is able to borrow and lend from foreign lenders at a gross rate of return $R^{FOR} > 1$. The government needs to create an amount G of public goods in period 1. It does so by borrowing G units of consumption goods in period 1 from an international debt market, and then transforming them, one for one, into the required public goods. It repays this loan in period 2, using taxes τ collected from the domestic lender.[7]

The key to the model is a non-trivial upper bound on aggregate liquidation. Total liquidation is bounded from above by ξ, where $1 \leq \xi < 2$. This constraint says that if both entrepreneurs default, it is not possible to take more than $\xi/2$ from either of them. This upper bound on liquidation lies at the heart of the model.

Note that the model is designed to be as simple as is possible, given the issues that we want to analyze. It has a government and a foreign lender to include international sovereign borrowing. It has a domestic lender to include private domestic borrowing/lending. Finally, it has more than one entrepreneur in order to get the possibility of a coordination problem of some kind.[8]

[7]Having lenders pay taxes as opposed to entrepreneurs simplifies the exposition but has no bearing on the results.

[8]To make the mechanism transparent, the model has only two entrepreneurs. Such an assumption, however, is not crucial for the results. Bassetto and Phelan (2008) show that implementation problems arise in more general environments with large number of agents.

2.2 Equilibrium

In period 2, the two entrepreneurs simultaneously announce their returns. There are four possible outcomes for these announcements. At the beginning of period 1, the government chooses a tax schedule $(\tau_s)_{s\in\{0,1,2\}}$, where τ_s is the domestic lender's tax payment when s entrepreneurs claim to have high returns. The government's goal is to maximize a weighted sum of the expected utilities of the entrepreneurs and the domestic lender.

After the government commits to a tax schedule, the domestic lender commits to a loan contract (F, L) at the beginning of period 1. Under this contract, if in period 2 entrepreneur 1's announced return is R^i and entrepreneur 2's announced return is R^j, then entrepreneur 1's repayment is F_{ij} and entrepreneur 1's liquidation is L_{ij}. Symmetrically, entrepreneur 2's repayment is F_{ji} and entrepreneur 2's liquidation is L_{ji}. The upper bounds on liquidation and lower bounds on consumption of each good imply that for all (i, j) in $\{H, 0\}^2$:

$$\begin{aligned} &F_{ij} \leq R^i \\ &1 \geq L_{ij} \geq 0 \\ &L_{ij} + L_{ji} \leq \xi \end{aligned} \tag{1}$$

The Revelation Principle says that, without loss of generality in terms of equilibrium outcomes, one can focus on loan contracts that satisfy the incentive-compatibility condition:

$$\begin{aligned} &(1-p)u_E(B_E\,(1-L_{HH}) + R^H - F_{HH}) + pu_E(B_E\,(1-L_{H0}) + R^H - F_{H0}) \\ \geq\ &(1-p)u_E(B_E\,(1-L_{0H}) + R^H - F_{0H}) + pu_E(B_E\,(1-L_{00}) + R^H - F_{00}) \end{aligned} \tag{2}$$

Intuitively, entrepreneurs send simultaneous announcements of their returns to the lenders. These incentive-compatibility conditions guarantee that truth-telling is a Bayesian-Nash equilibrium of this reporting game. The incentive-compatibility conditions for entrepreneurs with zero returns can be ignored because they turn out to be irrelevant in equilibrium.

While the model has only one active domestic lender, we suppose that there is potential

competition that forces the domestic lender to deliver all surplus to the entrepreneurs. This potential competition implies that, regardless of the government's choice of tax schedule, the domestic lender gets only the reservation utility $u_L(2R)$. (More specifically, if the lender gets more than that, a potential competitor will offer a loan contract with a lower F_{HH}.) Hence, an *equilibrium contract* (τ, F, L) maximizes the utility of the entrepreneurs, and is any solution to the optimization problem:

$$\max_{(\tau,F,L)} (1-p)^2 u_E(B_E\,(1-L_{HH}) + R^H - F_{HH}) + p(1-p)u_E(B_E\,(1-L_{H0}) + R^H - F_{H0}) \\ +p(1-p)u_E(B_E\,(1-L_{0H}) - F_{0H}) + p^2 u_E(B_E\,(1-L_{00}) - F_{00})$$

subject to (1), (2), an individual rationality constraint for the domestic lender:

$$(1-p)^2 u_L(2(F_{HH}+\delta L_{HH}) - \tau_2) + 2p(1-p)u_L(F_{0H}+F_{H0}+\delta(L_{0H}+L_{H0}) - \tau_1) \\ +p^2 u_L(2(F_{00}+\delta L_{00}) - \tau_0) = u_L(2R) \tag{3}$$

and a zero-profit constraint for the foreign lenders:

$$(1-p)^2\tau_2 + 2p(1-p)\tau_1 + p^2\tau_0 \geq R^{FOR}G \tag{4}$$

The last constraint says that the government's expected repayments are enough to compensate the foreign lenders for the initial loan of size G.

It is useful to understand when this constraint set is non-empty, so that there is an incentive-compatible contract that is superior to the outside options of the lenders. An entrepreneur who defaults alone can pay the lenders at most δ, while an entrepreneur who defaults with another can pay at most $\delta\xi/2$. Then, incentive-compatibility implies that the lenders can get at most $F_{\max}$ from a successful entrepreneur, where $F_{\max}$ satisfies:

$$u_E(R^H - F_{\max} + B_E) = pu_E(R^H) + (1-p)u_E(R^H + B_E(1-\xi/2))$$

It follows that the constraint set to the optimization problem is non-empty if and only if:

$$(1-p)^2 2F_{\max} + 2p(1-p)(F_{\max}+\delta) + p^2\delta\xi \geq 2R + R^{FOR}G$$

Note that it is harder to satisfy this condition with a small value of B_E. The lenders extract resources from successful entrepreneurs only because they lose their capital if they claim to be unsuccessful. Hence, $F_{\max}$ is increasing in the entrepreneur's benefits B_E from unliquidated capital. In particular, the condition is only satisfied if $B_E > 1$.[9]

The following proposition provides a partial characterization of equilibrium contracts. It shows that they look like debt contracts, with partial liquidations by the risk-averse entrepreneurs when they default.

Proposition 1. *Suppose* (τ, F, L) *is an equilibrium contract. Then:*

1. $F_{HH} = F_{H0} > 0$
2. *If* $R^H > F_{HH}$, *then* $L_{HH} = L_{H0} = 0$
3. (τ, F, L) *satisfies the incentive constraint* (2) *with equality*
4. *The zero profit constraint (4) is satisfied with equality*
5. $F_{00} = F_{0H} = 0$
6. $2R = 2(F_{HH} + \delta L_{HH}) - \tau_2 = F_{0H} + F_{H0} + (\delta L_{0H} + \delta L_{H0}) - \tau_1$
   $= 2(F_{00} + \delta L_{00}) - \tau_0$

Proof. See Appendix A □

The contracts described in Proposition 1 are essentially defaultable debt contracts. An entrepreneur who announces a high return R^H makes a positive repayment to the domestic lender, and his capital is not liquidated. An entrepreneur who announces a low return makes no payment to the domestic lender, and his capital is definitely partially liquidated. Thus, announcing a low return is akin to deciding to default. When the entrepreneur reports

[9]The capital liquidated by entrepreneurs can be easily interpreted as being "collateral goods", as in Kocherlakota (2001) and Kocherlakota and Shim (2007). Under this interpretation, B_E can be thought as being the entrepreneur's quantity of collateral, and $1/B_E$ as being the lender's marginal valuation of that collateral.

a high return, liquidation is not optimal because paying the lender with liquidated goods in inefficient given that $B_E > 1 > \delta$. $F_{HH} = F_{H0}$ for consumption smoothing reasons. During low return announcements, capital is partially liquidated to provide incentives to the entrepreneur to tell the truth but it is not optimal to give any transfers $F_{0H} = F_{00}$ because it would waste more liquidated goods.

One entrepreneur's contract depends on the other's default decision only through the level of liquidation. Conditional on the entrepreneurs' announced returns, there is no way to restructure payments to make all participants better off. In this sense, the equilibrium contracts are renegotiation-proof.

3 The Possibility of Crises

Suppose (τ, F, L) is an equilibrium contract. Given this contract, the two entrepreneurs play a reporting game with one another in which they decide to report 0 or R^H. Given the nature of the equilibrium loan contract, these choices can be interpreted as being to "default" or "not to default" respectively. The incentive-compatibility conditions guarantee that if a successful entrepreneur chooses not to default, then it is optimal for the other entrepreneur to make the same choice if successful. However, the incentive-compatibility conditions do not rule out the possibility of other (strict) equilibria in this reporting game between the entrepreneurs. Consider a putative equilibrium in which both entrepreneurs decide to default when in fact they have high returns. This strategy forms a strict equilibrium if:

$$u_E(B_E\,(1 - L_{00}) + R^H) > u_E(B_E + R^H - F_{H0})$$

(This condition exploits the result in Proposition 1 that $L_{H0} = 0$ and $F_{00} = 0$ in an equilibrium contract.) In words, this condition says that an entrepreneur, with a high return, finds

it strictly optimal to default because he knows that the other entrepreneur is defaulting.[10] Such an equilibrium is labeled *coordinated default crisis,* and the contracts that allow for such an equilibrium in the reporting game are labeled *crisis contracts.*

As the above description suggests, the constraint that caps aggregate liquidations plays a fundamental role in generating crises. In particular, because $F_{00} = F_{0H} = 0$, $L_{HH} = L_{H0} = 0$, and $F_{H0} = F_{HH}$, in any equilibrium:

$$\begin{aligned} & u_E(B_E + R^H - F_{H0}) \\ = \; & (1-p)[u_E(B_E\,(1 - L_{0H}) + R^H)] + p[u_E(B_E\,(1 - L_{00}) + R^H)] \end{aligned}$$

If $L_{0H} \leq L_{00}$, then the equilibrium contract is not a crisis contract, because:

$$u_E(B_E + R^H - F_{H0}) \geq u_E(B_E\,(1 - L_{00}) + R^H)$$

It follows that crisis contracts arise only because L_{0H} may be higher than L_{00}.

The following propositions provide a sharp characterization of the conditions under which equilibrium contracts are in fact crisis contracts. The key to this characterization is to understand when the constraint $L_{00} \leq \xi/2$ binds. To gain insight into this issue, the next proposition considers the *relaxed equilibrium contract problem,* which is the equilibrium contract problem without the four state-contingent constraints on aggregate liquidation.

Proposition 2. *Suppose* (τ, F, L) *is a solution to the relaxed equilibrium contract problem. Then:*

$$L_{00} = L_{0H} = L_0 = F_H/B_E$$

Proof. Suppose (τ, F, L) is an equilibrium, but $L_{0H} \neq L_{00}$. Define the certainty equivalent

[10] If entrepreneurs are indifferent between lying and telling the truth, it is assumed that they choose to tell the truth. This (conventional) assumption implies that any crisis must necessarily be a strict equilibrium.

$\widehat{L}_0$ so that:

$$u_E\left(B_E\left(1-\widehat{L}_0\right)+R^H\right)=(1-p)u_E(B_E\left(1-L_{0H}\right)+R^H)+pu_E(B_E\left(1-L_{00}\right)+R^H)$$

Define $(\widehat{\tau},\widehat{F},\widehat{L})$ to be a contract that is the same as (τ,F,L) except:

$$\begin{aligned}\widehat{L}_{00} &= \widehat{L}_{0H}=\widehat{L}_0\\ \widehat{\tau}_1 &= \delta\widehat{L}_{0H}-\delta L_{0H}+\tau_1\\ \widehat{\tau}_0 &= 2\left(\delta\widehat{L}_{00}-\delta L_{00}\right)+\tau_0\end{aligned}$$

Because u_E exhibits non-increasing absolute risk aversion:

$$u_E\left(B_E\left(1-\widehat{L}_0\right)\right)>(1-p)u_E(B_E\left(1-L_{0H}\right))+pu_E(B_E\left(1-L_{00}\right))$$

and so the objective increases. Clearly, $(\widehat{\tau},\widehat{F},L)$ satisfies (1), (2), and (3). Also,

$$\begin{aligned}&(1-p)^2\tau_2+2p(1-p)\widehat{\tau}_1+p^2\widehat{\tau}_0\\ =\;&(1-p)^2\tau_2+2p(1-p)[\delta\widehat{L}_{0H}-\delta L_{0H}+\tau_1]\\ &+p^2[2\delta\widehat{L}_{00}-2\delta L_{00}+\tau_0]\\ =\;&R^{FOR}G+2p\delta[\widehat{L}_0-(1-p)L_{0H}-pL_{00}]>R^{FOR}G\end{aligned}$$

where the last inequality is implied by the strict concavity of u_E. Hence, if $L_{0H}\neq L_{00}$, (τ,F,L) cannot be an equilibrium, because $(\widehat{\tau},\widehat{F},\widehat{L})$ improves upon it. The incentive constraint is then: $u_E(B_E+R^H-F_H)=u_E\left(B_E\left(1-\widehat{L}_0\right)+R^H\right)$, and so $\widehat{L}_0=F_H/B_E$. QED □

The aggregate resources the lender gets from entrepreneurs are lower when either of them defaults, because liquidation is a costly form of repayment. The taxes collected by the government perfectly insure the domestic lender against this risk, which is then absorbed by the foreign lender. Hence, the payments received by the foreign lender from the sovereign

borrower can be ordered as follows:

$$\tau_2 > \tau_1 > \tau_0.$$

τ_2 is the face value of the sovereign debt. A partial sovereign default occurs if the foreign lender receives τ_1 and a full sovereign default occurs if the foreign lender receives τ_0.

The results above can be used to readily solve for the solution to the relaxed equilibrium contract problem. In that case, $F_H/B_E = L_{0H} = L_{00} = L_0^*$. Hence, $\tau_2 = 2L_0^* B_E - 2R$, $\tau_1 = \delta L_0^* + B_E L_0^* - 2R$, and $\tau_0 = 2\delta L_0^* - 2R$. After substituting these taxes into the zero profit constraint of the foreign lender the following holds:

$$(1-p)^2 B_E L_0^* + p(1-p)(B_E + \delta)L_0^* + p^2 \delta L_0^* = R + R^{FOR} G/2$$

which implies that equilibrium liquidation is given by:

$$L_0^*(R, p, G, R^{FOR}, B_E, \delta) = \frac{R + R^{FOR} G/2}{(1-p)B_E + p\delta}. \tag{5}$$

This expression is useful in proving the following proposition that characterizes when equilibrium contracts are in fact crisis contracts.

Proposition 3. *If $L_0^*(R, p, G, R^{FOR}, B_E) \leq \xi/2$, then no equilibrium contracts are crisis contracts. If $L_0^*(R, p, G, R^{FOR}, B_E) > \xi/2$, then all equilibrium contracts are crisis contracts.*

Proof. Suppose that:

$$L_0^*(R, p, G, R^{FOR}, B_E, \delta) \leq \xi/2$$

As shown above in any solution to the relaxed problem, $L_{0H} = L_{00} = L_0^*$. Since $L_0^* \leq \xi/2$, any solution to the relaxed problem is also a solution to the original equilibrium contracting problem. Hence, in any equilibrium contract, $F_{HH} = F_{H0} = B_E L_0^*$, and $L_{0H} = L_{00} = L_0^*$.

Given that $L_{0H} = L_{00}$, none of these contracts is a crisis contract.

Now suppose that ξ is small enough such that $L_0^*(R, p, G, R^{FOR}, B_E) > \xi/2$. In any equilibrium contract (τ, F, L), $F_{HH} = F_{H0} = F_H$, and (F_H, L_{0H}, L_{00}) satisfy:

$$\begin{aligned}(1-p)u_E(B_E(1-L_{0H}) + R^H) + pu_E(B_E(1-L_{00}) + R^H) &= u_E(B_E + R^H - F_H) \\ (1-p)F_H + p(1-p)\delta L_{0H} + p^2\delta L_{00} &= R + R^{FOR}G/2\end{aligned}$$

(The first equality is the incentive constraint. The second equality is a combination of the individual rationality and zero profit constraints.) Let us claim this contract is a crisis contract; that is, $L_{0H} > L_{00}$. Suppose not. Then, $\xi/2 \geq L_{00} \geq L_{0H}$. The incentive constraint then implies that $F_H \leq B_E\xi/2$. Then, after substituting into the zero profit constraint one can get:

$$(1-p)B_E\xi/2 + p(1-p)\delta\xi/2 + p^2\delta\xi/2 \geq R + R^{FOR}G/2$$

But this implies that:

$$\xi/2 \geq \frac{R + R^{FOR}G/2}{(1-p)B_E + \delta p}$$

which violates the hypothesized upper bound on $\xi/2$. It follows that all equilibrium contracts are crisis contracts. QED □

The idea behind the proposition is simple. If ξ is high enough, then the upper bound on aggregate liquidation is basically irrelevant. It is possible to spread the equilibrium liquidation across the two states in such a way that L_{00} is equal to L_{0H}, which eliminates the possibility of a coordinated default crisis. On the other hand, if ξ is low enough that the constraint on aggregate liquidation binds, L_{00} must be less than L_{0H} in equilibrium.

It is simple to show that to satisfy the domestic lender's individual rationality constraint, it is necessary that $L_0^*(R, p, G, R^{FOR}, B_E, \delta) < 1$. Hence, Proposition 3 implies that no equilibrium contract is a crisis contract if $\xi = 2$. Crises occur only because there is a substantial

constraint on aggregate liquidation.

In the model, liquidation provides a way to compensate the lenders and it provides a way to discipline defaulting borrowers. Both roles matter in generating coordinated default crises. If ξ is too low, then it is not possible to deliver a sufficiently strong punishment if both borrowers default simultaneously. If δ is too low, then more liquidation is required to satisfy the zero-profit-constraint of the lender. If the required amount of liquidation grows to exceed $\xi/2$, then there is a possibility of coordinated default crises.

4 Crises and Correlations

The section above showed that when the bound on liquidation is sufficiently tight, under an equilibrium contract, there is the possibility of a second equilibrium being played in the reporting game between the entrepreneurs. However if this possibility is a real one, then the players, as Bayesians, should assign a positive ex-ante probability to this equilibrium being played. Doing so will affect the design of the original contract itself.

More specifically, suppose with probability ε, the entrepreneurs both privately observe 1 at the beginning of period 2, and with probability $(1-\varepsilon)$, they both observe 0. These private signals allow the entrepreneurs to coordinate their reports. In particular, assume that it is common knowledge that the entrepreneurs will default if they both observe 1 and if doing so is a mutual best response, given a contract.[11] Let ε denote the *sunspot probability*.

As is typical in the coordination failure literature, we are silent about what the coordination device is. The idea is that entrepreneurs observe a number of independent payoff irrelevant signals and they choose which of these signals to use as a coordination device.

This section examines the structure of equilibrium contracts, given that coordinated default crises are positive probability events. In this environment domestic and sovereign

[11]The lender could ask the entrepreneurs whether they have seen the sunspot or not. However, it is not possible to design a contract which does not have an equilibrium in which they jointly claim not to have seen the sunspot, but they actually have. For this reason, it is directly assumed that the contract does not depend on the sunspot.

defaults occur simultaneously and the equilibrium rates of return on domestic and sovereign foreign debt are positively correlated.

4.1 Domestic and Sovereign Default

The common private signal mentioned above does not affect the nature of the feasibility constraints (1) or incentive constraints (2). However, it does change the individual rationality constraint (3), the zero profit constraint (4), and the objective of the entrepreneurs. The individual rationality constraint becomes:

$$\begin{aligned}
&u_L(2R) = (1-\varepsilon)(1-p)^2 u_L(2(F_{HH}+\delta L_{HH})-\tau_2) \\
&+2(1-\varepsilon)p(1-p)u_L(F_{0H}+F_{H0}+\delta L_{0H}+\delta L_{H0}-\tau_1) \\
&+[(1-\varepsilon)p^2+\varepsilon]u_L(2(F_{00}+\delta L_{00})-\tau_0)
\end{aligned}$$

The zero profit constraint becomes:

$$(1-\varepsilon)(1-p)^2\tau_2 + 2(1-\varepsilon)p(1-p)\tau_1 + (p^2(1-\varepsilon)+\varepsilon)\tau_0 \geq R^{FOR}G$$

Finally, the entrepreneur's objective becomes:

$$\begin{aligned}
&(1-\varepsilon)(1-p)^2 u_E(B_E(1-L_{HH})+R^H-F_{HH}) \\
&+(1-\varepsilon)p(1-p)u_E(B_E(1-L_{H0})+R^H-F_{H0}) \\
&+(1-\varepsilon)p(1-p)u_E(B_E(1-L_{0H})-F_{0H})+[(1-\varepsilon)p^2+\varepsilon]u_E(B_E(1-L_{00})-F_{00})
\end{aligned}$$

An equilibrium contract, given sunspot probability ε, must maximize (the altered version of) the entrepreneur's objective subject to (1), (2) and the altered versions of (3) and (4).

Let $(\tau(\varepsilon), F(\varepsilon), L(\varepsilon))$ be an equilibrium contract given sunspot probability ε. It is straightforward to use the same logic as in Proposition 1 to establish the following characterization of $(\tau(\varepsilon), F(\varepsilon), L(\varepsilon))$, for any $\varepsilon \geq 0$.

Proposition 4. *Suppose* $(\tau(\varepsilon), F(\varepsilon), L(\varepsilon))$ *is an equilibrium contract given sunspot probability* ε*. Then:*

1. $F_{HH}(\varepsilon) = F_{H0}(\varepsilon) > 0$
2. *If* $R^H > F_{HH}(\varepsilon)$, *then* $L_{HH}(\varepsilon) = L_{H0}(\varepsilon) = 0$
3. $(\tau(\varepsilon), F(\varepsilon), L(\varepsilon))$ *satisfies the incentive constraint* (2) *with equality*
4. $\tau(\varepsilon)$ *satisfies the zero profit constraint* $(4')$ *with equality*
5. $F_{0H}(\varepsilon) = F_{00}(\varepsilon) = 0$
6. $2R = 2(F_{HH}(\varepsilon) + \delta L_{HH}(\varepsilon)) - \tau_2(\varepsilon) = F_{0H}(\varepsilon) + F_{H0}(\varepsilon) + (\delta L_{0H}(\varepsilon) + \delta L_{H0}(\varepsilon)) - \tau_1(\varepsilon)$
$= 2(F_{00}(\varepsilon) + \delta L_{00}(\varepsilon)) - \tau_0(\varepsilon)$

Proof. The same as the proof of Proposition 1. QED □

This proposition implies that in the equilibrium contract, given suspot probability ε, domestic and sovereign defaults occur simultaneously. When both entrepreneurs announce low returns, they default on their loan ($F_{00}(\varepsilon) = 0$), and their assets are liquidated ($L_{00}(\varepsilon) > 0$). These are times when the sovereign also defaults, as it cannot pay the foreign lender in full: $\tau_0(\varepsilon) = 2(\delta L_{00}(\varepsilon) - R) < 2(F_{HH}(\varepsilon) - R) = \tau_2(\varepsilon)$.

4.2 Positively Correlated Debt Returns

From Proposition 3, crisis contracts exist only if $\xi/2$ is sufficiently small, so that:

$$\xi/2 < L_0^*(R, p, G, R^{FOR}, B_E, \delta)$$

The following proposition uses this condition to prove that when sunspots are more likely to occur, both domestic debt and sovereign foreign debt returns – that is, both $F_{HH}(\varepsilon)$ and $\tau_2(\varepsilon)$ – are higher.

Proposition 5. *Define L_0^* as in (5) to be the equilibrium liquidation in a contract in which the upper bound on liquidation does not bind (assuming $\varepsilon = 0$). Suppose that:*

$$\xi/2 < L_0^*(R, p, G, R^{FOR}, B_E, \delta)$$

Then, for non-negative ε in a neighborhood of 0, $F_{HH}(\varepsilon)$ and $\tau_2(\varepsilon)$ are both strictly increasing in ε.

Proof. In Appendix A. □

This proposition shows that if ε increases, a non-defaulting entrepreneur will make a bigger debt repayment to the domestic lender and the government will make a bigger debt repayment to the foreign lender. Intuitively, when ε rises, the foreign lender is less likely to receive the high repayment τ_2. The foreign lender must be compensated for this probability reduction with increased repayments by the government. This in turn calls for a larger repayment of the non-defaulting entrepreneurs to the domestic lender.

The above assumes that the lender simply allows for the possibility of coordinated default crises in offering a contract. The lender could instead restrict contracts to ones that eliminate coordinated default crises entirely. To do so, let us augment the original contractual choice problem to include the constraint:

$$u_E(B_E + R^H - F_{H0}) \geq u_E(B_E\,(1 - L_{00}) + R^H)$$

or, equivalently, $F_{H0}/B_E \leq L_{00}$. Under the hypothesis of Proposition 3 about ξ, this constraint must be binding. In the resultant contracts, $F_{H0} < F_{HH}$. This extra randomness reduces the value of the entrepreneur's objective. However, the reduction is by an amount that is independent of ε. It follows that, as long as ε is sufficiently small, this kind of random contract is suboptimal relative to the one described in Proposition 5.

5 Evidence

Our model has two main empirical predictions. First, the model predicts that private and sovereign default happen together. In the model, it is optimal for domestic borrowers to default if other borrowers are also defaulting. The government also defaults because it lacks sufficient funds to pay the foreign lender due to low tax collections. Second, the model predicts that the incidence of such simultaneity in debt crises happens when the aggregate bound of liquidation is tight.

This section provides empirical support for the model predictions. It shows that empirically episodes of international sovereign defaults largely coincide with episodes of large domestic private defaults. Moreover, the simultaneity of debt crises is more prevalent in countries with weak bankruptcy institutions. It also documents that from an ex-ante perspective sovereign default risk and private default risk move together as the dollar or euro spreads on international sovereign bonds have a tight correlation to dollar or euro domestic lending spreads charged to private borrowers.

We construct a cross country dataset for middle income countries, emerging markets, and GIIPS with the dates of their sovereign defaults and internal debt crises from 1976 to 2012 as well as private recovery rates, as measuring the efficacy of bankruptcy institutions. Our sources for dating sovereign defaults and internal debt crises are Laeven and Valencia (2008 and 2012). Dates of internal debt crises are proxy with the dates of banking crises from Laeven and Valencia; which expands the commonly used dataset by Caprio and Klingebiel (2003). As they document, these crises are characterized by widespread domestic defaults with large increases in non-performing loans and collapses of banks.[12] Recovery rates for each country are taken from the World Bank Doing Business Dataset in 2013.

To examine actual sovereign defaults and internal debt crises, the number of sovereign defaults and internal debt crises episodes that have occurred since 1976 in our sample of

[12]Only two of the banking crises described by Laeven and Valencia (2008 and 2012) feature bank runs. This suggests that banks' difficulties were primarily on the asset side of their balance sheets.

67 countries are computed. A *joint crisis* is defined as an event with at least one year of overlap between a sovereign default and restructure and a banking crises. Crises that are only sovereign, contain a sovereign default but not a banking crisis. Crises that are only private contain a banking crises but not a sovereign default.

Table 1 shows that from 1976-2012 there have been 16 sovereign defaults in our sample of emerging and GIIPS countries and 13 of those have also involved an internal debt crisis. These countries have also experienced 16 additional internal debt crises without a sovereign default. Sovereign defaults also occur together with internal debt crises in our broader sample of middle income countries. Of the 39 sovereign defaults that occurred in these countries, 24 have been accompanied by internal debt crises. These countries have considerable number of internal debt crises without a sovereign default.

In a recent paper, Reinhart and Rogoff (2011) also show that banking crises often precede or accompany sovereign debt crises, and indeed they predict them. In particular, using data from 1824 to 2009 across 70 countries, they estimate a multinomial logit and show that banking crises predict sovereign defaults up to 3 years in the future in emerging and advanced countries after including controls such as the level of sovereign debt.

Domestic bankruptcy institutions are also systematically related to joint crises. Figure 1 plots the number of joint crises for every country in our sample against the average recovery rate. Countries have discrete number of joint crises ranging from 0 to 3. The figure shows that countries with lower recovery rates tend to have more joint crises.

The relation between joint crises and recoveries is also statistically significant. Table 2 shows results from regressions of the number of joint crises, only sovereign crises, and only private crises, on the recovery rate for the sample countries. The regressions also include a dummy variable for emerging markets and a constant.

The regressions state that countries with better bankruptcy institutions measured by higher recovery rates tend to have less joint crises. The coefficient is statistically significant at the 1% level and can explain a considerable fraction of the variation in joint crises, with

an R^2 of 0.21. The magnitude of the coefficient is economically sizable. It says that joint crises occur 0.3 times less in countries with recovery rates of 50% relative to countries with recovery rates of 20%. To put this number in context, note that the average recovery rate in the sample is 34% with a standard deviation of 17% and that the mean joint crises across countries equals 0.37.

Recovery rates are weakly negatively correlated with only sovereign crises. Countries with lower recoveries tend to have more sovereign defaults, but the R^2 from this regression is only 0.03. Recoveries appear to be positively correlated with only private crises. Nevertheless, the R^2 from the regression is small and equal to 0.12.

Finally we provide evidence that measures of sovereign default risk and private default risk also co-move from an ex-ante perspective. Our dataset consists of monthly data for a smaller sample of countries, fifteen emerging markets and the five European GIIPS countries. The countries in the sample are those with series for EMBI+ yields starting prior to the year 2000 and that have market lending rates. The measure for sovereign default probabilities is the EMBI+ spread for emerging countries and the 10-year spread of euro bonds for the European countries.[13] The spreads are the difference between the yield of dollar (or euro) denominated bonds relative to the yield of similar U.S. (or German) government bonds.

For the private sector, measure the probability of default of domestic private borrowers by the spread of dollar or euro lending rates relative to the yield of United States or Germany. In countries for which domestic dollar rates are not available,the local currency spread between the average lending rate and the average deposit rate is used to proxy default probabilities. The details of all the data are in Appendix B. The average correlation across all countries is positive and equal 0.36. For 18 countries the correlation is positive and for some countries like Mexico it is over 0.85. [14] Figure 2 illustrates the co-movement between sovereign default

[13]Treating the spreads are default probabilities ignores other possible sources of changes in expected returns. These include variations in liquidity or variations in country-specific betas relative to the world market portfolio.

[14]The correlations between spreads and nominal lending rates are strongly positive for all countries in the sample. This finding is similar to that of Mendoza and Yue (2011). They show that the correlation between EMBI+ spreads and firm financing costs are strongly positive. Their measure of the latter is in terms of

risk and private default risk and that spikes in sovereign default probabilities are generally accompanied by spikes in the domestic private default probabilities.

The findings from this section confirm the empirical implications of our model. Sovereign defaults largely coincide with periods of systemic domestic debt crises, and such relation is stronger for countries with weak bankruptcy institutions. Moreover, the coincidence in debt crises are also reflected in the interest rates on both debt classes that move together.

6 Discussion

This section discusses extensions of the model of sovereign default and how the model can capture the link between real exchange rate depreciations and crises.

6.1 Enriching Our Model of Sovereign Default

In our model, the government must repay all loans. In reality, governments have a choice over whether to do so or not, and indeed much of the literature on sovereign default focuses on this choice.[15] This subsection considers two different ways to add such a choice into the model. Enriching the model in this way does not affect our results greatly.

6.1.1 Ex-Post Participation Constraint

In our model, the sovereign has no ability to deviate from the recommendations of the contract. Suppose instead that in period 2, the sovereign has the option to pay the contractually mandated τ_s or choose to face a sanction with exogenously specified cost k. This option will impose an additional constraint on the equilibrium contracting problem that $\tau_s \leq k$ for all s. Intuitively, this additional constraint will increase the amount of risk each entrepreneur must bear in states when his announced return is R^H. To satisfy the incentive compatibility constraint of entrepreneurs, the contractually specified amount of liquidation must increase.

domestic currency, and so includes an own-country inflationary component.

[15] See for example Eaton and Gersovitz (1981), Bulow and Rogoff (1989), and Atkeson (1991).

Thus, the ability of the sovereign to default increases the range of the parameters consistent with equilibrium crisis contracts (just as increasing R or G does).

There is one empirical problem that emerges with this way of incorporating voluntariness on the part of the sovereign. If the participation constraint binds, so that $\tau_2 = k$, then τ_2 cannot vary with ε as in the prior section. Note that this empirically unattractive feature arises because in this model of default, the sovereign is tempted to endure the sanction in *good* times, not *bad* times.

6.1.2 Private Information About the Aggregate State

In the above simple model of sovereign default, the sanction k never occurs in equilibrium. Hence, in equilibrium, default is really still only a label that distinguishes repayment states from one another. Consider the following distinct model of default. Suppose that as above, it is possible to impose a sanction of cost k on the sovereign. In contrast to the above model, though, assume that the sovereign has full commitment and that τ_s is privately known to the sovereign.

The private information restriction will lead to an incentive-compatibility constraint on the sovereign. In this model, in an equilibrium contract, the sovereign will pay k (with some probability) for announcing values of s which lead to low repayments to the foreign lender. As is true of the private debt contract in our benchmark model, the sovereign's announcing a low value of s can be interpreted as declaring default.

This extra incentive constraint on the problem introduces even more risk to the entrepreneurs, and so increases the amount of liquidation required. Again, this private-information model of default expands the set of parameters consistent with equilibrium crisis contracts, relative to our benchmark model. One attractive feature of this model is that, unlike the prior participation-constraint model, the face value τ_2 is an increasing function of ε (the probability of a coordinated default crisis).

6.2 Real Exchange Rate Depreciations and Crises

Debt crises are often associated with periods of real exchange rate depreciation. Our model captures this connection in the following sense. In our model, the domestic lender can lend to an entrepreneur or invest in an outside option. Suppose that the utility of the lender is over bundles of tradable and nontradable goods. Then the lender wants to maximize its wealth to subsequently buy a bundle of tradable and nontradable goods. Suppose too that entrepreneurs are engaged in the production of nontradable goods, where incentive problems are severe, while the lender's outside opportunity consists of the production of tradable goods. Under this interpretation, a depreciated real exchange rate is a rise in the value of the tradable good production, that is, as an increase in R.

An increase in R can generate crises, when none existed before because

$$\frac{\partial L_0^*(R, p, R^{FOR}, G, B_E, \delta)}{\partial R} > 0,$$

where L_0^* is defined to be the equilibrium contract when the aggregate liquidation constraint does not bind, as in (5). When the outside option R rises, $L_0^*(R, p, G, R^{FOR}, B_E, \delta)$ can increase above $\xi/2$. This change can lead all equilibrium contracts to be crisis contracts. Hence, in our model real exchange rate depreciations can generate sovereign and domestic debt crises.

The relation between real exchange rate devaluations and crises is a common theme in the work on balance sheet effects (as in Calvo 1998). The idea is that an increase in the relative price of traded goods makes the value of the nontradable goods insufficient to pay the traded denominated debt through the debtor's budget constraint. In this paper a rise in the relative value of traded goods requires larger incentives for the entrepreneur to report truthfully and repay. However increasing repayment incentives requires larger liquidation which could exceed the aggregate bound. Thus, real exchange rate depreciations can generate coordinated default crises because repayment incentives are insufficient due to

the inability of the economy to deal with large scales defaults.

7 Conclusion

Debt crises are characterized by episodes where defaulters' assets are not seized by creditors due to weak bankruptcy institutions. Empirically across countries internal crises occur together with sovereign debt and these joint crises happen more frequently in economies with weak bankruptcy institutions. The paper develops an optimal contracting model that is consistent with these empirical facts. In the model, entrepreneurs borrow from a lender to invest in projects that deliver random returns that are private information to entrepreneurs. The key component is that it is impossible to liquidate large amounts of entrepreneurial assets. In the optimal loan contract a successful entrepreneur repays the lender yet an unsuccessful one defaults and liquidates his assets. However, the inability to liquidate extensive asset quantities generates the possibility of a second equilibrium with coordinated defaults. During coordinated default crises, successful entrepreneurs find it optimal to default because the sanction of doing so is small when all other entrepreneurs are defaulting. During these crises, the government's tax collections fall and thus it cannot pay the international lender in full. The model shows that, given tight aggregate constraints on liquidation, joint debt crises are an inevitable part of an optimal response to informational problems in private-sector lending.

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Table 1: Sovereign Defaults and Internal Debt Crises from 1976-2012

	Joint Crises	Only Sovereign	Only Private
Emerging markets and GIIPS	13	3	16
Middle income countries	24	15	41

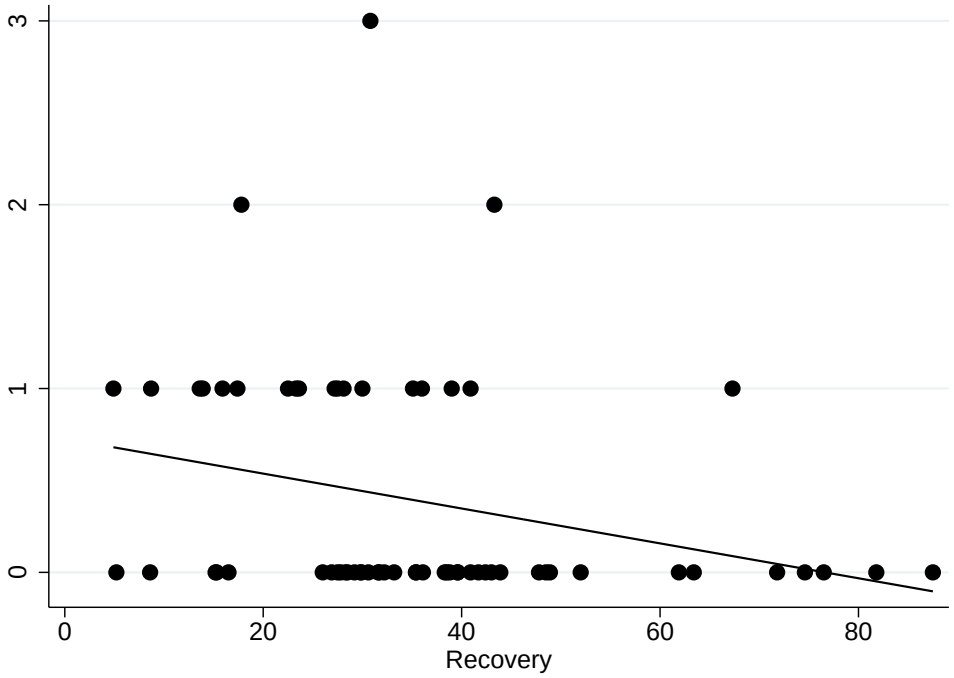
Note: Internal debt crises are measured by the banking crises dataset in Laeven and Valencia (2008 and 2012). Sovereign default dates also come from Laeven and Valencia (2008 and 2012). Joint Crises are events when a sovereign default and a banking crises overlap for at least one year.

Table 2: Crises and Bankruptcy Institutions

	Joint Crises	Only Sovereign	Only Private
Recovery	-0.010***	-0.004*	0.011***
EM Dummy	0.556**	0.005	0.016
Observations	64	64	64
R^2	0.21	0.03	0.12

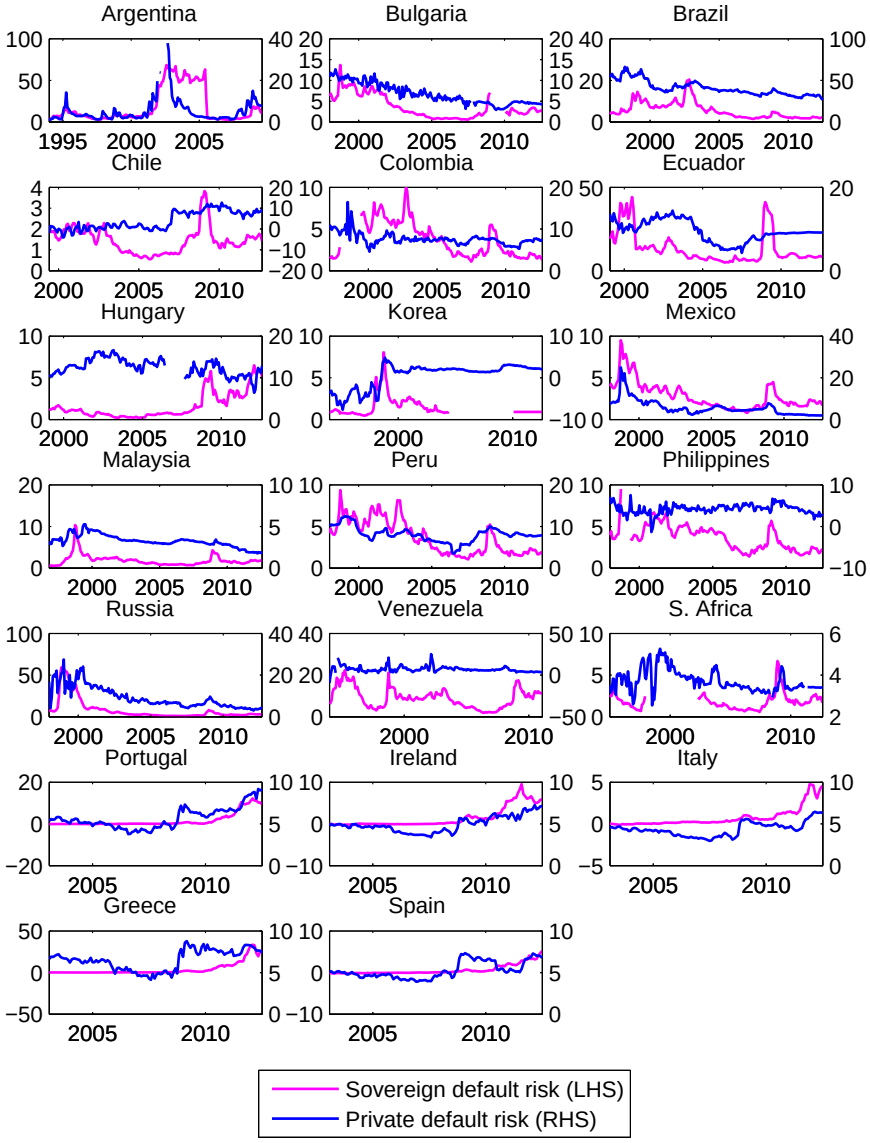
Note: Dependent variables are the number of joint crises, only sovereign crises, and only private crises in each of the 64 countries. The independent variables are the average recovery rate creditors get during bankruptcy which come from the World Bank Doing Business (2012) and a dummy variable which equals one if the country is an emerging market as defined by the IMF.

Figure 1: Joint Crises and Bankruptcy Institions



Note: This figure plots the number of joint crises across 67 countries for the period of 1976-2012 against the average recovery that creditors get during bankruptcy.

Figure 2: Private and Sovereign Default Risk



Note: This figure plots the time series for measures of private and sovereign default risk across 15 emerging market countries as well as for the GIIPS countries.

Appendix of: Internal Debt Crises and Sovereign Defaults

Cristina Arellano and Narayana Kocherlakota

Federal Reserve Bank of Minneapolis

Appendix A

This appendix contains the proofs of Propositions 1 and 5.

Proposition 1. *Suppose* (τ, F, L) *is an equilibrium contract. Then:*

1. $F_{HH} = F_{H0} > 0$
2. *If* $R^H > F_{HH}$, *then* $L_{HH} = L_{H0} = 0$
3. (τ, F, L) *satisfies the incentive constraint* (2) *with equality*
4. *The zero profit constraint (4) is satisfied with equality*
5. $F_{00} = F_{0H} = 0$
6. $2R = 2(F_{HH} + \delta L_{HH}) - \tau_2 = F_{0H} + F_{H0} + (\delta L_{0H} + \delta L_{H0}) - \tau_1$
   $= 2(F_{00} + \delta L_{00}) - \tau_0$

Proof. **Statement 1:** Suppose $F_{HH} \neq F_{H0}$. Define a new $\widehat{F}$ which is the same as F except $\widehat{F}_{HH} = \widehat{F}_{H0} = (1-p)F_{HH} + pF_{H0}$. Then, the entrepreneurs get higher utility with $(\tau, \widehat{F}, L)$, because of the strict concavity of the objective. As well, $(\tau, \widehat{F}, L)$ satisfies (1)-(4). Hence, in any equilibrium contract, $F_{HH} = F_{H0}$.

Statement 2: The existence of an equilibrium contract implies that $B_E > 1$. If L_{HH} or L_{H0} are positive, we can increase the objective, without violating the constraints, by lowering them by ε while increasing F_{HH} and F_{H0} by ε.

Statement 3: Suppose the third statement is false. Given that the incentive-compatibility constraint does not bind, the first order conditions for the equilibrium problem imply that:

$$B_E(1 - L_{HH}) + R^H - F_{HH} = B_E(1 - L_{H0}) + R^H - F_{H0}$$
$$= B_E(1 - L_{0H}) - F_{0H} = B_E(1 - L_{00}) - F_{00}$$

But this violates the incentive constraint:

$$u_E(B_E\,(1-L_{HH})+R^H-F_{HH}) < (1-p)u_E(B_E\,(1-L_{0H})+R^H-F_{0H})+pu_E(B_E\,(1-L_{00})+R^H-F_{00})$$

Statement 4: If the fourth statement is false, we can lower τ_2 by ε and lower F_{HH} by $\varepsilon/2$ without violating any of the constraints and increasing the objective; hence, in any equilibrium the zero profit constraint holds with equality.

Statement 5: By (1), F_{00} and F_{0H} are non-positive. To satisfy (2), we need that $F_{0j}+L_{0j}>0$ for at least one j. Suppose that $F_{0H}<0$ and $L_{0H}>0$. Define $(\widehat{\tau},\widehat{F},\widehat{L})$ to be a contract that is the same as (τ,F,L) except:

$$\begin{aligned}
\widehat{F}_{0H} &= 0\\
\widehat{L}_{0H} &= L_{0H}+F_{0H}/B_E\\
\widehat{\tau}_1 &= \widehat{F}_{0H}-F_{0H}+\delta\widehat{L}_{0H}-\delta L_{0H}+\tau_1
\end{aligned}$$

The value of the objective under $(\widehat{\tau},\widehat{F},\widehat{L})$ is the same, and constraints (1), (2) and (3) are satisfied. The zero profit condition (4) is slack now:

$$\begin{aligned}
&(1-p)^2\tau_2+2p(1-p)\left(\widehat{F}_{0H}-F_{0H}+\delta(\widehat{L}_{0H}-L_{0H})+\tau_1\right)+p^2\tau_0\\
=\;& R^{FOR}G-F_{0H}2p(1-p)(1-\delta/B_E) > R^{FOR}G
\end{aligned}$$

From the proof of Statement 4 above, we know that we can now lower τ_2 by ε and lower F_{HH} by $\varepsilon/2$ to improve the entrepreneurs' objective. Hence, if $F_{0H}<0$, (τ,F,L) cannot be an equilibrium, because $(\widehat{\tau},\widehat{F},\widehat{L})$ improves upon it. A similar argument can be used to show that $F_{00}<0$ cannot be an equilibrium.

Statement 6: Suppose this statement is false. Then, we can define**:**

$$\begin{aligned}
\tau_2' &= 2(F_{HH}+\delta L_{HH})-2R\\
\tau_1' &= F_{H0}+F_{0H}+(\delta L_{0H}+\delta L_{H0})-2R\\
\tau_0' &= 2(F_{00}+\delta L_{00})-2R
\end{aligned}$$

The value of the objective has remained the same, and constraints (1), (2) and (3) are satisfied. Because u_L is strictly concave, we know that the expected value of the domestic lender's consumption is lower under τ':

$$\begin{aligned} & (1-p)^2(2(F_{HH}+\delta L_{HH})-\tau_2')+2p(1-p)(F_{H0}+F_{0H}+\delta L_{0H}+\delta L_{H0}-\tau_1') \\ & +p^2(2(F_{00}+\delta L_{00})-\tau_0') \\ < \; & (1-p)^2(2(F_{HH}+\delta L_{HH})-\tau_2)+2p(1-p)(F_{H0}+F_{0H}+\delta L_{0H}+\delta L_{H0}-\tau_1) \\ & +p^2(2(F_{00}+\delta L_{00})-\tau_0) \end{aligned}$$

This implies that:

$$\begin{aligned} & (1-p)^2\tau_2'+2p(1-p)\tau_1'+p^2\tau_0' \\ > \; & (1-p)^2\tau_2+2p(1-p)\tau_1+p^2\tau_0 \end{aligned}$$

From the proof of Statement 4 above, we know that we can now lower τ_2' by ε and lower F_{HH} by $\varepsilon/2$ to improve the entrepreneurs' objective. QED □

Proposition 5. *Define L_0^* as in (5) to be the equilibrium liquidation in a contract in which the upper bound on liquidation does not bind (assuming $\varepsilon = 0$). Suppose that:*

$$\xi/2 < L_0^*(R, p, G, R^{FOR}, B_E, \delta)$$

Then, for non-negative ε in a neighborhood of 0, $F_{HH}(\varepsilon)$ and $\tau_2(\varepsilon)$ are both strictly increasing in ε.

Proof. We first prove that there is a neighborhood of 0 such that there is a unique equilibrium contract for all $\varepsilon \geq 0$. We start with $\varepsilon = 0$. Suppose that the equilibrium contract was such that the constraint on aggregate liquidation does not bind. Then, the equilibrium contract's

payments would be given by:

$$\begin{aligned} F_{HH} &= F_{H0} = B_E L_0^*(R, p, G, R^{FOR}, B_E, \delta) \\ L_{0H} &= L_{00} = L_0^*(R, p, G, R^{FOR}, B_E, \delta) \end{aligned}$$

But this contract exceeds the upper bound on aggregate liquidation (because $2L_{00}$ exceeds ξ), and cannot be an equilibrium contract. It follows that there is a unique equilibrium contract (τ, F, L):

$$\begin{aligned} F_{HH} &= F_{H0} = \widehat{F}_H \\ F_{00} &= F_{0H} = L_{H0} = L_{HH} = 0 \\ L_{0H} &= \widehat{L}_{0H},\ L_{00} = \delta^{-1}\xi/2 \\ \tau_2 &= 2\widehat{F}_H - 2R \\ \tau_1 &= \widehat{F}_H + \delta\widehat{L}_{0H} - 2R \\ \tau_0 &= \xi - 2R \end{aligned}$$

where $(\widehat{F}_H, \widehat{L}_{0H})$ is the unique solution to:

$$\begin{aligned} & u_E(B_E + R^H - \widehat{F}_H) = (1-p)u_E\left(B_E\left(1 - \widehat{L}_{0H}\right) + R^H\right) + pu_E(B_E\,(1-\xi/2) + R^H) \\ & (1-p)\widehat{F}_H + \delta p(1-p)\widehat{L}_{0H} + p^2\xi/2 = R + R^{FOR}G/2 \end{aligned}$$

Now suppose $\varepsilon > 0$. By the Theorem of the Maximum, there is a unique equilibrium contract for ε near 0, and that contract's (F, L) satisfies:

$$u_E(B_E + R^H - F_H) - (1-p)u_E(B_E\,(1 - L_{0H}) + R^H) - pu_E(B_E\,(1-\xi/2) + R^H) = 0 \tag{6}$$

$$[p^2(1-\varepsilon) + \varepsilon]\xi/2 + \delta p(1-p)(1-\varepsilon)L_{0H} + (1-p)(1-\varepsilon)F_H = R + R^{FOR}G/2 \tag{7}$$

For notational convenience, we've set $F_H = F_{HH} = F_{H0}$ and suppressed the dependence of the payments on ε. Using the implicit function theorem, we can show that F_H is continuously

differentiable in ε for ε near 0. Differentiating (6) and (7) with respect to ε, around $\varepsilon = 0$, we get:

$$\begin{aligned}(1-p)u'_E\left(B_E\left(1-\widehat{L}_{0H}\right)+R^H\right)B_E L'_{0H}(0) &= u'_E(B_E+R^H-\widehat{F}_H)F'_H(0)\\ p(1-p)\delta L'_{0H}(0)+(1-p)F'_H(0) &= R+R^{FOR}G/2-\xi/2\end{aligned}$$

Substituting the first equation into the second, we get:

$$p\frac{\delta u'_E(B_E+R^H-\widehat{F}_H)}{u'_E(B_E\left(1-\widehat{L}_{0H}\right)+R^H)B_E}F'_H(0)+(1-p)F'_H(0)=R+R^{FOR}G/2-\xi/2$$

which implies that $F'_H(0)>0$. Since F_H is C^1 for ε near 0, we can conclude that $F'_H(\varepsilon)>0$ for ε in a neighborhood of zero.

From Proposition 3, we know that:

$$\tau_2(\varepsilon)=2F_H(\varepsilon)-2R$$

and so $\tau'_2(\varepsilon)>0$. □

Appendix B

In this appendix we provide details on the data sources, series and default events dates used in the Section 5.

Default Risk Data

Private default risk is calculated as follows. For Ecuador, Peru, Greece, Ireland, Italy, Portugal and Spain we use the spread between dollar (euro) average domestic lending rate and the U.S. Treasury (or German) 1 year maturity yield. For Argentina, Brazil, Bulgaria, Chile, Colombia, Hungary, Korea, Malaysia, Mexico, Philippines, Russia, South Africa, and Venezuela, we use the spread between the average local currency domestic lending rate and

the average local currency domestic deposit rate.

Sovereign default risk is the EMBI+ spread for all emerging countries. For the European countries sovereign default risk is the spread of a 10 year government bond yield for each country relative to the 10 year German bond yield.

All the data come from the Global Financial Statistics Database and the International Financial Statistics at the IMF.

Dates of Sovereign Defaults and Internal Debt Crises

The following table reports the dates of sovereign defaults and internal debt crises from Laeven and Valencia (2008 and 2012) for the emerging markets in our sample and for the GIIPS.

Table 3: Crises Dates

	Sovereign Defaults	Internal Debt Crises
Emerging Markets		
Argentina	82-93, 89, 01-05	80-82, 89-91, 95, 01-04
Bulgaria	90-95	96-97
Brazil	83-94	90-94
Chile	83-90	76, 81-85
Colombia		82, 98-00
Ecuador	85-95, 99-00, 07-08	82-86, 98-02
Hungary		91-95, 08-present
Korea		97-98
Malaysia		97-99
Mexico	82-90	81-85, 94-96
Peru	80, 84-96	83
Philippines	83-92	83-86, 97-01
Russia	98-00	98, 08-present
Venezuela	83-88, 90, 95-97	94-95
South Africa	85-93	
GIIPS		
Greece	12	08-present
Ireland		08-present
Italy		08-present
Portugal		08-present
Spain		77-81,08-present