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SNB Working Papers
15/2018

SCHWEIZERISCHE NATIONALBANK
BANQUE NATIONALE SUISSE
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BANCA NAZIUNALA SVIZRA
SWISS NATIONAL BANK

Legal Issues

ISSN 1660-7716 (printed version)
ISSN 1660-7724 (online version)

Sovereign debt crises and cross-country assistance*

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September 2018

Abstract

We provide a theoretical study of the interplay between cross-country assistance and expectations-driven sovereign debt crises. A self-interested "safe" country may choose to assist a "risky" country that is prone to default. Investors internalize the potential for assistance when lending to fragile countries. If the safe country is not able to commit to or rule out cross-country transfers, assistance only improves the equilibrium outcomes if the risky country is fundamentally insolvent and cannot handle its debt even at the risk-free interest rate. If a default requires pessimistic expectations, an incentive-compatible assistance policy has adverse side effects.

Keywords: Sovereign default, self-fulfilling expectations, bailout.

JEL classification: F34.

*The views expressed in this paper are of the authors and do not necessarily reflect those of the Swiss National Bank.

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1 Introduction

Because of the European sovereign debt crises, questions of how to deal with debt-burdened sovereigns have re-emerged high on the international policy agenda. Sovereigns that are prone to default risk must weigh the costs of raising taxes and cutting spending to repay creditors against the benefits of avoiding a default. In countries where banks and citizens are exposed to a sovereign default in another country, the governments must balance the benefits of financially assisting debtor countries against the domestic tax costs of such a bailout. These governments may also have to consider the option of bailing out their domestic agents directly. Moreover, investors are aware of these policy tradeoffs and internalize them when pricing sovereign debt. In this paper, we develop a theoretical model in which all of these elements are in play and shape the answer to the following question: How effective are the assistance policies that are selected by self-interested governments in response to interest rate movements?

Our framework is a two-country extension of the hallmark Calvo (1988) model of self-fulfilling sovereign debt crises. The government in a "risky" country, which we denote r, has outstanding debt to domestic and international creditors. The government in "safe" country s has the option to financially assist r. Default costs make debt service desirable, and in conjunction with cross-country bond holdings they could motivate s to provide assistance. From s's perspective, though larger bailouts may reduce its own residents' losses from a default, the consequent taxation is associated with conventional deadweight costs. The safe country balances these considerations whilst internalizing how assistance affects r's willingness to raise its own taxes for repayment. Importantly, investors who ex-ante contemplate lending to r must take these ex-post policy considerations of countries r and s into account when they form expectations about the likelihood of repayment.

As typically holds in this type of environment, two equilibria may exist. In a "good" equilibrium, optimistic investors demand a low interest rate. This low interest rate ensures that the debt burden remains manageable, hence, investors' optimistic beliefs are self-fulfilling in that they lead to full repayment. Conversely, in a "bad" equilibrium, pessimistic investor beliefs lead to high interest rates, and therefore, default.

In this setting, we characterize how incentive-compatible assistance policies affect defaults in equilibrium. We show that if country r has sufficiently low debt, whereas the incentive-compatible assistance policy does not influence the good equilibrium in which the debt is repaid in full, it does affect the bad equilibrium in which pessimism causes a default. Unfortunately, assistance increases both the interest rate and the severity of the default in this bad equilibrium. Hence, investor anticipation and self-fulfilling expectations could render an assistance policy counterproductive. However, for a higher level of initial debt, assistance increases the scope for equilibria with repayment, which would otherwise be infeasible. In these scenarios, the incentive-compatible assistance policy is beneficial. In contrast to the conventional wisdom and popular debate, our analysis supports measures to prevent self-interested creditor countries from assisting debtors that suffer from pessimistic investor beliefs rather than high debt levels. Self-interested creditors should only be allowed to assist fundamentally insolvent countries, by which we mean countries whose debt burden is beyond what they can service even at the risk-free interest rate. The key mechanism behind these results is that investors anticipate how interest rate movements shape assistance and repayment.

Rather than provide financial assistance to failing countries, the safe country may cover the losses of its own residents through domestic bailouts. When we extend our framework to allow this possibility, we find that cross-country assistance is still chosen in equilibrium and that all of our main results hold provided that the default costs and cross-country bond holdings are sufficiently high. Intuitively, international assistance could be preferable to a domestic bailout because the former option prevents disruptive costs from materializing in the defaulting country, which enables it to spend more on servicing its outstanding debt. Indeed, if the default costs are large, assistance that prevents country r from defaulting pays off more than one-for-one for country s.

Overall, our main contribution is to provide a simple, tractable framework for studying cross-country assistance that is endogenously chosen. This model is useful to build intuition and can serve as a benchmark for further work. In this framework, ex post (given interest rate levels) cross-country assistance can increase the domestic welfare. Therefore, governments cannot credibly commit to refraining from such assistance. Still, depending on the initial conditions, international assistance can have adverse consequences ex ante, as the potential for assistance may affect interest rates in such a way that a commitment to refrain from bailouts could be beneficial.

This paper is related to the large literature on sovereign debt crises, and our model shares many important features with that earlier literature. Our assumption that defaults are costly is typically motivated by the idea that defaulting governments are subject to sanctions after a default, such as exclusion from financial markets.[1] More recently, Gennaioli et al. (2014) have presented a theoretical model where sovereign default is costly because of the resulting losses for domestic banks who hold sovereign debt. These losses lead to drops in credit and output.[2] We also assume that the risky government cannot selectively default exclusively on foreign bondholders. In practice, sovereign debt is traded on secondary markets, which makes it difficult to discriminate against foreign bondholders in a sovereign default (Broner, Martin and Ventura (2010)).

Our paper is most closely related to Tirole (2015), Cooper (2012) and Marin (2017), who also study international bailouts in the context of self-fulfilling sovereign debt crises. In common with these papers, we assume that debt crises have spillover costs to foreign countries, which may motivate international bailouts. Tirole (2015) characterizes ex-ante optimal risk-sharing between

[1] See, e.g., Eaton and Gersovitz (1981), Calvo (1988), Arellano (2008) and Yue (2010).

[2] Causality between sovereign and bank risk runs both ways: from sovereigns to banks that hold government debt, and from banks to sovereigns that may opt to bail out distressed banks. This "doom loop" has recently been studied in a number of theoretical papers. See, for example, Bolton and Jeanne (2011), Niepmann and Schmidt-Eisenlohr (2013), Acharya et al. (2014), Cooper and Nikolov (2018), and Farhi and Tirole (2018).

countries that are asymmetric in their exposure to default risk, as in our model. An important point there is how the ex-post choice of assistance, which is motivated by default cost spillovers, shapes a safe country's willingness to enter binding agreements ex ante. A key distinction of our paper is that we consider expectations-driven default, which is when an ex-post optimal assistance policy may harm both the defaulting and assisting sovereigns as foreseen ex ante. In more similar work to ours, Cooper (2012) extends Calvo's (1988) framework to include multiple countries and focuses on a setting where ex-ante bailout commitments are not credible. Our paper differs by studying bailouts by a single self-interested sovereign rather than a federation and by highlighting how an incentive-compatible assistance policy may have adverse consequences.

In Marin (2017), sovereigns need to roll over debt continuously, and investors' willingness to hold debt depends on sunspots. As in our setting, multiple equilibria arise for intermediate levels of debt. Because other sovereigns not directly affected by the crisis suffer output losses if another sovereign experiences a rollover crisis, they may find it optimal to provide cross-country assistance to countries experiencing a crisis. As in our paper, sovereigns cannot commit to providing bailouts and cannot commit to not defaulting if they receive a bailout. In addition to the model setting (we build on Calvo (1988), whereas Marin (2017) extends Cole and Kehoe (2000)), one important difference between our setting and Marin (2017) is that we allow for partial default, whereas in Marin (2017) sovereigns experiencing a roll-over crisis must either default fully or repay at least a specified amount. In addition, we explicitly link the costs of a foreign default on the domestic economy to the cross-country debt holdings. The following key results are not present in Marin (2017): first, we show that the potential for bailouts may increase the default rates in the crisis equilibrium; second, we show that sovereigns may find it optimal to provide cross-country bailouts even if they have the alternative option to spend resources on compensating domestic losses due to a foreign default.

Morris and Shin (2004) and Corsetti, Guimaraes and Roubini (2006) explore when bailouts by an international institution, such as the IMF, can succeed in motivating greater debt service by a struggling sovereign. In contrast to our study, they do not emphasize how the incentives for assistance affect the interest rate determination ex ante. Fink and Scholl (2016) and Roch and Uhlig (2018) also study bailouts by international financial institutions; their studies are more quantitatively oriented in environments where sovereigns default fully or not at all. Then, sufficiently high willingness to assist ex post will suffice to rule out defaults caused by pessimism alone. In contrast, our study shows that when the default costs are proportional to the amount of debt defaulted upon, the ex-post incentive-compatible assistance policy not only fails to fully prevent a self-fulfilling debt crisis but also may exacerbate it.

While we follow much of the related literature by focusing on a "real" model , monetary policy naturally has an important role to play in the context of debt crises. Corsetti et al. (2014) study sovereign risk in a DSGE model of a two-country monetary union that is calibrated to the euro area. The key assumptions are that private credit spreads are increasing with sovereign risk, which in turn is increasing in the expected path for public debt (the "sovereign risk channel"). These authors analyze the effects of monetary and fiscal policies in the monetary union for the local determinacy of the model, and thus, on the potential for beliefs-driven crises. One important result is that the sovereign risk channel becomes more important when monetary policy is constrained by the lower bound. The focus of Corsetti et al. (2014) is on the interplay between monetary and fiscal policies in a sovereign debt crisis without explicitly modelling the strategic default decision by governments. By contrast, we study governments' incentives to repay or default and to provide financial assistance to other countries, abstracting from monetary policy.

2 The model

Our model is based on Calvo (1988), which we extend to a setting with two countries. We will refer to these countries as "safe" and "risky", and they will be denoted as $\{s, r\}$, respectively. We also introduce a negative spillover from a sovereign default to private sector resources and permit cross-country financial assistance. Under the standard assumption that debtors cannot discriminately default on only foreign creditors (for example because bonds are issued under international law), we study governments' incentives to default and to provide assistance.

Country j's government faces the budget constraint

$$T^j + A^{i,j} = G^j + \left(1 - \theta^j\right) R^j b^j + \alpha^j \theta^j R^j b^j + A^{j,i}, \tag{1}$$

where $R^j \geq 1$ is the gross interest rate, b^j is debt, T^j are taxes, G^j are exogenous government expenditures, $\theta^j \in [0,1]$ denotes the fraction of debt that the government defaults upon, and $\alpha^j \in (0,1)$ are default costs directly faced by the government. $A^{j,i}$ is assistance provided by j to i.

Investors are risk neutral and have an alternative investment opportunity paying interest R with certainty. Therefore, arbitrage ensures

$$R = R^j \left[1 - \mathbb{E}\left(\theta^j\right)\right], \tag{2}$$

where $\mathbb{E}\left(\theta^j\right)$ denotes investors' rational expectations of θ^j. For expositional purposes, we restrict attention to scenarios where s never defaults, $\theta^s = 0$. Knowing this, investors charge $R^s = R$. Without loss of generality, we simplify by normalizing $b^s = 0$. Because there is no incentive for the risky country to assist the safe country, $A^{r,s} = 0$. Therefore, we simplify the notation further by writing $\theta^r = \theta$ and $A^{s,r} = A$.

Each country's private consumption must satisfy the resource constraints

$$c^s = y^s - z(T^s) - T^s + \beta^r (1-\theta) R^r b^r - \kappa^s \beta^r \theta b^r R^r \tag{3}$$

$$c^r = y^r - z(T^r) - T^r + (1-\beta^r)(1-\theta) R^r b^r - \kappa^r (1-\beta^r) \theta b^r R^r, \tag{4}$$

where y^j is output, β^j is the fraction of country j's debt held by foreigners, and $z\left(T^j\right)$ captures dead-weight losses from taxation with $z', z'' > 0$ and $z(0) = 0$. The parameter $\kappa \geq 0$ captures the indirect costs from a sovereign default to the private sector, for instance, because banks suffer losses and intermediate less efficiently.[3] Later, we allow a country to mitigate these costs by directly supporting its own residents instead of assisting a defaulting sovereign. Cross-country financial assistance A may be provided by the government of the safe country to the government of the risky country, which can elect to use it for debt repayment or to lower taxes. As a result, assistance does not directly influence private consumption in (3) and (4); instead, it only enters governments' budget constraints (1).

The timing is as follows: in period $t = 0$, investors lend b^j at interest rates R^j; in $t = 1$, the safe country sets assistance A; lastly, in $t = 2$, the risky country decides on taxation and the default rate θ. These timing assumptions are chosen to capture the realistic scenario where countries have not pre-committed to how they handle debt crises and where a sovereign itself ultimately decides on default. The implications of alternative timing assumptions are discussed in the conclusion.

3 Optimal tax and assistance policies

The model is solved by backward induction to find subgame perfect equilibria in (T^r, θ, A, R^r). Thus, we start by analyzing r's choices of taxes and default, taking assistance and interest rates as given. Then, we discuss optimal cross-country assistance by s, taking interest rates as given. Finally, we impose the arbitrage condition (2).

3.1 Optimal tax and default policy for the risky country

Country r selects T^r and θ to maximize c^r subject to (1) and (4), taking A and R^r as given. Here, we follow the setting in Calvo (1988), where the government's objective is to maximize domestic consumption. In a more detailed model, the benevolent government would maximize domestic welfare. In effect, Calvo (1988) assumes that domestic welfare is a linear function of domestic

[3] A large empirical literature has documented that sovereign debt crises are associated with output losses, in particular when they are associated with banking crises. See, for example, De Paoli et al. (2009), Furceri and Zdzienicka (2012), and Trebesch and Zabel (2017). Black et al. (2016) show empirically that sovereign default risk increased the systemic risk of European banks in the European debt crisis. Gennaioli et al. (2014) find that sovereign defaults are followed by declines in private credit. By considering the 2011 European bailout of Greece as an unanticipated sovereign risk shock, Augustin et al. (2018) provide evidence that sovereign risk increases the corporate credit risk.

consumption. To find r's optimal policy, we first assume $0 < \theta < 1$. This assumption allows us to solve (1) for θ and insert the solution into (4) to obtain

$$c^r = y^r - z(T^r) - T^r + (1-\beta^r) b^r R^r - (1+\kappa^r)(1-\beta^r) \frac{G^r + b^r R^r - T^r - A}{1-\alpha^r} \tag{5}$$

Note that because $z''(\cdot) > 0$, a necessary condition for any repayment is that $\frac{dc^r}{dT^r}|_{T^r = G^r} > 0$, which implies from (5) that $(1-\beta^r)(1+\kappa^r)/(1-\alpha^r) > 1 + z'(G^r)$. We assume that this parameter restriction holds, as r would otherwise always elect to default. From (5), it follows that the first-order condition for an interior optimum of c^r with respect to T^r reads

$$1 + z'(T^{r*}) = (1-\beta^r) \frac{1+\kappa^r}{1-\alpha^r}. \tag{6}$$

Equation (6) implicitly defines r's "tax capacity" T^{r*}: r will never want to raise taxes beyond T^{r*}. The left-hand side of (6) represents the marginal costs of taxation. The right-hand side of (6) shows the marginal benefits from repayment, which increase in the share of debt held domestically, $(1-\beta^r)$, and the default costs κ^r and α^r.

Condition (5) holds only for the interior solution, where $0 < \theta < 1$. To fully characterize r's policy, we must also consider the possible corner solutions where $\theta = 0$ or $\theta = 1$. First, note that r will repay fully if and only if $T^{r*} \geq G^r + b^r R^r - A$. However, r will default fully if and only if $T^{r*} < G^r + \alpha^r b^r R^r - A$, where the right-hand side of the inequality contains the default costs due to $\theta = 1$. Based on these considerations, we define

$$\overline{A}(R^r) \equiv G^r + b^r R^r - T^{r*}, \tag{7}$$

$$\underline{A}(R^r) \equiv G^r + \alpha^r b^r R^r - T^{r*}. \tag{8}$$

Here, we denote these bounds as functions of R^r to emphasize that they depend on this endogenous variable, which is to be determined in equilibrium. However, in what follows we will mostly simplify the notation by denoting the bounds as $\overline{A}$ and $\underline{A}$. $\overline{A}$ is the assistance needed for r to repay fully when taxes are T^{r*}. If $A > \overline{A}$, the risky government can repay fully with taxes below T^{r*}. Conversely, $\underline{A}$ denotes the assistance needed for r to cover its default costs and G^r if $\theta = 1$ and taxes are set to T^{r*}. If $A < \underline{A}$, then T^{r*} is insufficient to cover the expenses even with a full default. In this case, r is forced to set $T^r > T^{r*}$ to cover the default costs. Finally, if $\underline{A} \leq A \leq \overline{A}$, country r will set $T^r = T^{r*}$, as implied by the first-order condition, and partially default. Therefore, the tax schedule is summarized as

$$T^r(A) = \begin{cases} G^r + \alpha^r b^r R^r - A & \text{if } A < \underline{A} \\ T^{r*} & \text{if } \underline{A} \leq A \leq \overline{A} \\ G^r + b^r R^r - A & \text{if } A > \overline{A} \end{cases} \tag{9}$$

Notice that the assistance fully crowds out taxes unless $\underline{A} \leq A \leq \overline{A}$, where taxes are T^{r*} independently of A. The tax schedule above implies the default rates

$$\theta(A) = \begin{cases} 1 & \text{if } A < \underline{A} \\ \frac{G^r + b^r R^r - T^{r*} - A}{b^r R^r (1-\alpha^r)} & \text{if } \underline{A} \leq A \leq \overline{A} \\ 0 & \text{if } A > \overline{A} \end{cases}, \tag{10}$$

where θ in the intermediate case follows from r's budget constraint (1). Hence, the effect of assistance on the debt repayment is

$$\theta'(A) = \begin{cases} -\frac{1}{b^r R^r (1-\alpha^r)} & \text{if } \underline{A} \leq A \leq \overline{A} \\ 0 & \text{otherwise} \end{cases} \tag{11}$$

Thus, a marginal increase in assistance reduces the default incidence or has no effect at all. The intuition is as follows: if $A < \underline{A}$, the bailout is so *small* that a marginal increase will not change r's default decision. Consequently, r still defaults fully and uses any assistance it receives to cut T^r. Conversely, if $A > \overline{A}$, the bailout is so *large* that a marginal change will not affect r's default decision: r already has sufficient funds to repay fully, and it uses any additional assistance to cut T^r. Only if $\underline{A} \leq A \leq \overline{A}$ will a marginal increase in A influence the default rate. In this range, increasing the bailout does not affect the risky country's tax choice, which remains $T^r = T^{r*}$; however, r uses the additional funds to repay its creditors. As reflected by the denominator in (11), the amount repaid increases more than one-for-one with assistance because repayment prevents default costs α^r from materializing.

3.2 Optimal assistance policy for the safe country

Country s selects A and T^s to maximize c^s subject to the government budget constraint (1), the consumers' resource constraint (3) and r's optimal tax policy function (9), taking R^r as given.

From (3) and (1), the marginal benefit of a tax-financed increase in A is:

$$\frac{dc^s}{dA} = -z'(A + G^s) - 1 - \beta^r R^r b^r \theta'(A) - \kappa^s \beta^r b^r R^r \theta'(A). \tag{12}$$

From (11), $\theta'(A) = 0$; hence, $\frac{dc^s}{dA} < 0$ if $A < \underline{A}$ or $A > \overline{A}$. This finding implies that either $A = 0$ or $\underline{A} \leq A \leq \overline{A}$. Consider setting $\underline{A} \leq A \leq \overline{A}$. After substituting (11) into (12), we find the first-order condition for an internal assistance optimum to be as follows:

$$1 + z'(A^* + G^s) = \frac{\beta^r (1 + \kappa^s)}{(1 - \alpha^r)}, \tag{13}$$

which implicitly defines the maximum assistance s is willing to provide, A^*, as a function of the underlying parameters. At A^*, the marginal costs of financing additional assistance equal the marginal benefits of greater repayment from r to s. Because $z''(\cdot) > 0$, $A^* > 0$ if and only if $1 + z'(G^s) < \beta^r (1 + \kappa^s) / (1 - \alpha^r)$. The left-hand side of (13) reflects the marginal costs of cross-country financial assistance to the safe country: additional assistance must be financed by a tax increase, which results in a drop in consumption. The right-hand side of (13) captures the marginal benefits of assistance, namely, the benefit to domestic citizens of reducing the foreign default rate. This marginal benefit increases with the claims of s on r (β^r), the side effects of the creditor losses in s (κ^s), and the extent to which assistance stimulates r's repayment by preventing default costs (α^r). Intuitively, country s will only provide assistance if it stimulates a sufficient repayment of debt it holds by doing so.

In summation, we have shown that the optimal assistance policy is characterized by

$$A = \begin{cases} \overline{A} & \text{if } A^* > \overline{A}(R^r) \\ A^* & \text{if } \underline{A}(R^r) \leq A^* \leq \overline{A}(R^r) \\ 0 & \text{if } A^* < \underline{A}(R^r) \end{cases}, \tag{14}$$

where $\overline{A}$, $\underline{A}$ and A^* are given by (7), (8) and (13), respectively. The first part of this schedule states that assistance will never exceed $\overline{A}$, as any assistance above this level will not return to the safe country's residents. The next subsection describes an internal optimum where the marginal deadweight costs of taxes equal the marginal gains of preventing a default, as expressed in (13). This occurs when the recipient country uses assistance to repay debt. The final part shows that assistance below a certain threshold is not worth providing, as debtors will not repay anything despite receiving assistance in that case.

3.3 Resources for repayment

The risky country defaults whenever $T^r + A < G^r + b^r R^r$. As demonstrated above, there are three scenarios to consider under a default. First, if $A^* < \underline{A}$, and hence, $T^{r*} + A^* < G^r + \alpha^r b^r R^r$, the safe country sets $A = 0$. Then, there is a full default, $\theta = 1$, and r only raises taxes to cover the default costs. Second, if $A^* > \overline{A}$, which would imply that $T^{r*} + A^* > G^r + b^r R^r$, then A^* is so large relative to the outstanding amount that r has more funds than it needs to repay fully. Because it realizes this fact, s will not offer A^* but will limit the bailout to $A = \overline{A} = G^r + b^r R^r + a^r - T^{r*}$. Thus, $\theta = 0$ if $T^r = T^{r*}$. In response, r sets taxes equal to T^{r*}. The overall funds available to r equal the amount needed for expenditure and debt repayment. Third, if $\underline{A} \leq A^* \leq \overline{A}$, which would imply that $G^r + \alpha^r b^r R^r \leq T^{r*} + A^* \leq G^r + b^r R^r$, then the safe country sets $A = A^*$ and r sets $T^r = T^{r*}$.

To summarize, the funds spent by r are given by

$$T^r + A = \begin{cases} G^r + \alpha^r b^r R^r & \text{if } T^{r*} + A^* < G^r + \alpha^r b^r R^r \\ G^r + b^r R^r & \text{if } T^{r*} + A^* > G^r + b^r R^r \\ T^{r*} + A^* & \text{otherwise} \end{cases} \tag{15}$$

Finally, note that the schedule above depends on the interest rate R^r. We define $\underline{R}^r \equiv (T^{r*} - G^r + A^*)/b^r$ and $\overline{R}^r \equiv (T^{r*} - G^r + A^*)/(\alpha^r b^r)$. Then, the total funds of r can alternatively be expressed as

$$T^r + A = \begin{cases} G^r + b^r R^r & \text{if } R^r < \underline{R}^r \\ G^r + \alpha^r b^r R^r & \text{if } R^r > \overline{R}^r \\ T^{r*} + A^* & \text{otherwise} \end{cases}$$

The policy functions are illustrated in Figure 1. The solid line is r's selected taxation, which first increases with R^r to enable full repayment of debt, and then flattens out once the tax capacity T^{r*} is reached. Taxes will increase again once the default costs become so large that $T^{r*} + A^*$ is insufficient to support any repayment at all. The vertical distance from the solid line to the dashed line represents A. For low R^r, country r needs no assistance to repay, hence, s chooses $A = 0$. When the interest rate is sufficiently high that r will default if left alone, s starts assisting.[4] On the increasing segment of the dashed line, the assistance barely suffices to support full repayment. A marginal increase in R^r is accompanied by a marginal increase in A. Beyond a certain interest rate level, full repayment requires $A > A^*$. In that case, country s prefers to let θ increase rather than inflict further deadweight losses on its own economy. To the far right, R^r is so high that $\theta = 1$ even if $A = A^*$. In that case, the assistance returns to zero because no transfer below A^* trickles back to the creditors of country s. The upper envelope of the solid and dashed lines is the repayment schedule $T^r + A$, which is drawn as a function of R^r. The points $(\underline{R}^r, T^{r*} + A^*)$ and $(\overline{R}^r, T^{r*} + A^*)$ mark the kinks in the $T^r + A$ schedule.

4 The effects of cross-country assistance in equilibrium

The investors price debt according to (2) based on their rational expectations about country r's repayment policy. Hence, they internalize how R^r affects country s's selection of A and the risky country's tax response, which together determine θ.

By rearranging equation (2) and imposing perfect foresight $\mathbb{E}(\theta) = \theta$, we get $\theta R^r = R^r - R$. This equation can be substituted into r's government budget constraint to obtain

$$T^r + A = G^r + (1 - \alpha^r) b^r R + \alpha^r b^r R^r. \tag{16}$$

[4]Note that s begins to assist when R^r exceeds $(T^{r*} - G^r)/b^r$, which is the interest rate such that T^{r*} is insufficient to service r's debt without assistance.

This equation is the 2-country equivalent to what Calvo (1988) called the "consistency condition"; it gives levels of $T^r + A$ that are consistent with the no-arbitrage condition for R^r determined in period 0. In Figure 1, the market consistency condition (16) is drawn as the upward-sloping dotted curve. This curve runs parallel to the upward segment of the funding curve. Because the repayment is non-negative, the consistency condition is only relevant when $R \leq R^r$.

An intersection between the total funding schedule (15) and the consistency condition (16) constitutes an equilibrium in our model. Because R^r depends on the expected repayment and θ depends on R^r, multiple equilibria may exist.

Proposition 1 *Existence of equilibria:*

1. *If $T^{r*} + A^* < G^r + Rb^r$, no equilibrium exists.*

2. *If $T^{r*} + A^* = G^r + Rb^r$, a unique equilibrium exists with $R^r = R$ and $\theta = 0$.*

3. *If $T^{r*} + A^* > G^r + Rb^r$, two equilibria exist: one with $R^r = R$ and $\theta = 0$ and another with $R^r = R^{r*} \equiv \frac{T^{r*}+A^*-G^r-(1-\alpha^r)Rb^r}{\alpha^r b^r}$ and $\theta = \theta^* \equiv \frac{G^r+R^{r*}b^r-T^{r*}-A^*}{R^{r*}b^r(1-\alpha^r)}$.*

Proof. *Part 1: (1) implies $T^r + A = G^r + [(1-\theta) R^r + \alpha^r \theta R^r] b^r$, and (2) implies $R < (1-\theta) R^r + \alpha^r \theta R^r$. Hence, if $T^{r*} + A^* < G^r + Rb^r$, there exists no interest rate that is compatible with both (1) and (2).*

Part 2: Assume $T^r + A = T^{r*} + A^*$. Then, both (1) and (2) hold if and only if $R^r = R$ and $\theta = 0$. In that case, (15) validates $T^r + A = T^{r*} + A^*$. Hence, an equilibrium with $\{R^r = R, \theta = 0\}$ exists. (1), (2) and (15) cannot simultaneously hold for any other R^r.

Part 3: Assume $T^r + A = T^{r*} + A^*$. Then, both (1) and (2) hold if and only if $R^r = R^{r*}$ and $\theta = \theta^*$. $R^r = R^{r*}$ implies $G^r + \alpha^r R^r b^r = T^{r*} + A^* - (1-\alpha^r) Rb^r$. As a result, $G^r + \alpha^r R^r b^r \leq T^{r*} + A^*$. $R^r = R^{r*}$ also implies $G^r + R^r b^r = G^r + \frac{T^{r*}+A^*-G^r-(1-\alpha^r)Rb^r}{\alpha^r} = T^{r*} + A^* + \frac{(1-\alpha^r)}{\alpha^r}(T^{r*} + A^* - G^r - Rb^r)$. From $T^{r*} + A^* > G^r + Rb^r$, it follows that $G^r + R^r b^r > T^{r*} + A^*$. Hence, $G^r + \alpha^r R^r b^r < T^{r*} + A^* < G^r + R^r b^r$, and (15) validates $T^r + A = T^{r*} + A^*$. Thus, an equilibrium with $\{R^r = R^{r*}, \theta = \theta^*\}$ exists. If $R^r = R$, $T^{r*} + A^* > G^r + Rb^r$ and (15) imply $T^r + A = G^r + Rb^r$. Consequently, (1) and (2) hold with $\theta = 0$. Hence, an equilibrium with $\{R^r = R, \theta = 0\}$ exists. (1), (2) and (15) cannot simultaneously hold for any other R^r. ■

Proposition 1 shows that depending on the initial conditions, the consistency condition and the repayment schedule may cross once (case 2 in Proposition 1), twice (case 3), or never (case 1). When no equilibrium exists (case 1), risk-neutral investors are not willing to lend to the risky country at any interest rate level. In this case, the risky country has to run a balanced budget and finance its government expenses from taxes alone. As in Calvo (1988), multiple equilibria can exist due to self-fulfilling expectations. If investors are pessimistic and expect a high default rate, they are willing to lend only at a high interest rate. The result is a large debt burden for the risky country, which generates a larger default rate and thereby validates the investors' pessimism. However, if investors are optimistic and expect full repayment, they are willing to lend at the risk-free rate. With low interest rates, the risky country can afford to repay fully, which again validates the investors' expectations. Multiple equilibria are possible only if the risky country's government has sufficient resources to repay fully at the risk-free rate. This requires both the domestic tax capacity T^{r*} and the assistance A^* to be sufficiently high, and it also requires both the government expenditure G^r and the debt burden at the risk-free rate Rb^r to be sufficiently low.

Figure 1 illustrates case 3 of Proposition 1. There are two equilibria. In E^0, because all of the debt is fully repaid, the investors are happy to hold debt at the same interest rate as the rate paid on the safe alternative R. In E^1, r defaults partly $(0 < \theta < 1)$ and $R^r > R$, as investors require compensation for the haircut. Hence, assistance by s does not prevent the possibility of a self-fulfilling default. Indeed, compared to the partial-default equilibrium without assistance, which would occur at the intersection of the tax curve and the consistency condition (E^{1a} in the figure), we see that all that the assistance achieves in this situation is to raise the equilibrium interest rate until it is consistent with a partial default. Furthermore, inasmuch as the interest rate is higher, condition (16) implies that the default rate in this equilibrium must also be higher than the rate without assistance.

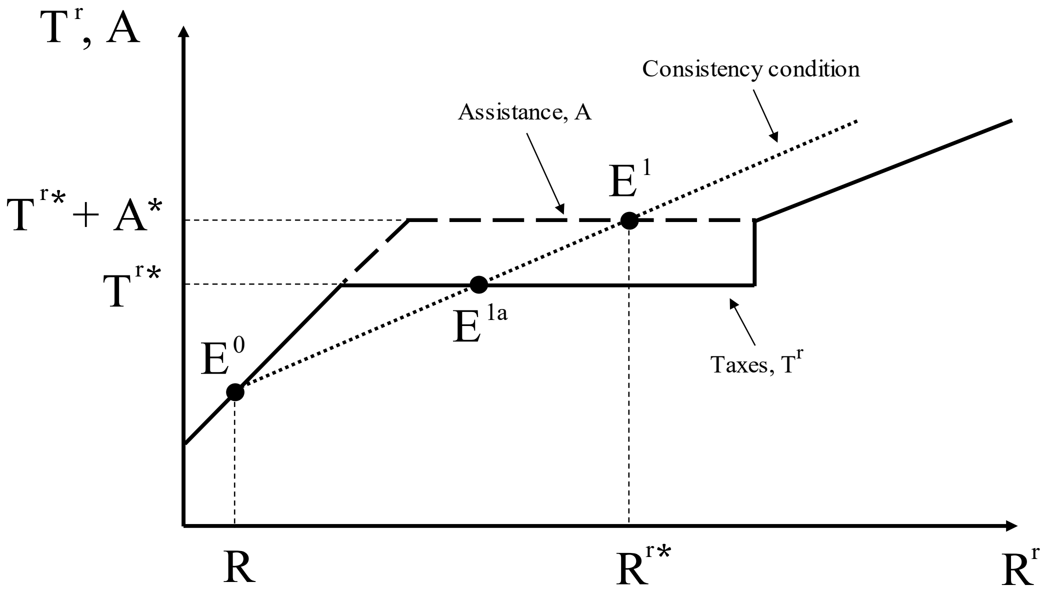
More generally, Proposition 1 implies that the equilibrium influence of country s's assistance policy is ambiguous and depends on the initial conditions. Compared to a situation where assistance is impossible, although country s's assistance policy is Pareto improving if the recipient country r has sufficiently weak finances, it could harm both r and s otherwise.

Corollary 2 *Effects of incentive-compatible (IC) cross-country assistance policy:*

1. *If $T^{r*} < G^r + Rb^r - A^*$, then the IC assistance policy has no effect.*
2. *If $G^r + Rb^r - A^* \leq T^{r*} < G^r + Rb^r$, then the IC assistance policy reduces θ in equilibrium.*
3. *If $T^{r*} > G^r + Rb^r$, then the IC assistance policy does not affect the equilibrium with full repayment ($\theta = 0$) but raises θ in the equilibrium with a partial default ($0 < \theta < 1$).*

In case 1, the tax capacity T^{r*} is so small relative to G^r and b^r that even if $R_b^r = R$ and $A = A^*$, no debt is repaid. Therefore, assistance will not be provided because assistance up to A^* will never trickle back to country s. As a result, the economy behaves as if assistance were impossible. In case 2, the country would default if it were left alone, but the sum of the maximum assistance and tax revenues would enable full repayment if $R^r = R$. Because default is costly for country r, it will use the assistance to repay its debt. As it understands this scenario, country s will find it optimal to provide assistance, which ultimately reduces the default rate. In case 3, T^{r*} is sufficient to support

Figure 1: Equilibria



Note: Taxes in the risky country T^r (solid line) and assistance A (dashed line) as functions of the interest rate R^r. The upper envelope of taxes and assistance represents the total funds that r has available to repay the debt and finance G^r. The dotted line is the consistency condition for the market interest rate as a function of the total funds $(T^r + A)$ when the initial conditions satisfy $T^{r*} + A^* > G^r + Rb^r$, as in case 3 of Proposition 1. The possible equilibria are indicated by E^0 and E^1. E^{1a} is the bad equilibrium if assistance is prohibited.

full repayment if $R^r = R$. Therefore, a "good" equilibrium exists, though assistance is irrelevant for its existence and properties. However, there is still a "bad" equilibrium with partial default due to self-fulfilling pessimistic expectations of θ. Assistance increases the default and interest rate in this equilibrium.

5 Cross-country assistance versus domestic bailouts

In practice, we observe that sovereigns often choose to assist crisis-ridden countries, as emphasized in the analysis above. However, in principle they could have compensated their own citizens instead. Spillovers of a foreign sovereign default to the domestic banking sector are likely to be particularly detrimental to the domestic economy, and governments may wish to provide support to their banks to mitigate the potential negative repercussions of a foreign default. It is important to determine whether the mechanisms in our above analysis would remain relevant if the safe country could elect to provide direct domestic support.

Extending our framework to allow this possibility is relatively straightforward. We let the safe country issue domestic assistance a^s to its own residents only to compensate them for losses on r's default. Then, the government budget constraint in country s becomes

$$T^s - G^s = A + a^s. \tag{17}$$

The resource constraint on consumption in country s is now as follows:

$$c^s = y^s + a^s - z\left(T^s\right) - T^s + \beta^r\left(1-\theta\right) R^r b^r - \kappa\left[\beta^r \theta b^r R^r - a^s\right]^+, \tag{18}$$

where $\left[\beta^r \theta b^r R^r - a^s\right]^+ \equiv \min\left\{0, \beta^r \theta b^r R^r - a^s\right\}$. Hence, the domestic compensation a^s can perfectly offset the negative spillovers from a foreign default. The following proposition shows when s would still find it optimal to provide cross-country assistance A, as studied above.

Proposition 3 *Cross-country assistance versus domestic bailouts:*

1. *If $\beta^r + \alpha^r > 1$, then s assists r rather than its own residents whenever $\left(T^{r*} - G^r\right)/b^r \leq R^r \leq \overline{R}^r$.*

2. *Otherwise, s does not assist r; instead, s assists its own residents.*

Proof *The government of the safe country maximizes c^s subject to its budget constraint. The marginal effect of raising taxes to finance domestic transfers is*

$$\frac{dc^s}{da^s} = -z'\left(T^s\right) + \kappa$$

The safe country will prefer to assist the risky country rather than bail out its own citizens directly if and only if $dc^s/dA - dc^s/da^s > 0$. From (17) and (18), this can be expressed as follows:

$$\frac{dc^s}{dA} - \frac{dc^s}{da^s} = -\theta'\left(A\right)\beta^r R^r b^r\left(1+\kappa\right) - 1 - \kappa.$$

Note that whereas expression (7) implies $\overline{A} < 0$ if $R^r < \widehat{R} \equiv \left(T^{r*} - G^r\right)/b^r$, (8) implies $\underline{A} > A^*$ if $R^r > \overline{R}^r$. Hence, expressions (14) and (11) imply that $\theta'\left(A\right) = -\frac{1}{b^r R^r\left(1-\alpha^r\right)}$ if the interest rate is in the region $\widehat{R} \leq R^r \leq \overline{R}^r$, and $\theta'\left(A\right) = 0$ otherwise. It follows that

$$\frac{dc^s}{A} - \frac{dc^s}{a^s} = \begin{cases} \beta^r \frac{1+\kappa}{1-\alpha^r} - \left(1+\kappa\right) & \text{if } \widehat{R} \leq R^r \leq \overline{R}^r \\ 0 \text{ or } -\kappa & \text{otherwise} \end{cases}$$

Hence, $dc^s/dA - dc^s/a^s > 0$ if and only if $\beta^r + \alpha^r > 1$ and $\widehat{R} \leq R^r \leq \overline{R}^r$. ■

Thus, even if a creditor country has the option to selectively compensate its own residents for their losses after a foreign default, it may still find it optimal to assist the distressed country instead. The intuitive explanation is that when government assistance reduces the default rate θ, the government prevents default costs (α^r) from materializing. As a result, this measure frees up resources for repayment by country r. Hence, assistance stimulates repayment more than one-for-one through a "default cost multiplier". Of course, the safe country's valuation of this repayment depends on the share of risky debt held by its residents β^r. This result is summarized by the first inequality in part 1 of the proposition. In addition, $(T^{r*} - G^r)/b^r \leq R^r \leq \overline{R}^r$ ensures that the receiving country does not use all of the assistance to cut taxes, which is the same condition that motivated assistance in our main analysis where a^s was ruled out. Therefore, when $\beta^r + \alpha^r > 1$, all of the results from our main analysis remain valid.[5]

6 Conclusion

Our analysis centers on how a sovereign may choose to assist a distressed country because doing so frees resources for debt repayment. A key mechanism is that if this willingness to assist is understood by the markets, it will affect equilibrium interest rates. We show that cross-country assistance is beneficial only if the recipient country is insolvent in the sense that it would default without a bailout. In that case, assistance can enhance welfare by supporting equilibria where debt is repaid either fully or partly, and the default costs are avoided or at least reduced. However, potential assistance may also adversely increase the equilibrium default rate ("haircut") on outstanding debt when countries are driven into default by expectations alone. Hence, while potential assistance is Pareto improving for a country with weak finances that cannot repay without assistance, it may not be for a country that is fundamentally solvent but subject to pessimistic investor expectations.

Our analysis assumes that the assistance policy is determined after the debt is priced. Effectively, this assumption implies that a safe country cannot credibly commit to abstaining from reacting to interest rate movements. With different timing assumptions, the assisting country could have committed to zero transfers, and the bad equilibrium would have involved a lower default rate and less waste. This point captures the policy implication of our paper: constraints on a government's willingness to bail out other illiquid countries may be desirable.

A caveat to these results is that our framework does not assign probabilities to the different candidate equilibria. Although the insight that assistance raises the costs of a self-fulfilling default is likely to be a general one, it appears to be plausible that in an environment with uncertainty over outcomes, assistance could reduce the probability of a default. Finally, we provide a static model of

[5] Proposition 3 gives a stark result in that s either provides cross-country assistance or chooses domestic bailouts. This result follows from the simple linear representation of the default costs. In the perhaps more realistic scenario with convex default costs, one would likely observe a combination of cross-country assistance and domestic transfers.

debt, bailouts and default. Studying these issues in a dynamic model, with repeated decisions on debt issuance, debt pricing, cross-country assistance and default would be an important next step. We leave these extensions of our work for future research.

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