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Sovereign debt crises and cross-country assistance*

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Abstract

We provide a parsimonious framework to study the interplay between cross-country assistance and expectations-driven sovereign debt crises. Our framework extends the traditional single-country model of how multiple perfect-foresight equilibria are possible when a sovereign attempts to service public debt. The extension is that a self-interested "safe" country may choose to assist a "risky" country which is prone to default. Investors internalize the potential for assistance when lending to fragile countries. If the safe country cannot commit to fixed cross-country transfers or rule them out completely, assistance improves equilibrium outcomes only if the risky country is fundamentally insolvent in the sense that it cannot repay existing debt 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.

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1 Introduction

Following 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 preventing a default. In countries where banks and citizens are exposed to sovereign defaults elsewhere, governments must balance the benefits of financially assisting debtor countries against the domestic tax costs of such bailouts. As part of these considerations, governments in creditor countries may also contemplate the option of bailing out their domestic agents directly. Complicating matters further, investors are aware of these policy trade-offs and internalize them when pricing sovereign debt. In this paper, we develop a parsimonious theoretical model in which all these elements are in play and shape the answer to the following question: How effective are assistance policies that are chosen by self-interested governments in response to interest rate movements?

Our framework is a two-country extension of the landmark Calvo (1988) model of self-fulfilling sovereign debt crises. The government in a "risky" country has outstanding debt to domestic and international creditors. The government in a "safe" country has the option to financially assist the risky country. Default costs make debt service desirable, and in conjunction with cross-country bond holdings they might motivate the safe country to provide assistance. From the safe government'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 the risky government's willingness to raise its own taxes for repayment.[1] Importantly, investors who ex-ante contemplate lending to the risky country must take these ex-post policy considerations 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 equilibrium repayment. With incentive compatibility, we here mean the requirement that a policy action is optimal for the government choosing it, at the time of reaching the decision. We show that if the risky country has sufficiently low debt, the incentive-compatible assistance policy does not influence the good equilibrium in which debt is repaid in full, but it does affect the bad equilibrium in which pessimism causes default. Unfortunately, assistance increases both the interest rate and

[1] An additional policy option for the risky country (assuming it is not part of a monetary union) could be to reduce the real value of it debt through inflation. We ignore this alternative in our study.

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. Our analysis thus supports measures to prevent self-interested creditor countries from assisting debtors that suffer from pessimistic investor beliefs rather than high debt. In principle, 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, governments may in reality also have the option to cover their own residents' losses on foreign lending directly via domestic bailouts. We therefore extend our framework to allow for this possibility. Yet, even under this extension we find that under mild conditions cross-country assistance will still be chosen (ahead of domestic bailouts) in equilibrium, in which case all our other results remain valid. The conditions are that default costs and cross-country bond holdings are sufficiently high.[2] The intuition here is that, from the perspective of the assisting country, it is better to provide international assistance than to bail out exposed domestic banks if the former option makes the debtor country repay more than it receives in assistance. Such a multiplier effect is present if assistance prevents disruptive default costs from materializing in the debtor country. Indeed, if the default costs are large, assistance that prevents the risky country from defaulting pays off more than one-for-one for the safe country.

Our model is inspired by historical sovereign debt crises. For example, two episodes that have been interpreted as beliefs-driven were the 1998 Argentine crisis and the recent European sovereign debt crisis. In Argentina, spreads on US dollar-denominated Argentinian sovereign bonds rose despite a relatively low debt-to-GDP ratio (Ayres et al., 2015). Similarly, for the euro area sovereign debt crisis, De Grauwe (2012) highlights the fact that sovereign bond spreads rose much more in the euro zone than in the US and the UK, despite the debt-to-GDP ratio increasing less in the euro zone. He argues that because US and UK have an independent monetary policy, they are less prone to self-fulfilling debt crises as their central banks can always print money to repay creditors.[3] De Grauwe and Ji (2013) more formally test whether self-fulfilling beliefs were driving the euro area sovereign debt crisis. They find that for many euro area countries, sovereign bond spreads increased

[2] An alternative and plausible explanation why a government might be reluctant to bail out its domestic banks when they suffer losses on lending abroad, is moral hazard. A domestic bailout policy would naturally induce domestic banks to lend excessively to risky sovereigns, and motivate risky sovereigns to excessively seek foreign credit. De Ferra (2017) studies this issue. A further explanation why creditor hosting countries do not bail their own banks out directly, is that multilateral lenders mediate between creditors and debtors.

[3] Bacchetta and van Wincoop (2018) make the point, however, that bailouts via monetary policy are costly because they generate inflation. Therefore, monetary policy bailouts might not be optimal ex post, and hence not credible ex ante.

by more than fundamentals justified, and interpret this finding as evidence that self-fulfilling beliefs were a driver of the crisis. Consistent with this view, ECB President Mario Draghi's 2012 pledge to do "whatever it takes" to save the euro and the ECB's subsequent introduction of the "outright monetary transactions (OMT)" program have been credited for stemming the European sovereign debt crisis by calming expectations. For example, the Financial Times argues that the "undeniable turning point in the Eurozone crisis came when Mr Draghi announced the ECB would do 'whatever it takes' to defend the common currency."[4]

Default costs play an important role in our analysis, as they do in much of the literature on sovereign debt crises. Prominent examples are the studies by Eaton and Gersovitz (1981), Calvo (1988), and Arellano (2008). One reason why sovereign defaults might be costly is that they ignite spillovers via banks to the real economy. Gennaioli et al. (2014) develop a theoretical model where bank losses on sovereign debt cause credit contractions and thereby lower overall economic activity. This channel is active when a government cannot selectively default on foreign creditors only, as emphasized by Broner et al. (2010) who argue that it is difficult to discriminate against foreign bondholders because sovereign debt is traded on secondary markets. We follow the line of reasoning in these papers when we introduce spillovers from sovereign default in one country to output losses in creditor countries, and assume that governments cannot selectively default on foreigners only.[5]

Our model shares the common feature of most other studies on expectations-driven default that roll-over crises are sudden, see e.g. Cole and Kehoe (2000). Lorenzoni and Werning (2019) and Stangeby (2017) do away with this feature as they focus specifically on the pricing of short- and long-term debt and how debt crises the can entail a *gradual* build-up of debt. Our main extension relative to these and most other papers on expectations-driven default is to allow for endogenous cross-country assistance.

Like us, Marin (2017), Tirole (2015), and Cooper (2012) assume that debt crises entail cross-country spillovers which might motivate international bailouts. Marin (2017) assumes sovereigns experiencing a roll-over crisis must either default fully or repay at least a specified amount, whereas we allow for partial default and spillovers that depend on debt magnitude. These differences explain why our study stands out by finding that (i) the potential for bailouts may increase default rates in the crisis equilibrium; (ii) self-interested sovereigns may find it optimal to provide cross-country bailouts rather than to compensate domestic creditors directly. Tirole (2015) characterizes ex-ante optimal risk-sharing between countries that are asymmetric in their exposure to default risk, as in

[4]See Financial Times, "Mario Draghi's policy bazooka may be his most precious legacy", May 29, 2019, available at `https://www.ft.com`. Saka et al. (2015) provide empirical evidence consistent with the hypothesis that Draghi's pledge, together with the introduction of OMT (making the pledge credible), worked by preventing the "bad equilibrium" of a self-fulfilling crisis.

[5]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).

our model. A key distinction from 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 from an ex-ante perspective. Cooper (2012), like us, 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.

Pancrazi et al. (2017) also study cross-country assistance, but differ by assuming that bailouts are conditional and always available to the risky country. By contrast, our main objective is to analyze outcomes when all policy choices are time-consistent: bailouts are granted only to the extent that they are optimal for the assisting country, and a receiving country cannot commit to obey loan conditions.

Our paper also relates to studies of bailouts by other institutions than self-interested sovereigns. Corsetti et al. (2014) study the interplay between monetary and fiscal policies in a sovereign debt crisis, without explicitly modeling the strategic default and assistance decisions by governments. In contrast, we focus on governments' incentives to repay debt and provide financial assistance to other countries, abstracting from monetary policy. Morris and Shin (2004) and Corsetti, Guimarães and Roubini (2006) explore how an international institution's bailouts can motivate a struggling sovereign to repay debt. Unlike us, they do not emphasize how the incentives for assistance affect interest rate determination ex ante. Fink and Scholl (2016) and Roch and Uhlig (2018) also study bailouts by international financial institutions, but their studies are more quantitatively oriented using models where sovereigns default fully or not at all. Then, sufficiently high willingness to assist ex post will prevent defaults caused by pessimism alone. In contrast, we show that when default costs are proportional to default size, ex-post incentive-compatible assistance policy not only fails to fully prevent a self-fulfilling debt crisis, but may also exacerbate it.

In short, our main contribution is to provide a tractable framework for studying debt crises when cross-country assistance is endogenously chosen. This model is useful to build intuition and can serve as a benchmark for studying more complicated issues. In this framework, ex post (at given interest rates) cross-country assistance may increase domestic welfare. Therefore, governments cannot credibly commit to abstain from such assistance. Then, depending on initial conditions, international assistance can have adverse consequences ex ante. The potential for assistance might affect interest rates in such a way that commitment to refrain from bailouts is beneficial.

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". Safe country variables and parameters will be denoted by

asterisk-superscripts, while risky country variables and parameters will not carry superscripts. We also introduce a negative spillover from a sovereign default to private sector resources and permit cross-country financial assistance. Following much of the literature on sovereign debt crises, we assume that debtors cannot discriminately default on foreign creditors only. One rationale could be that bonds are issued under international law prohibiting such discrimination. Alternatively, as emphasized by Broner, Martin and Ventura (2010), even if debt is issued under domestic law, discriminatory default may be impossible when foreign creditors can sell their bond holdings to domestic creditors in the secondary market, thus undermining any attempt to discriminate.

The risky country's government faces the budget constraint

$$T + A = G + (1 - \theta) Rb + \alpha\theta Rb + A^*, \tag{1}$$

where $R \geq 1$ is the gross interest rate, b is debt, T are taxes, G are exogenous government expenditures, $\theta \in [0, 1]$ denotes the fraction of debt that the government defaults upon, and $\alpha \in (0, 1)$ are default costs directly faced by the government. A denotes assistance received from the safe country, while A^* is assistance paid to the safe country. Similarly, the safe country's government must satisfy the budget constraint

$$T^* + A^* = G^* + (1 - \theta^*) R^* b^* + \alpha^* \theta^* b^* + A, \tag{2}$$

For expositional purposes, we restrict attention to scenarios where the safe country never defaults, $\theta^* = 0$. Knowing this, investors charge R^* equal to the risk-less rate. Without loss of generality, we simplify by normalizing $b^* = 0$, and use R^* to denote the gross risk-less interest rate. Because there is no incentive for the risky country to assist the safe country, $A^* = 0$.

Investors are risk neutral. Therefore, arbitrage between risky and safe debt ensures that the following relationship holds:

$$R^* = R(1 - \theta), \tag{3}$$

There is no uncertainty in the model, so that investors correctly anticipate the risky country's default choice θ.

Each country's private consumption must satisfy the resource constraints

$$c = y - z(T) - T + (1 - \beta)(1 - \theta)Rb - \kappa(1 - \beta)\theta bR \tag{4}$$

$$c^* = y^* - z(T^*) - T^* + \beta(1 - \theta)Rb - \kappa^* \beta\theta bR, \tag{5}$$

where y and y^* are output in the risky and safe country, respectively, β is the fraction of risky country debt held by safe country residents, and $z(\cdot)$ captures dead-weight losses from taxation with $z', z'' > 0$ and $z(0) = 0$. The parameters $\kappa \geq 0$ and $\kappa^* \geq 0$ capture the indirect costs from a sovereign default to the private sector, for instance, because banks suffer losses and intermediate

less efficiently.[6] 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 risky country, which can choose to use it for debt repayment or tax reduction. As a result, assistance does not directly influence private consumption in (4) and (5); instead, it only enters governments' budget constraints (1) and (2).

The timing is as follows: in period $t = 0$, investors lend b at interest rate R; 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 its own taxes and 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, θ, A, R). Thus, we start by analyzing the risky country's choices of taxes and default, taking assistance and interest rates as given. Then, we discuss optimal cross-country assistance by the safe country, taking interest rates as given. Finally, we impose the arbitrage condition (3).

3.1 Optimal tax and default policy for the risky country

The risky country selects T and θ to maximize c subject to (1) and (4), taking A and 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 consumption. To find the 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

$$c = y - z(T) - T + (1 - \beta)bR - (1 + \kappa)(1 - \beta)\frac{G + bR - T - A}{1 - \alpha} \tag{6}$$

Note that because $z''(\cdot) > 0$, a necessary condition for any repayment is that $\frac{dc}{dT}|_{T=G} > 0$, which implies from (6) that $(1-\beta)(1+\kappa)/(1-\alpha) > 1 + z'(G)$. We assume that this parameter restriction holds, as the risky government would otherwise always decide to default. From (6), it follows that

[6] 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.

the first-order condition for an interior optimum of c with respect to T reads

$$1 + z'\left(T^{cap}\right) = (1-\beta)\frac{1+\kappa}{1-\alpha}. \tag{7}$$

Equation (7) implicitly defines the risky country's "tax capacity" T^{cap}. This is the highest tax level that the risky country will ever want to implement. The left-hand side of (7) represents the marginal costs of taxation. The right-hand side of (7) shows the marginal benefits from using tax revenues to repay debt. From the risky country's perspective, these benefits increase with the share of debt held domestically, $(1-\beta)$. The benefits also increase with the default cost parameters κ and α because higher such costs imply greater gains from avoiding default.

Condition (6) holds only for the interior solution, where $0 < \theta < 1$. To fully characterize the risky country's policy, we must also consider the possible corner solutions where $\theta = 0$ or $\theta = 1$. First, note that the risky country will repay fully if and only if $T^{cap} \geq G + bR - A$. However, it will default fully if and only if $T^{cap} < G + \alpha bR - A$, where the right-hand side of the inequality contains the default costs due to $\theta = 1$. Based on these considerations, we define

$$\overline{A}(R) \equiv G + bR - T^{cap}, \tag{8}$$

$$\underline{A}(R) \equiv G + \alpha bR - T^{cap}. \tag{9}$$

Here, we denote these bounds as functions of 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 the risky government to repay fully when taxes are T^{cap}. If $A > \overline{A}$, the risky government can repay fully with taxes below T^{cap}. Conversely, $\underline{A}$ denotes the assistance needed for the risky country to cover its default costs and G if $\theta = 1$ and taxes are set to T^{cap}. If $A < \underline{A}$, then T^{cap} is insufficient to cover the expenses even with a full default. In this case, the risky government is forced to set $T > T^{cap}$ to cover the default costs. Finally, if $\underline{A} \leq A \leq \overline{A}$, the risky government will set $T = T^{cap}$, as implied by the first-order condition, and partially default. Therefore, the tax schedule is summarized as

$$T(A) = \begin{cases} G + \alpha bR - A & \text{if } A < \underline{A} \\ T^{cap} & \text{if } \underline{A} \leq A \leq \overline{A} \\ G + bR - A & \text{if } A > \overline{A} \end{cases} \tag{10}$$

Notice that assistance fully crowds out taxes unless $\underline{A} \leq A \leq \overline{A}$, where taxes are T^{cap} independently

of A. The tax schedule above implies the default rates

$$\theta(A) = \begin{cases} 1 & \text{if } A < \underline{A} \\ \frac{G+bR-T^{cap}-A}{bR(1-\alpha)} & \text{if } \underline{A} \leq A \leq \overline{A} \\ 0 & \text{if } A > \overline{A} \end{cases}, \tag{11}$$

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

$$\theta'(A) = \begin{cases} -\frac{1}{bR(1-\alpha)} & \text{if } \underline{A} \leq A \leq \overline{A} \\ 0 & \text{otherwise} \end{cases} \tag{12}$$

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 the risky government's default decision. Consequently, the risky country still defaults fully and uses any assistance it receives to cut taxes. Conversely, if $A > \overline{A}$, the bailout is so *large* that a marginal change will not affect risky government's default decision: it already has sufficient funds to repay fully, and uses any additional assistance to cut taxes. 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 $T = T^{cap}$; however, the risky government uses the additional funds to repay its creditors. As reflected by the denominator in (12), the amount repaid increases more than one-for-one with assistance because repayment prevents default costs α from materializing.

3.2 Optimal assistance policy for the safe country

The government in the safe country selects A and (by implication) T^* to maximize c^* subject to the government budget constraint (2), the consumers' resource constraint (5) and the risky government's optimal tax policy function (10), taking R as given.

From (5) and (2), the marginal benefit of a tax-financed increase in A is:

$$\frac{dc^*}{dA} = -z'(A + G^*) - 1 - \beta R b \theta'(A) - \kappa^* \beta b R \theta'(A). \tag{13}$$

From (12), $\theta'(A) = 0$; hence, $\frac{dc^*}{dA} < 0$ 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 (12) into (13), we find that the first-order condition for an internal assistance optimum reads as follows:

$$1 + z'(A^{cap} + G^*) = \frac{\beta(1+\kappa^*)}{1-\alpha}. \tag{14}$$

This expression implicitly defines the maximum assistance that the safe government is willing to provide, or "assistance capacity" to use Calvo's (1988) expression, A^{cap}, as a function of the

underlying parameters. At A^{cap}, the marginal costs of financing additional assistance equal the marginal benefits of greater repayment from the risky to the safe country. Because $z''(\cdot) > 0$, $A^{cap} > 0$ if and only if $1 + z'(G^*) < \beta(1+\kappa^*)/(1-\alpha)$. The intuition is as follows. The left-hand side of (14) 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 (14) captures the marginal benefits of assistance, namely, the benefit to domestic citizens of reducing the foreign default rate. This marginal benefit increases with the safe country's claims on the risky country (β), the side effects of the creditor losses in the safe country (κ^*), and the extent to which assistance stimulates repayment by preventing default costs (α). Hence, that $A^{cap} > 0$ if and only if $1 + z'(G^*) < \beta(1+\kappa^*)/(1-\alpha)$ means the safe country will only provide assistance if it stimulates a sufficient repayment of outstanding debt to its own residents.

Summing up, we have shown that the optimal assistance policy is characterized by

$$A = \begin{cases} \overline{A} & \text{if } A^{cap} > \overline{A}(R) \\ A^{cap} & \text{if } \underline{A}(R) \leq A^{cap} \leq \overline{A}(R) \\ 0 & \text{if } A^{cap} < \underline{A}(R) \end{cases}, \tag{15}$$

where $\overline{A}$, $\underline{A}$ and A^{cap} are given by (8), (9) and (14), respectively. The first part of this schedule states that assistance will never exceed $\overline{A}$, the level that allows the risky country to repay all its debt. The reason is that above $\overline{A}$, further assistance will only end up in the pockets of the risky country's residents, and none of it will be returned to the safe country. The second part of the schedule describes an internal optimum where the marginal deadweight costs of taxation equal the marginal gains of preventing a default, as expressed in (14). This occurs when the recipient country uses assistance funds to repay outstanding debt to creditors from the safe country. The third and final part shows that from the safe country's perspective, if even A^{cap} (the maximum assistance that the safe country is willing to provide if all is used for repayment) is insufficient to prevent a full default, then the safe country prefers to give no assistance at all. The reason is that in this case, none of the assistance below A^{cap} will find its way back to the creditors located in the safe country.

3.3 Resources for repayment

The risky country defaults whenever $T + A < G + bR$. As demonstrated above, there are three scenarios to consider under a default. First, if $A^{cap} < \underline{A}$, and hence, $T^{cap} + A^{cap} < G + \alpha bR$, the safe country sets $A = 0$. Then, there is a full default, $\theta = 1$, and the risky government only raises taxes to cover the default costs. Second, if $A^{cap} > \overline{A}$, which would imply that $T^{cap} + A^{cap} > G + bR$, then A^{cap} is so large relative to the outstanding amount that the risky government has more

funds than it needs to repay fully. Because it realizes this fact, it will not offer A^{cap} but will limit the bailout to $A = \overline{A} = G + bR + a - T^{cap}$. Thus, $\theta = 0$ if $T = T^{cap}$. In response, the risky government sets taxes equal to T^{cap}. The overall funds available to the risky country equal the amount needed for expenditure and debt repayment. Third, if $\underline{A} \leq A^{cap} \leq \overline{A}$, which would imply that $G+\alpha bR \leq T^{cap}+A^{cap} \leq G+bR$, then the safe country sets $A = A^{cap}$ and the risky government sets $T = T^{cap}$.

To summarize, the funds spent by the risky government are given by

$$T + A = \begin{cases} G + \alpha bR & \text{if } T^{cap} + A^{cap} < G + \alpha bR \\ G + bR & \text{if } T^{cap} + A^{cap} > G + bR \\ T^{cap} + A^{cap} & \text{otherwise} \end{cases} \tag{16}$$

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

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

The policy functions are illustrated in Figure 1. The solid line is the risky government's selected taxation, which first increases with R to enable full repayment of debt, and then flattens out once the tax capacity T^{cap} is reached. Taxes will increase again once the default costs become so large that $T^{cap} + A^{cap}$ is insufficient to support any repayment at all. The vertical distance from the solid line to the dashed line represents A. For low R, the risky country needs no assistance to repay, hence, the safe country chooses $A = 0$. When the interest rate is sufficiently high that the risky country will default if left alone, the safe country starts assisting.[7] On the increasing segment of the dashed line, the assistance barely suffices to support full repayment. A marginal increase in R is accompanied by a marginal increase in A. Beyond a certain interest rate level, full repayment requires $A > A^{cap}$. In that case, the safe government prefers to let θ increase rather than inflict further deadweight losses on its own economy. To the far right, R is so high that $\theta = 1$ even if $A = A^{cap}$. In that case, the assistance returns to zero because no transfer below A^{cap} trickles back to the creditors of the safe country. The upper envelope of the solid and dashed lines is the repayment schedule $T + A$, which is drawn as a function of R. The points $(\underline{R}, T^{cap} + A^{cap})$ and $\left(\overline{R}, T^{cap} + A^{cap}\right)$ mark the kinks in the $T + A$ schedule.

[7] Note that the safe country begins to assist when R exceeds $(T^{cap} - G)/b$, which is the interest rate such that T^{cap} is insufficient to service risky debt without assistance.

4 The effects of cross-country assistance in equilibrium

The investors price debt according to (3) based on their rational expectations about the risky country's repayment policy. Hence, they internalize how R affects the safe country's selection of A and the risky country's tax response, which together determine θ.

By rearranging equation (3), we get $\theta R = R - R^*$. This equation can be substituted into the risky government's budget constraint to obtain

$$T + A = G + (1-\alpha)bR^* + \alpha bR. \tag{17}$$

This equation is the 2-country equivalent to what Calvo (1988) called the "consistency condition"; it gives levels of $T + A$ that are consistent with the no-arbitrage condition for R determined in period 0. In Figure 1, the market consistency condition (17) 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 $R^* \leq R$.

An intersection between the total funding schedule (16) and the consistency condition (17) constitutes an equilibrium in our model. Because R depends on the expected repayment and θ depends on R, multiple equilibria may exist.

Proposition 1 *Existence of equilibria:*

1. *If $T^{cap} + A^{cap} < G + R^*b$, no equilibrium exists.*
2. *If $T^{cap} + A^{cap} = G + R^*b$, a unique equilibrium exists with $R = R^*$ and $\theta = 0$.*
3. *If $T^{cap} + A^{cap} > G + R^*b$, two equilibria exist: one with $R = R^*$ and $\theta = 0$ and another with $R = R^{cap} \equiv \frac{T^{cap}+A^{cap}-G-(1-\alpha)R^*b}{\alpha b}$ and $\theta = \theta^{cap} \equiv \frac{G+R^{cap}b-T^{cap}-A^{cap}}{R^{cap}b(1-\alpha)}$.*

Proof. *Part 1: (1) implies $T + A = G + [(1-\theta)R + \alpha\theta R]\, b$, and (3) implies $R^* < (1-\theta)R + \alpha\theta R$. Hence, if $T^{cap} + A^{cap} < G + R^*b$, there exists no interest rate that is compatible with both (1) and (3).*

Part 2: Assume $T + A = T^{cap} + A^{cap}$. Then, both (1) and (3) hold if and only if $R = R^*$ and $\theta = 0$. In that case, (16) validates $T + A = T^{cap} + A^{cap}$. Hence, an equilibrium with $\{R = R^*, \theta = 0\}$ exists. (1), (3) and (16) cannot simultaneously hold for any other R.

Part 3: Assume $T + A = T^{cap} + A^{cap}$. Then, both (1) and (3) hold if and only if $R = R^{cap}$ and $\theta = \theta^{cap}$. $R = R^{cap}$ implies $G + \alpha Rb = T^{cap} + A^{cap} - (1-\alpha)R^*b$. As a result, $G + \alpha Rb \leq T^{cap} + A^{cap}$. $R = R^{cap}$ also implies $G + Rb = G + \frac{T^{cap}+A^{cap}-G-(1-\alpha)R^*b}{\alpha} = T^{cap} + A^{cap} + \frac{1-\alpha}{\alpha}(T^{cap} + A^{cap} - G - R^*b)$. From $T^{cap} + A^{cap} > G + R^*b$, it follows that $G + Rb > T^{cap} + A^{cap}$. Hence, $G + \alpha Rb < T^{cap} + A^{cap} < G + Rb$, and (16) validates $T + A = T^{cap} + A^{cap}$. Thus, an equilibrium with $\{R = R^{cap}, \theta = \theta^{cap}\}$

exists. If $R = R^*$, $T^{cap} + A^{cap} > G + R^*b$ *and (16) imply* $T + A = G + R^*b$. *Consequently, (1) and (3) hold with* $\theta = 0$. *Hence, an equilibrium with* $\{R = R^*, \theta = 0\}$ *exists. (1), (3) and (16) cannot simultaneously hold for any other* R. ■

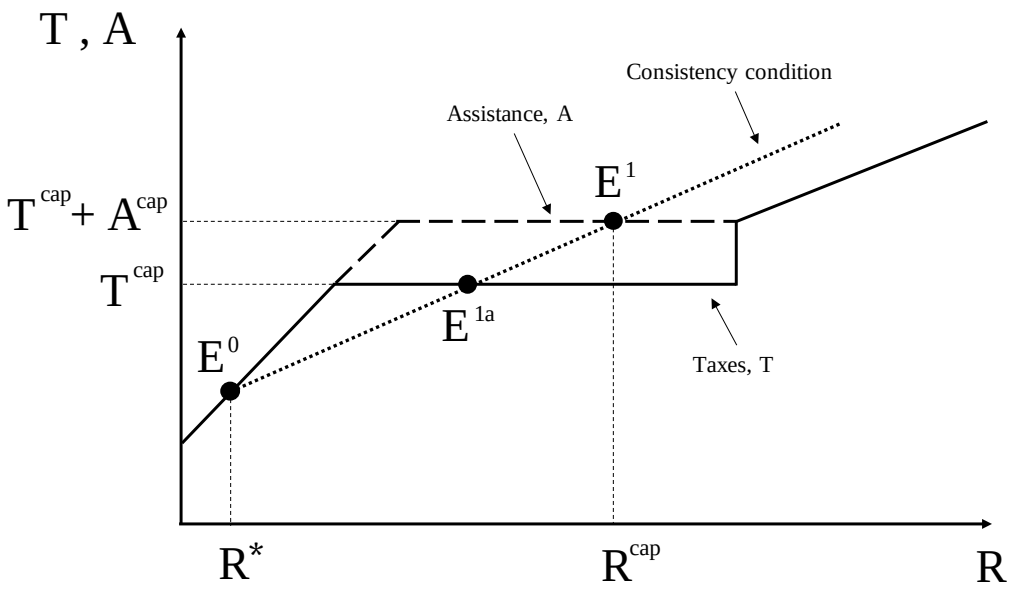
Proposition 1 shows that depending on the initial conditions, the consistency condition and the repayment schedule may cross once (case 2 in Proposition 1), twice (case 3), or never (case 1). When no equilibrium exists (case 1), risk-neutral investors are not willing to lend to the risky country at any 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^{cap} and the assistance A^{cap} to be sufficiently high, and it also requires both the government expenditure G and the debt burden at the risk-free rate R^*b 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, the risky government defaults partly ($0 < \theta < 1$). Consequently, $R > R^*$ because investors require compensation for the haircut. Hence, assistance 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), 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 (17) implies that the default rate in this equilibrium must also be higher than the rate without assistance.

Proposition 1 implies that the equilibrium influence of the safe country's assistance policy is ambiguous and depends on initial conditions. In particular, it depends on the risky country's financial situation as summarized by its outstanding debt relative to its tax capacity. Compared to a situation where assistance is impossible, assistance is Pareto improving only if the risky country has so weak finances that it would default for certain if left alone. If instead the risky country is financially strong enough to serve its debt when investors are optimistic and charge only the risk-free rate, the availability of assistance might harm both countries.

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

Figure 1: Equilibria



Note: Taxes in the risky country T (solid line) and assistance A (dashed line) as functions of the interest rate R. The upper envelope of taxes and assistance represents the total funds that the risky country has available to repay the debt and finance G. The dotted line is the consistency condition for the market interest rate as a function of the total funds (T + A) when the initial conditions satisfy $T^{cap} + A^{cap} > G + R^*b$, 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.

1. *If $T^{cap} < G + R^*b - A^{cap}$, then the IC assistance policy has no effect.*
2. *If $G + R^*b - A^{cap} \leq T^{cap} < G + R^*b$, then the IC assistance policy reduces θ in equilibrium.*
3. *If $T^{cap} > G + R^*b$, 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^{cap} is so small relative to G and b that even if $R = R^*$ and $A = A^{cap}$, no debt is repaid. Therefore, assistance will not be provided because assistance up to A^{cap} will never trickle back to the safe country. As a result, the economy behaves as if assistance were impossible. In case 2, the risky country would default if it were left alone, but the sum of the maximum assistance and tax revenues would enable full repayment if $R = R^*$. Because default is costly for the risky country, it will use the assistance to repay its debt. As it understands this scenario, the safe country will find it optimal to provide assistance, which ultimately reduces the default rate. In case 3, T^{cap} is sufficient to support full repayment if $R = R^*$. 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^* to its own residents only to compensate them for losses due to a default by the risky country. Then, the government budget constraint in the safe country becomes

$$T^* - G^* = A + a^*. \tag{18}$$

The resource constraint on consumption in the safe country now reads follows:

$$c^* = y^* + a^* - z\left(T^*\right) - T^* + \beta(1-\theta)Rb - \kappa^* \left[\beta\theta bR - a^*\right]^+, \tag{19}$$

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

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

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

2. *Otherwise, the safe government does not assist the risky country; instead, it assists its own residents.*

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

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

The safe country will prefer to assist the risky country rather than bail out its own citizens directly if and only if $dc^*/dA - dc^*/da^* > 0$. *From (18) and (19), this can be expressed as follows:*

$$\frac{dc^*}{dA} - \frac{dc^*}{da^*} = -\theta'(A)\,\beta Rb\,(1+\kappa^*) - 1 - \kappa^*.$$

Note that whereas expression (8) implies $\overline{A} < 0$ *if* $R < \widehat{R} \equiv (T^{cap} - G)/b$, *(9) implies* $\underline{A} > A^*$ *if* $R > \overline{R}$. *Hence, expressions (15) and (12) imply that* $\theta'(A) = -\frac{1}{bR(1-\alpha)}$ *if the interest rate is in the region* $\widehat{R} \leq R \leq \overline{R}$, *and* $\theta'(A) = 0$ *otherwise. It follows that*

$$\frac{dc^*}{dA} - \frac{dc^*}{da^*} = \begin{cases} \beta\frac{1+\kappa^*}{1-\alpha} - (1+\kappa^*) & \text{if } \widehat{R} \leq R \leq \overline{R} \\ -(1+\kappa^*) & \text{otherwise} \end{cases}$$

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

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) from materializing. As a result, this measure frees up resources for repayment by the risky country. 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. This result is summarized by the first inequality in part 1 of the proposition. In addition, $(T^{cap} - G)/b \leq R \leq \overline{R}$ 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^* was ruled out. Therefore, when $\beta + \alpha > 1$, all of the results from our main analysis remain valid.[8]

6 Conclusion

Our analysis centers on how a sovereign may choose to assist a distressed country because assistance frees resources for debt repayment. A key mechanism is that if this willingness to assist is understood by market participants, equilibrium interest rates will be affected. In our model, 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

[8]Proposition 3 gives a stark result in that the safe country 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.

when countries are driven into default by expectations alone. Hence, while potential assistance is Pareto improving for a country with such weak finances that it cannot repay if left alone, it may not be for a country that is fundamentally solvent but subject to pessimistic investor beliefs.

In our model, assistance is decided after debt has been priced. Effectively, this assumption implies that a safe country cannot credibly commit to abstain 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 a policy implication of our paper: constraints on a government's ability to bail out other illiquid countries may be desirable. Implementation of such a policy will admittedly be difficult, since in practice it is hard to distinguish illiquidity from insolvency. Hence, for practical policymaking, our primary message is a call for caution against cross-country assistance which is based on the claim that the recipient is illiquid. We believe this to be a notable caution, since a traditional recommendation for lenders of last resort, dating back to Bagehot (1873) and resurrected by for instance De Grauwe (2011) in the context of the European debt crisis, is that central banks should lend freely, at penalty rates, to *illiquid but solvent* banks. Our study implies that when the policy instrument is cross-country financial assistance, instead of the interest rate, the recommendation should perhaps be the opposite.

Notably, our analysis takes the existing stock of debt as given and thus ignores how assistance policy might affect the incentives for borrowing and lending initially. Such issues of moral hazard are separate arguments why cross-country assistance policy, as well as domestic bailouts by creditor-hosting countries, should be avoided. We believe that the arguments we put forward add to the more conventional ones that are based on moral hazard.

A caveat to our 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 seems plausible that in an environment with uncertainty over outcomes, assistance could reduce the probability of a default. Here, a promising extension could be to introduce private information about fundamentals (such as the risky country's spending needs G, or default costs α and κ^*) into our model, and use the global games approach to obtain a unique equilibrium as in, for example, Corsetti, Guimarães and Shin (2006). This would sharpen the results and allow one to study how financial assistance shapes solvency and liquidity crisis. Moreover, our model is static. Studying the same issues that we consider in a dynamic model, with repeated decisions on debt issuance, debt pricing, cross-country assistance and default would be an important next step. For instance, moral hazard on the side of both creditors and debtors would likely emerge as important in such a dynamic setting. Finally, our study naturally raises the possibility of a novel source of contagion: in a multi-country setting, the willingness to provide assistance in an initial crisis may serve to signal leniency in possible future crisis events. A natural

positive application could be the European sovereign debt crisis, where the initial willingness of core European countries to extend a bailout to Greece spilled over to other peripheral European governments with weak finances. We hope that our parsimonious framework can provide a starting point for future research in these directions.

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