Department of Economics

Essays on Sovereign Default and the Link with the Domestic Economy

Eugenia Andreasen

Thesis submitted for assessment with a view to obtaining the degree of Doctor of Economics of the European University Institute

Florence
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Part I

Introduction

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This thesis studies the causes and consequences of sovereign defaults focusing on non-traditional links between sovereign default and the domestic economy: the impact of sovereign defaults on the external financial conditions for the private sector; and the ex-ante implications of the redistributive effects of default and repayment on the political support that the government requires to implement either of these decisions.

In the first chapter of my thesis I analyze the worsening of the external financial conditions for the private sector that follows sovereign defaults. To explore the issue I develop a signaling model in which sovereign defaults reveal negative information to foreign lenders regarding the institutional quality in the country. Foreign lenders care about institutional quality because it affects the expected repayment of loans. Therefore, if foreign lenders receive negative information on the institutional quality from the sovereign default they worsen the financial conditions they offer to local firms triggering a sharp reduction in credit and investment ("updating effect"). The model can rationalize the worsened financial conditions in international capital markets for the private sector observed after default episodes.

In the second chapter, a joint work with Guido Sandleris and Alejandro Van der Ghote, we analyze how the presence of political constraints affects sovereign governments' borrowing and default decisions. We do so in a standard DSGE model with endogenous default risk where we introduce two novel features: heterogeneous agents in the domestic private sector and a requirement that the government obtains some of their support to implement the fiscal program needed to repay the debt. In this framework, we demonstrate that sovereign default can also arise due to insufficient political support and we explore the implications of different income distribution, political systems and tax systems over the repayment decision.

Chapter 1: Sovereign Default, Institutions and the External Cost of Capital

Emerging market economies face recurrent and costly sovereign defaults that have pernicious effects on investment, consumption and growth. The ensuing worsening of private firms' external financial conditions (Eichengreen and Moody (2000), Hale and Arteta (2008) and Trebesch (2009, 2010)) presents one key channel through which sovereign default affects economic activity. Since in emerging economies about 25% of corporate bonds and bank credits are external, a worsening of external financial conditions can have pervasive negative consequences in the economy.

What triggers the worsening of financial conditions for the private sector after sovereign defaults? In this paper, I address this question by developing a signaling model in which the sovereign debt repayment decision of the government provides new information to foreign lenders regarding the institutional quality in the country. Foreign lenders care about the institutional quality since institutions affect the expected repayment of loans. Therefore,

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if foreign lenders receive negative information regarding the institutional quality from the sovereign default, they worsen the financial conditions they offer to the entrepreneurs in the country triggering a collapse in credit and investment.

The model can rationalize the worsened financial conditions in international capital markets for the private sector observed after default episodes. The key mechanism is the "updating effect" that the repayment decision generates over the expected institutional quality in the country, which triggers a discrete increase on the private interest rate and a sharp reduction in credit and investment when the government defaults on its sovereign debt. There are two crucial features that combine to generate this effect. The first one is that foreign lenders worsen the financial conditions they offer to the private sector if they receive negative information about the institutional quality. The second feature is that institutional quality affects the repayment decision of the government making the sovereign default informative about the institutional quality.

This set up also allows making interesting predictions regarding the thresholds of sovereign debt sustainability. The analysis of past defaults shows that while some economies seem to be able to manage very high debt-to-GDP ratios (Japan 120%) some other economies have defaulted at ratios of external debt to GDP that would not be considered excessive for the typical advanced economy: for example, Mexico's 1982 debt crisis occurred at a ratio of debt to GDP of 47%, and Argentina's 2001 crisis at a ratio slightly above 50%. Furthermore, over 50% of the sovereign defaults in the period 1970-2000 happened at debt-to-GDP ratios lower than 60%. Therefore it seems, as argued by Reinhart et al. (2003), that "safe" external debt-to-GDP thresholds vary across countries and that there are "clubs" and regions of countries with different levels of vulnerability. In the current framework, I am able to provide a justification to these phenomena.

Chapter 2: The Political Economy of Sovereign Defaults (Joint work with Guido Sandleris and Alejandro Van der Ghote)

In the months prior to the Argentine sovereign default of 2001 and, more recently, during the debt crises in Europe, governments faced tough political battles when they tried to implement the fiscal adjustments required to avoid sovereign default. Greece, for example, has implemented several fiscal austerity packages since 2009. Nevertheless, these adjustments have been insufficient to bridge the budget gap and solve the debt crisis. Furthermore, the austerity packages have been met by growing civil unrest and political opposition that might make further adjustments politically unfeasible.

The presence of political constraints that limit the margin of action of governments during the run-ups to sovereign debt crises seems the rule rather than the exception. However, the

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literature on sovereign default has abstracted from them, assuming that governments have unlimited access to the country's resources. This implies that the default or repayment decision is essentially determined by the government's will. Nevertheless, the real world sovereign default universe is richer than the traditional theoretical depiction of it. In many circumstances, sovereign defaults are not the result of the governments' unwillingness to repay but of the tough political opposition they face when trying to raise the funds necessary to repay the debt.

This paper analyzes how the presence of political constraints affects sovereign governments' borrowing and default decisions. We do this by introducing in a standard dynamic stochastic general equilibrium (DSGE) model with endogenous sovereign default risk two novel features: heterogeneous households and a requirement that the government garners some of their support to repay its sovereign debt.

The introduction of these two novel features in a standard sovereign debt model allows us to understand why individuals might disagree on the funding policy the government should implement in order to repay sovereign debt and how these disagreements can affect the government's repayment capacity.

This framework also generates a richer typology of sovereign default events. In contrast with the standard sovereign debt literature, in this framework, sovereign defaults are not exclusively determined by the government's **unwillingness** to repay. Moreover, two new types of default events arise in our model that capture situations in which the government is **unable** to repay. These events can occur either because the government cannot raise sufficient funds to repay even if it could access all the resources in the economy, or, alternatively, because the fiscal programs that raise sufficient funds are not politically feasible.

We calibrate the model to the Argentine economy and estimate the quantitative consequences of the political constraint. Among other things, we analyze how the default set grows as the political constraint becomes more stringent, how is the bond price schedule affected by this higher default probability and which is the range of debt to GDP for which the political constraint becomes more relevant in determining the default.

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CHAPTER 1

SOVEREIGN DEFAULT, INSTITUTIONS AND THE EXTERNAL COST OF CAPITAL

1.1 Introduction

Emerging market economies face recurrent and costly sovereign defaults that have pernicious effects on investment, consumption and growth.[1] The ensuing tightening of private firms' external financial constraints presents one key channel through which sovereign default affects economic activity. Since in emerging economies about 25 percent of corporate bonds and bank credits are external, a worsening of international credit conditions may have pervasive negative consequences in the economy. In effect, recent empirical studies find a significant and economically relevant worsening of external financial conditions for the private sector after sovereign defaults and a consequent reduction in private credit (Eichengreen and Moody (2000), Arteta and Hale (2008), Trebesch (2010) and Trebesch et al. (2010)). Figure 1, illustrates this effect: after controlling for fundamentals, banking crises and currency crises, Arteta and Hale (2008) find a decline in foreign private credit of over 20 percent below the country-specific average that lasts for over 2 years after the sovereign debt restructuring ("talks" indicates the month during which debt renegotiations started; "deal" indicates the month in which the debt restructuring agreement was reached).[2]

[1] The recent Eurozone crisis has evidenced that developed countries have also become potential victims of sovereign defaults; adding to the relevance of a better understanding of the phenomenon studied in this paper.

[2] Each point on the solid line represents a β-coefficient on the appropriate lead or lag in the regression where the dependent variable is the percentage deviations of the amount borrowed. Dashed lines represent a 95% confidence interval for each β-coefficient. "Prob>F" indicates the P-values for the test of the hypothesis that the sum of the coefficients in the relevant range is different from zero. The picture represents an example of a timeline for the case when the renegotiations take exactly a year.

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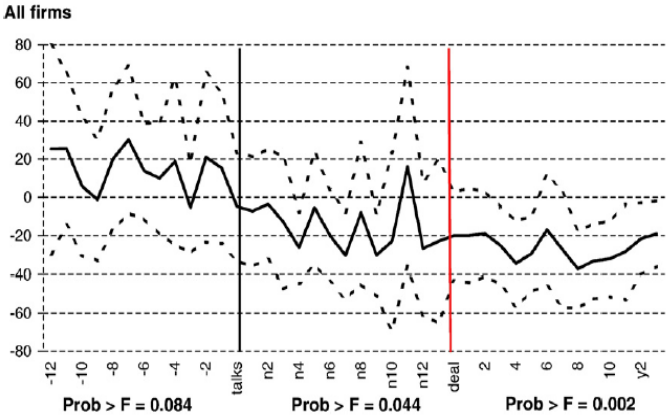

Figure 1: Percentage deviation from country mean of the total amount borrowed by the private sector in external markets as a result of the sovereign default. Source: Arteta and Hale (2008).

What triggers the worsening of external financial conditions for the private sector after sovereign defaults? In this paper, I address this question by developing a signaling model in which the government has private information regarding the institutional quality in the country. In this framework, if the sovereign default reveals negative information to the foreign lenders regarding the institutional quality it triggers a worsening of financial conditions for the private sector and a collapse in credit and investment.

The model developed in this paper considers a small open economy that lasts for two periods. The economy is composed of a benevolent government and a continuum of identical entrepreneurs that have access to foreign credit. In the initial period the government, which has private information regarding the institutional quality, inherits and exogenous amount of sovereign debt and it decides whether to repay it or default. In particular, the government has private information on its willingness to enforce contracts and property rights, which can affect several aspects of what we understand by institutional quality, i.e. enforcement of creditor rights and bankruptcy procedures, and control of corruption and tax evasion. After the government repays or defaults, the entrepreneurs are allowed to borrow in the international financial market. The interest rate of the entrepreneurs' borrowing depends on the new information about the institutional quality revealed by the repayment/default decision of the government. Finally, in the last period, the entrepreneurs decide whether to repay or default on their loans and consume.

The model can rationalize the worsened financial conditions in international capital markets for the private sector observed after default episodes. The key mechanism is the "updating effect" that the repayment decision generates over the expected institutional quality

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in the country, which triggers a discrete increase on the private interest rate and a sharp reduction in credit and investment when the government defaults on its sovereign debt. There are two crucial features that combine to generate this effect. The first one is that foreign lenders worsen the financial conditions they offer to the private sector if they receive negative information about the institutional quality. This happens because the expected repayment of loans to the foreign lenders depends on the institutional quality, in particular, on the enforcement of creditor rights and bankruptcy procedures.[3] The second feature is that institutional quality affects the repayment decision of the government making the sovereign default informative about the institutional quality. This happens through two main channels. Firstly, poor institutional quality negatively affects tax revenues (Murphy et al. (1993) and Shleifer et al. (1993)) making it more difficult for the government to raise the funds needed to repay sovereign debt and therefore increasing the probabilities of default. Secondly, the government's enforcement of its own sovereign debt contracts during a sovereign debt crisis is also revealing of its willingness to enforce private debt contracts (Trebesch (2009, 2010)). Then, if foreign lenders observe a sovereign default they infer that there is a high probability that the institutional quality in the country is low.

Apart from the "updating effect", there is a second effect of the sovereign repayment decision over the private credit market: the "risk-transfer effect". This second effect is an indirect transfer of risk from the sovereign to the private sector that takes place through the taxes that the government needs to levy in order to repay the sovereign debt, which indirectly affect the repayment ability of the private sector. In equilibrium, this second effect generates that the private interest rate grows monotonically with the level of sovereign debt (within each repayment equilibria); with the consequent decline in credit and investment. This effect is also consistent with the empirical evidence that "an increase in the external debt of emerging market governments significantly raises the borrowing costs of the domestic corporate sector" (Celasun and Ağca (2009)) and with the sovereign ceiling literature.

In this framework, governments have incentives to repay their debt in spite of the finite horizon setting and the absence of direct penalties to avoid the negative consequences that sovereign defaults have over the financial conditions faced by the private sector. Nevertheless, higher levels of sovereign debt and lower institutional quality reduce these incentives increasing the risk of sovereign default (Reinhart et al. (2003) and Kraay and Nehru (2006).

In two subsequent extensions of the model I allow for the level of sovereign debt and the institutional quality to be determined endogenously generating a new series of interesting

[3] The quality of institutions is widely recognized as one of the main determinants of the terms and quantity of credit available for and within a country (La Porta et al. (1997), Djankov et al. (2007, 2008), and Alfaro et al. (2007, 2008)).

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results. First, endogenizing the sovereign debt allows to characterize the sovereign interest rate which in equilibrium, and consistent with empirical evidence, is increasing on the level of sovereign debt until a critical threshold where credit rationing occurs. Second, it suggests that the choice of the optimum level of sovereign debt in this context is not trivial since it can be the case that governments that have high preference for private versus public consumption still choose relatively higher levels of sovereign debt. Finally, the solution for the case with endogenous institutions indicates that more impatient governments tend to invest less in institutional quality and to default with a higher probability.

Among the innovations of this paper is the possibility to make interesting predictions regarding the link between the institutional quality and the thresholds of sovereign debt sustainability. The analysis of past defaults shows that while some economies have been able to manage for long periods of time very high debt-to-GDP ratios (Japan (2006): 160 percent, Italy (2011) 120 percent), some other economies have defaulted at ratios of external debt-to-GDP that would not be considered excessive for the typical advanced economy (Mexico (1982): 47 percent, Argentina (2001): 50 percent). Therefore it seems, as argued by Reinhart et al. (2003), that safe external debt-to-GDP thresholds vary across countries and that there are clubs and regions of countries with different levels of vulnerability. In the current framework, I am able to provide a justification for this phenomenon by considering two groups of countries that differ in their average institutional quality. In this case, the results show that countries that belong to "better clubs" are able to sustain higher levels of sovereign debt than countries in the "not so good clubs" due to the stronger signaling effect of the repayment decision.

This paper contributes to the debate on the negative effects of sovereign defaults on the domestic economy, specifically focusing on the private credit channel. Most of the literature that analyzes the effects on the domestic economy concentrates on the negative effect that sovereign defaults have over the balance sheets of domestic agents that hold sovereign debt (Broner and Ventura (2008), Gennaioli et al. (2010), and Guembel and Sussman (2009)). In particular, Gennaioli et al. (2010) analyze how domestic credit is affected by the negative balance sheet effect that sovereign default has on domestic banks that held sovereign bonds. While the relevance of this mechanism to explain the negative effect of sovereign default over domestic credit is very intuitive, it seems unrealistic to assume that negative balance sheet effects can also explain the reduction in foreign credit. Besides, the applicability of this channel is restricted to countries whose financial market has reached a minimum level of development that guarantees that domestic banks do hold significant levels of sovereign bonds.

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In contrast, the model developed in this paper does not need to assume that domestic agents hold sovereign debt. Nevertheless, the domestic economy is still harmed by the default due to the negative information that it reveals to international financial markets. This information story links the paper with the "reputational spillovers" of Cole and Kehoe (1997, 1998), the signaling model of Sandleris (2008, 2010) and with the "default traps" of Catao et al. (2009). In particular, the signaling mechanism I adopt here is closer to the formulations in Sandleris (2008, 2010). However, there are significant differences that make my paper applicable to a wider set of sovereign default cases and also more thorough on its account of the phenomenon under study. Firstly, in my paper I can explain the effect over both the private interest rate and the levels of credit while the work of Sandleris is silent about the price effect and only focuses on the credit rationing. Secondly, the mechanism at work in my paper captures not only the effect of sovereign default over private interest rates ("updating effect") but also the negative effect over private credit of higher levels of sovereign debt over ("risk transfer effect") which is absent in Sandleris (2008). Finally, the fact that the transmission in the work of Sandleris depends on the economy being credit constrained limits the applicability of his papers to developing economies making it irrelevant to explain the negative effect over private credit of the recent sovereign debt crises in the Euro zone.

The remainder of the paper is organized as follows: Section 2 presents the environment and describes the model; Section 3 characterizes the possible equilibria and discusses the main results; Section 4 explores the implications of the model in terms of sovereign debt sustainability and endogenizes both the level of sovereign debt and the institutional quality; and Section 5 concludes.

1.2 Environment

Consider a small open economy that lasts for two periods, $t = 0, 1$. The economy is composed of a government and a continuum of entrepreneurs that have access to the international financial market, which is composed of a continuum of identical foreign lenders.

The government is benevolent and inherits and exogenous amount of sovereign debt S_0. In line with most of the sovereign debt literature, S_0 is neither collateralized nor subject to external enforcement. As a result, in the event of sovereign default, the foreign lenders do not recover anything. Besides, the government has private information regarding its willingness to enforce contracts, i.e. the institutional quality in the country, θ_i with $i = \{G, B\}$ and $\theta_G > \theta_B$, (the institutional quality is in Section 4.3).

At the beginning of $t = 0$, the government must decide whether to repay or default on its sovereign debt, $z_0 = \{0\ (default),\ 1\ (repayment)\}$. If the government chooses to

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repay, it can exercise its taxation power over the entrepreneurs' assets. Nevertheless, the government's ability to collect revenues is affected by the institutional quality in the country, θ_i, which determines the level of corruption and tax evasion in the economy. This feature is incorporated in the model by assuming that for each dollar of tax revenue, a proportion $(1-\theta_i)$ gets lost or stolen. Then, for each dollar of financing needs, the government must collect $\frac{1}{\theta_i}$ dollars in tax revenues from the entrepreneurs.

The representative entrepreneur is risk neutral. He values private consumption, C, in $t=1$, and his preferences are given by:

$$U = C_1.$$

The representative entrepreneur owns a risky productive technology that allows him to get $A(s)I_0^{\alpha}$ units of consumption in $t=1$ by investing I_0 units of capital in $t=0$. $A(s)$, with $s=l,\ h$, is an idiosyncratic shock realized at the beginning of $t=1$ that takes the value $A(h)=A>0$ with probability $p(h)=p$, and $A(l)=0$, with probability $p(l)=1-p$. Capital can be converted into consumption goods at a one-to-one rate but it depreciates at the rate $(1-\delta)$, with $\delta>0$, from period to period. α, $p(s)$ and $A(s)$ are public information.

At $t=0$, the entrepreneur receives an endowment e_0, which he can use to invest in the risky technology and to pay taxes. Additionally, at $t=0$ the entrepreneur gains access to the financial markets and can thus borrow an amount D_0 from the foreign lenders at the interest rate R_{E0}. The financial contract available to the entrepreneur is collateralized by his assets. Nevertheless, if the entrepreneur defaults the enforcement of the creditor rights and the bankruptcy procedures depends on the institutional quality in the country. This means that in the event of a default, only a share θ_i of the entrepreneur's assets can be seized by the foreign lenders and the rest is lost. [4]

Foreign lenders face perfect competition and are risk-neutral. Therefore, the representative foreign lender is willing to lend any amount of money to the entrepreneurs as long as he breaks even and recovers, in expected terms, the opportunity cost of his funds in the international market, which is equal to R_W.

Foreign lenders are restricted by the information they observe. In terms of the parameters of the economy, they observe everything except from the institutional quality but they know the parameters that determine its probability distribution: $\{\theta_G, \theta_B\}$ and $\pi(\theta_G) \in (0,1)$,

[4] The fact that I use only one parameter to represent different aspects of insitutitional quality is only due to notational convenience. In terms of the model I only need to assume that the different aspects of institutional quality in the country are positively correlated. The empirical evidence supports this. Institutional quality tends to be homogeneous within an economy: countries with good creditor rights also have, for example, low levels of corruption and efficient tax systems. In effect, there is a very high correlation between the different aspects of institutional quality. For instance the correlation across the aspects of institutional quality reflected on the different indicators of the International Country Risk Guide are all above 0.75.

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which is the probability that $\theta_i = \theta_G$. In terms of the actions, foreign lenders can observe the actions of the government since it is a big player on the market but they cannot observe the actions of the anonymous and atomistic entrepreneurs. In order to compensate for the informational restrictions, foreign lenders use all their knowledge about the economy and any kind of inference that they can make from the behavior of the local agents to determine the interest rate, R_{E0}, that maximizes their profits.

1.2.1 Timing

The timing of events in this economy is as follows. At $t = 0$ the entrepreneurs receive their endowments, e_0, and the government, who has private information regarding the institutional quality in the country, θ_i, receives the exogenous amount of sovereign debt, S_0. Given its private information, the government decides whether to repay or default on the sovereign debt, z_0, and set the level of taxes, T_0. After observing the repayment/default decision of the government, the foreign lenders determine the interest rate at which they are willing to lend to the entrepreneurs, R_{E0}. Given R_{E0}, the entrepreneurs decide how much they want to invest, I_0, and borrow, D_0. In the last period, $t = 1$, the entrepreneurs decide to repay or default on their private loans and consume whatever resources they have left. Figure 3 below shows the timing in a more schematic way.

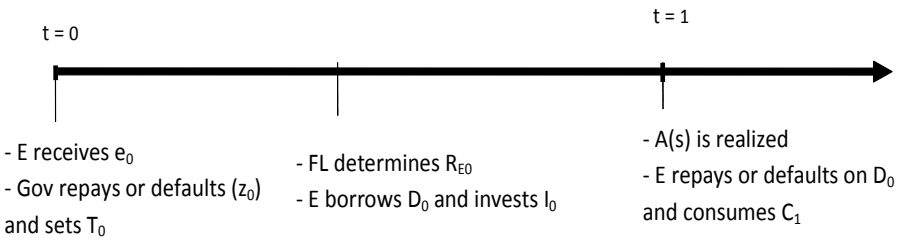

Figure 3: Timing of main events in the economy

Where: Gov = Government; E = Entrepreneurs; FL = Foreign Lenders

1.3 Equilibrium

Given the timing of events in the economy, the equilibrium needs to be solved by backward induction. First, I solve the problem of the representative entrepreneur since he is the last agent to make decisions in the economy: given the interest rate, he chooses how much to invest and borrow and whether to repay or default on his debt. Second, I solve the problem

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of the foreign lenders that, after observing the government's repayment decision, decide on the interest rate at which they lend to the entrepreneurs. Finally, I solve the problem of the government that chooses whether to repay or default on the sovereign debt. After solving all these maximizations, I define the equilibrium for this economy and characterize it for all the possible values of sovereign debt.

The representative entrepreneur maximizes his expected consumption by deciding how much to invest and borrow at $t = 0$ and whether to repay or default on his debt at $t = 1$. Then the entrepreneur's optimization problem for a given R_{E0} is:

$$\max_{I_0, D_0} E_0 \left[C_1(s) \right]$$

subject to

$$t = 0 : I_0 = e_0 - T_0 + D_0, \text{ and} \tag{1.1}$$

$$t = 1 : C_1(s) = \max \left\{ A(s) I_0^{\alpha} + \delta I_0 - D_0 R_{E0}, 0 \right\}. \tag{1.2}$$

Since the representative entrepreneur cannot hide resources and all his assets are liquidated if he defaults, he always prefers to repay his debt as long as it is feasible. Furthermore, the entrepreneur would never choose a level of debt so high that it would force him to default in all states, s, since this would imply zero consumption, an alternative that is inferior to just not contracting any debt at all. Nevertheless, depending on the value of the parameters, the entrepreneur can prefer one of two possible situations:

i) $\{I_0, D_0\}$ are set such that the entrepreneur has enough resources to repay independently of s. In this case the entrepreneur's expected consumption and optimum level of investment are given by:

$$t = 1 : E_0 \left[C_1(s) \right] = p A I_0^{\alpha}(R_{E0}) + \delta I_0(R_{E0}) - R_{E0} D_0 \tag{1.3}$$

$$I_0(R_{E0}) = \min \left\{ \left[\frac{pA\alpha}{R_{E0} - \delta} \right]^{\frac{1}{1-\alpha}}, \frac{R_{E0}}{R_{E0} - \delta} \left(e_0 - T_0 \right) \right\}; \tag{1.4}$$

where the second element follows from the feasibility constraint when $s = l$.

ii) $\{I_0, D_0\}$ are set such that the entrepreneur can only repay if $s = h$. In this case, the entrepreneur's expected consumption and optimum level of investment are given by:

$$t = 1 : E_0 \left[C_1(s) \right] = p \left[A I_0^{\alpha}(R_{E0}) + \delta I_0(R_{E0}) - R_{E0} D_0 \right] \tag{1.5}$$

$$I_0(R_{E0}) = \left[\frac{A\alpha}{R_{E0} - \delta} \right]^{\frac{1}{1-\alpha}}. \tag{1.6}$$

In order to focus only in the case where private lending is risky, from now on I assume: A1: $A > \frac{(R_W - p\delta)^{\alpha}}{p^2 \alpha} \left(R_W e_0 \right)^{1-\alpha}$. Intuitively, this assumption implies that the returns of the

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investment are so high that the representative entrepreneur prefers to borrow a lot even if this implies the risk of having zero consumption when the bad shock is realized.

The next problem that needs to be analyzed is the decision of the foreign lenders, at $t = 0$, over the interest rate at which they are going to lend to the entrepreneurs, R_{E0}. Since foreign lenders face perfect competition, in equilibrium, R_{E0} must be such that the foreign lenders break even by recovering in expected terms their opportunity cost R_W.

Given the assumption over the productivity parameter A, the foreign lenders know that entrepreneurs only repay their debts if they receive the good productivity shock and default otherwise. In this last case, the assets of the entrepreneurs, which are equal to their depreciated capital, are liquidated and distributed equally among his creditors. Then, from each dollar lent to the entrepreneurs the foreign lenders recover $\frac{\theta_i * \delta I_0(R_{E0})}{D_0(R_{E0})}$. Nevertheless, since the foreign lenders cannot observe neither $I_0(R_{E0})$ nor $\frac{\theta_i}{D_0(R_{E0})}$, they try to infer them indirectly. In the case of $I_0(R_{E0})$, since they know all the relevant parameters that determine investment they can calculate it from (1.6) by anticipating the entrepreneurs' behavior.

On the other hand, further inspection of $\frac{\theta_i}{D_0(R_{E0})}$ shows that it depends on the unobservable θ_i not only directly but also indirectly. The indirect dependence is a result of T_0, one of the determinants of $D_0(R_{E0})$, being a function of the institutional quality, as it will be shown in the analysis of the government's problem. From now on, I write $D_0(R_{E0}, \theta_i)$ to make this dependence explicit. Then, to make any inference about $\frac{\theta_i}{D_0(R_{E0},\theta_i)}$ the foreign lenders need some beliefs regarding the unobservable θ_i. Their initial unconditional beliefs are given by the probability of the country of having the good institutional quality: $\pi(\theta_G)$. However, after observing z_0, foreign lenders update these beliefs. In equilibrium, the inference process is governed by a belief pattern, $\pi(\theta_G/z_0)$, that specifies the updated probability that the foreign lenders assign to the institutional quality of being good for a given value of z_0 observed. Using $\pi(\theta_G/z_0)$ foreign lenders calculate their conditional expectation on the recovery rate per dollar of depreciated capital in the following way:

$$E_0\left[\frac{\theta_i}{D_0(R_{E0},\theta_i)}/z_0\right] = \pi(\theta_G/z_0)\frac{\theta_G}{D_0(R_{E0},\theta_G)} + (1-\pi(\theta_G/z_0))\frac{\theta_B}{D_0(R_{E0},\theta_B)}. \tag{1.7}$$

Given (1.7), the interest rate, R_{E0}, that allows the foreign lenders to break even in expected terms is such that:

$$R_W = pR_{E0} + (1-p)\delta I_0(R_{E0}) E_0\left[\frac{\theta_i}{D_0(R_{E0},\theta_i)}/z_0\right]. \tag{1.8}$$

which cannot be solved for R_{E0} because investment depends non-linearly on the interest rate. Nevertheless, by totally differentiating (1.8), it becomes evident that a higher updated belief that the institutional quality is good, $\pi(\theta_G/z_0)$, reduces the interest rate the foreign

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lenders charge to the entrepreneurs. Then, it is possible to see that the equilibrium private interest rate is a function of the updated beliefs: i.e. $R^*_{E0}(\pi(\theta_G/z_0))$, which implies that also the level of investment and the credit demand in equilibrium are a function of $\pi(\theta_G/z_0)$, i.e. $I_0(R^*_{E0}(\pi(\theta_G/z_0))) = I^*_0(\pi(\theta_G/z_0))$ and $D_0(R^*_{E0}(\pi(\theta_G/z_0)), \theta_i) = D^*_0(\pi(\theta_G/z_0), \theta_i)$.

In order to be able to characterize further the private interest rate it is necessary to have more information on the behavior of $\pi(\theta_G/z_0)$ which depends on the repayment/default decision of the government in equilibrium. Then, in the next paragraphs I analyze the government's repayment decision at $t = 0$ and in the next section I characterize the equilibrium value of $\pi(\theta_G/z_0)$ for each possible level of S_0. The objective of the government at $t = 0$ is to maximize the welfare of the entrepreneurs by deciding whether to repay or default on the sovereign debt:

$$\max_{z_0(\theta_i), T_0(\theta_i)} E_0 [W] = E_0 [C_1(s, \theta_i)],$$

subject to

$$t = 0 : T_0(\theta_i) = \tfrac{z_0(\theta_i) S_0}{\theta_i}, \tag{1.9}$$

$$z_0 S_0 \leq e_0 \theta_i, \text{ and} \tag{1.10}$$

$$t = 1 : E_0 [C_1(s, \theta_i)] = p [A I_0^{*\alpha}(.)) + \delta I^*_0(.)) - R^*_{E0}(.) D^*_0(R_{E0}(.), \theta_i)]. \tag{1.11}$$

The optimum repayment decision, $z_0(\theta_i)$, depends on the comparison of the costs and benefits of repaying versus defaulting taking the belief pattern of the foreign lenders as given. Repayment is costly because taxes absorb resources that the entrepreneurs could use for investment. Besides, marginal repayment costs are higher the lower the institutional quality since this implies that the tax burden on the entrepreneurs needs to be higher for each dollar of sovereign debt. The different marginal costs generate the single crossing property in the model. Additionally, lower institutional quality implies that the feasibility constraint (1.10) binds for lower levels of sovereign debt, forcing the government to default at levels of indebtedness that would be sustainable with better institutional quality. In terms of the benefits, if in equilibrium the observed repayment decision, z_0, has an effect over the welfare of the entrepreneurs, then the government might have incentives to repay. The channel through which sovereign repayment can affect the welfare of the entrepreneurs is the belief of the foreign lenders about the institutional quality. As previously argued better beliefs imply a lower private interest rate, $R^*_{E0}(\pi(\theta_G/z_0)$ and, consequently, higher investment and consumption for the entrepreneurs. The specific effect of z_0 on $R^*_{E0}(\pi(\theta_G/z_0))$ in equilibrium is discussed in the next section for each possible level of S_0.

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The trade-off between the costs and benefits of sovereign repayment is reflected in the following incentive compatibility constraint; the government prefers to repay as long as:

$$E_0\left[C_1(s,\theta_i)/z_0(\theta_i)=0\right] \leq E_0\left[C_1(s,\theta_i)/z_0(\theta_i)=1\right]. \tag{1.12}$$

Replacing the equilibrium levels of investment and interest rate under repayment and default in (1.12), and rearranging we see that the incentive compatibility constraint holds for levels of S_0 lower than:

$$\frac{\theta_i\left[A(1-\alpha)\left[I_0^{*\alpha}(\pi(\theta_G/1))-I_0^{*\alpha}(\pi(\theta_G/0))\right]+e_0\left(R_{E0}^*(\pi(\theta_G/1))-R_{E0}^*(\pi(\theta_G/0))\right)\right]}{R_{E0}^*(\pi\left(\theta_G/1\right))}. \tag{1.13}$$

The expression between brackets in (1.13) represents the net benefits from sovereign repayment as a function of the updated beliefs $\pi\left(\theta_G/z_0\right)$. For future notational convenience I use $\triangle\left(\pi\left(\theta_G/1\right),\pi\left(\theta_G/0\right)\right)$ to refer to this expression. Combining (1.13) with the feasibility constraint, (1.10), gives us the following necessary and sufficient condition for government repayment:

$$S_0 \leq \min\left\{e_0\theta_i, \tfrac{\theta_i}{R_{E0}^*(\pi(\theta_G/1))}\triangle\left(\pi\left(\theta_G/1\right),\pi\left(\theta_G/0\right)\right)\right\}. \tag{1.14}$$

The government repays as long as the level of sovereign debt is below the two debt thresholds specified. From this condition it becomes evident that the government's repayment decision changes with S_0 as higher levels of sovereign debt, by increasing the costs and reducing the net benefits of repayment, make it harder for this condition to hold. Additionally, since the two elements on the RHS of (1.14) depend on the institutional quality, the decision of the government varies with θ_i providing the signaling value to the sovereign default.

Now that the problem for each of the agents has been analyzed, it is possible to define the equilibrium for this economy.

Given the level of sovereign debt, S_0, a Perfect Bayesian Equilibrium (PBE) in pure strategies for this economy is:

- a strategy profile: $\{z_0(\theta_i), T_0(\theta_i), D_0(\pi(\theta_G/z_0),\theta_i), I_0(\pi(\theta_G/z_0)), R_{E0}(\pi(\theta_G/z_0))\}^*$;

- and a belief pattern $\pi(\theta_G/z_0)$; *such that:*

i) $(D_0(\pi(\theta_G/z_0),\theta_i), I_0(\pi(\theta_G/z_0)))^*$ *is a solution to the problem of the entrepreneurs given* $R_{E0}^*(\pi(\theta_G/z_0))$.

ii) $(z_0(\theta_i), T_0(\theta_i))^*$ *is a solution to the problem of the government given* θ_i *and* $R_{E0}^*(\pi(\theta_G/z_0))$.

iii) $R_{E0}^*(\pi(\theta_G/z_0))$ *satisfies in expected terms the zero profit condition of the foreign lenders given* $\pi(\theta_G/z_0)$ and $(z_0(\theta_i), T_0(\theta_i)D_0(\pi(\theta_G/z_0),\theta_i), I_0(\pi(\theta_G/z_0)))^*$.

iv) In equilibrium, beliefs, $\pi(\theta_G/z_0)$, *are updated with Bayes rule, while out of equilibrium they are specified following the intuitive criterion.*

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1.3.1 Characterization of Equilibrium

The previous definition of *PBE* allows for two types of equilibria depending on the information revealed by the repayment decision of the government, z_0: pooling and separating. Within the pooling equilibria the government always behaves in the same way independently of the institutional quality in the country. Therefore the foreign lenders cannot make any inference on the institutional quality, θ_i, from observing the equilibrium repayment decision. There are two possible types of pooling equilibria in this setting, either the government always repays or it always defaults. In contrast, within the separating equilibria, the repayment decision of the government changes depending on its institutional quality allowing the foreign lenders to learn the value of θ_i from the observed z_0. There are also two possible types of separating equilibria in this setting, either the government repays when the institutional quality in the country is good and defaults otherwise, or vice versa. Only the first type constitutes an equilibrium in this economy.

For existence of equilibrium over the whole range of parameter values, I also need to allow for mixed strategies over the repayment decision in the previous definition of PBE. Within the mixed strategies equilibria the government has different repayment probabilities, $0 \leq \sigma(\theta_i) \leq 1$, depending on the institutional quality. This allows the foreign lenders to obtain partial or full information about θ_i from the observed z_0. In principle, there are many types of mixed strategies equilibria, but only one arises in this economy and only for certain combinations of parameters. In this specific mixed strategies equilibrium the government repays with certainty when the institutional quality is good while it only repays with a probability, $\sigma(\theta_B)$, smaller than one when the institutional quality is bad.

In the next proposition, I characterize the type of equilibrium that arises for each possible value of sovereign debt, S_0.

Proposition 1.1 *Let's define:*
$\overline{S}^P = \min\left\{e_0\theta_B, \frac{\theta_B \triangle(\pi(\theta_G),0)}{R^*_{E0}(\pi(\theta_G))}\right\}$; $\underline{S}^S = \min\left\{e_0\theta_B, \frac{\theta_B \triangle(1,0)}{R^*_{E0}(1)}\right\}$; *and* $\overline{S}^S = \min\left\{e_0\theta_G, \frac{\theta_G \triangle(1,0)}{R^*_{E0}(1)}\right\}$.
Then, for values of S_0 *such that:*
i) $S_0 \in \left[0, \overline{S}^P\right]$; *there exists a first type of pooling equilibrium in which the government always repays*;
ii) $S_0 \in \left(\overline{S}^P, \underline{S}^S\right)$; *there exists a mixed strategies equilibrium in which the government repays with certainty when the institutional quality is high while it only repays with a probability* $\sigma(\theta_B) < 1$ *when the institutional quality is low. This interval exists for values of* $e_0 > \overline{e_0} = \frac{A(1-\alpha)\left[I_0^{*\alpha}(\pi(\theta_G/1)) - I_0^{*\alpha}(\pi(\theta_G/0))\right]}{R^*_{E0}(\pi(\theta_G/0))}$.
iii) $S_0 \in \left(\underline{S}^S, \overline{S}^S\right]$; *there exists a separating equilibrium where the government only*

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repays if the institutional quality is good and defaults otherwise;

iv) $S_0 > \overline{S}^S$; *there exists a second type of pooling equilibrium in which the government always defaults.*

Since $0 < \overline{S}^P \leq \underline{S}^S < \overline{S}^S$, *the pooling and the separating equilibria always exist and do not overlap while the mixed strategies equilibrium only arises if* $e_0 > \overline{e_0}$.

In all these equilibria: $R_W = pR^*_{E0}(\pi(\theta_G/z_0)) + (1-p)\delta I^*_0(\pi(\theta_G/z_0))E_0\left[\frac{\theta_i}{D^*_0(\pi(\theta_G/z_0),\theta_i)}/z_0\right]$.

Proof. *See Appendix A.* ■

1.3.1.1 Sovereign Repayment and Interest Rates

What triggers the worsening of external financial conditions for the private sector after sovereign defaults? In this framework, the new negative information revealed by the sovereign default triggers an increase in external private interest rates ("updating effect"), which translates into a sharp reduction in credit and investment. Therefore, the signaling mechanism about the institutional quality provides an explanation for the worsening of external financial conditions to the private sector after default episodes. In particular, the level of information revelation increases with the level of sovereign debt in the interval $\left[0, \underline{S}^S\right]$.

In this section, I illustrate the equilibrium properties of the government's repayment decision, and the private interest rates that emerge from the equilibrium characterization. As stated in the previous proposition, when $e_0 > \overline{e_0}$ the interval in point (ii) is non-empty and for values of $S_0 \in \left(\overline{S}^P, \underline{S}^S\right)$ there is a mixed strategies equilibrium. Therefore, in the analysis of the equilibrium I consider both the cases when $e_0 > \overline{e_0}$ and when $e_0 \leq \overline{e_0}$,

I begin by analyzing the government's repayment decision as a function of S_0. Starting from very low levels of S_0, i.e. $S_0 \leq \overline{S}^P$, the government always prefers to repay its sovereign debt and has the necessary resources to do it. Nevertheless, as S_0 becomes larger repayment costs increase and these increments depend on the institutional quality. Eventually, as S_0 crosses some critical thresholds, repayment becomes too costly either in terms of incentives or resources and the government changes its optimal decision to default. When the institutional quality in the country is poor, this change happens at $\underline{S}^S$ if $e_0 \leq \overline{e_0}$, or more gradually throughout $\left(\overline{S}^P, \underline{S}^S\right)$ if $e_0 > \overline{e_0}$. When the institutional quality is good the change only happens at $\overline{S}^S$, the upper limit of the separating equilibrium. The ex-post result of the repayment behavior of the government is an increasing level of information revelation to the foreign lenders in the interval $\left[0, \underline{S}^S\right]$. Figures 4 and 5 present the behavior of the government as a function of S_0.

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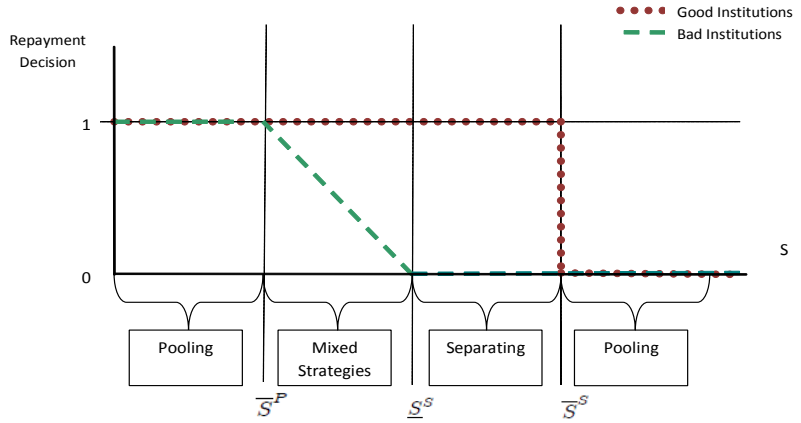

Figure 4: Repayment decision as a function of sovereign debt when $e_0 > \overline{e_0}$

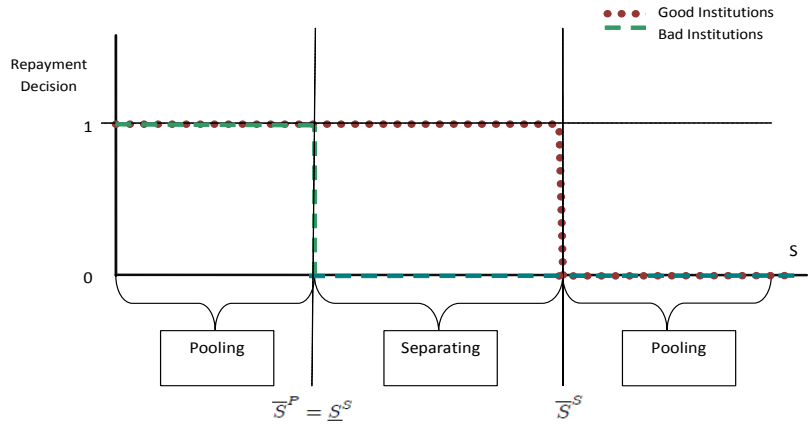

Figure 5: Repayment decision as a function of sovereign debt when $e_0 \leq \overline{e_0}$

The repayment behavior of the government affects private interest rates through two effects an "updating effect" and a "risk-transfer effect". The key effect is the "updating effect" which depends on the information released by the repayment decision of the government. This information is used by the foreign lenders to "update" their perception over the institutional quality in the country. If the new information is negative, as it happens after a sovereign default, it triggers a discrete increase on private the interest rate and a sharp reduction in credit and investment. Thus the "updating effect" rationalizes the worsening of the financial conditions for the private sector in international capital markets observed after sovereign defaults.

There are two crucial features that combine to generate this effect. The first one is that foreign lenders worsen the financial conditions they offer to the private sector if they receive negative information about the institutional quality. This happens because the expected repayment of loans to the foreign lenders depends on the institutional quality, in particular,

on the enforcement of creditor rights and bankruptcy procedures.[5] The second feature is that institutional quality affects the repayment decision of the government making the sovereign default informative about the institutional quality. This happens through two main channels. Firstly, poor institutional quality negatively affects tax revenues (Murphy et al. (1993) and Shleifer et al. (1993)) making it more difficult for the government to raise the funds needed to repay sovereign debt and therefore increasing the probabilities of default. Secondly, the government's enforcement of its own sovereign debt contracts during a sovereign debt crisis is also revealing of its willingness to enforce private debt contracts (Trebesch (2009, 2010)). Then, if foreign lenders observe a sovereign default they infer that there is a high probability that the institutional quality in the country is low.

There is also a second effect that affects interest rates, credit and investment: the "risk-transfer effect". This second effect is an indirect transfer of risk from the sovereign to the private sector that takes place through the taxes that the government needs to levy in order to repay the sovereign debt, which indirectly increases the leverage and reduces the repayment ability of the entrepreneurs when they receive the negative shock. In equilibrium, this second effect generates that the private interest rate grows monotonically with the level of sovereign debt (within each repayment equilibria); with the consequent decline in credit and investment. This effect is also consistent with the empirical evidence that "an increase in the external debt of emerging market governments significantly raises the borrowing costs of the domestic corporate sector" (Celasun and Ağca (2009)) and with the sovereign ceiling literature.

Figure 6 illustrates the private interest rate as a function of sovereign debt for each type of institutional quality for the case of $e_0 > \overline{e_0}$, I omit the other case since the only difference is that the mixed strategies interval disappears. Within the pooling equilibrium there is no information revelation from the sovereign repayment and $R^*_{E0}(\pi(\theta_G))$ is the same independently of the institutional quality. Nevertheless, $R^*_{E0}(\pi(\theta_G))$ is increasing in S_0 due to the "risk-transfer effect". In contrast with the pooling equilibrium, in the separating equilibrium the institutional quality is fully revealed and the interest rate charged to the private sector differs depending on the country's institutional quality as credit is perfectly priced ("updating effect"). The interest rate in the repaying country increases with S_0 throughout the interval for the same reasons explained in the first type of pooling. Finally, the case with mixed strategies reveals partial information under repayment and full information under default. In terms of the interest rates this means that the interest rate after default is the

[5] The quality of institutions is widely recognized as one of the main determinants of the terms and quantity of credit available for and within a country (La Porta et al. (1997), Djankov et al. (2007, 2008), and Alfaro et al. (2007, 2008)).

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same as the default interest rate in the separating equilibrium, while the interest rate after repayment decreases with the level of sovereign debt and lies between the lowest interest rate of the separating case and the highest interest rate after repayment of the pooling case. The decreasing pattern of the interest rate under the mixed strategies equilibrium is a consequence of the "updating effect" being stronger than the "risk-transfer effect" throughout the interval.

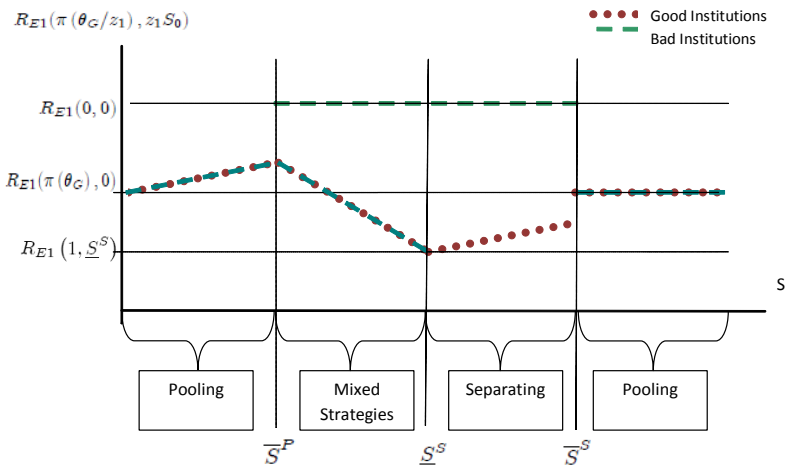

Figure 6: Private interest rates as a function of sovereign debt when $e_0 > \overline{e_0}$

As it is possible to observe from Figure 6, independently of the level of information revelation, for all possible equilibria: $R^*_{E0}(\pi(\theta_G/1)) \leq R^*_{E0}(\pi(\theta_G/0))$. Combining this result with the optimum levels of investment and credit chosen by the entrepreneurs, it is possible to see that higher interest rates charged by the foreign lenders imply lower investment and credit in the domestic economy: $\frac{\partial I^*_0(R^*_{E0}(\pi(\theta_G/z_0)))}{\partial R^*_{E0}(\pi(\theta_G/z_0))} < 0$ and $\frac{\partial D^*_{0i}(R^*_{E0}(\pi(\theta_G/z_0)),\theta_i)}{\partial R^*_{E0}(\pi(\theta_G/z_0))} < 0$ creating a link between the default/repayment decision of the government and the real economy. These effects provide incentives for sovereign debt repayment even in this finite horizon setting.

1.4 Discussion

In this section, I first explore the implication of the model in terms of sovereign debt sustainability for groups of countries that differ in the parameters that determine the distribution of institutional quality and then I discuss how to enrich the model by endogenizing the level of sovereign debt and the institutional quality.

1.4.1 Sovereign Debt Sustainability

The analysis of past defaults shows that while some economies have been able to manage for long periods of time very high debt-to-GDP ratios, at least until very recently, (for instance, Japan's debt-to-GDP ratio was 160 percent, in 2006, while Italy's reached 120 percent in 2011) some other economies have defaulted at ratios of external debt-to-GDP that would not be considered excessive for the typical advanced economy. For example, Mexico's 1982 debt crisis occurred at a ratio of debt-to-GDP of 47 percent, and Argentina's 2001 crisis at a ratio slightly above 50 percent. Furthermore, over 50 percent of the sovereign defaults in the period 1970-2000 happened at debt-to-GDP ratios lower than 60 percent. Therefore it seems, as argued by Reinhart et al. (2003), that safe external debt-to-GDP thresholds vary across countries and that there are clubs and regions of countries with different levels of vulnerability. The differences in vulnerability are also reflected in the "extreme duress many emerging markets experience at debt levels that would seem manageable by advanced standards" a concept that Reinhart et al. (2003) call "debt intolerance".

The simple structure of the model makes it easy to do interesting predictions regarding these phenomena. Within the context of the model it is straightforward to interpret the sovereign debt boundaries of each equilibria as thresholds that determine the sustainability or "safety" of sovereign debt: while within the pooling equilibrium sovereign debt is fully sustainable and always repaid, as we move towards the mixed strategies and separating equilibria, sovereign debt sustainability decreases as default probabilities increase. In the present section, I analyze the consequences over these thresholds of assuming that countries belong to separate groups that differ in their average institutional quality. The objective of this modification is to capture the fact that foreign lenders are usually able to classify countries in some general frame; for instance wether it is an emerging or developed country or whether the country belongs to Europe, Latin America, etc., but apart from these major classifications it can be difficult for foreign lenders to compare Chile with Brazil or Greece with Portugal.

Let's consider two countries x and y that belong to two different groups X and Y . The groups of countries only differ in their average institutional quality with $\overline{\theta}^X > \overline{\theta}^Y$, but given this average, the dispersion of the institutional quality of the countries within each group is the same, i.e. $\theta_B^X - \theta_G^X = \theta_B^Y - \theta_G^Y$. As it was the case before, foreign lenders do not know whether x and y have good or bad institutions but they know the distribution of the institutional quality within each group and the group that each country belongs to. Even though the results with this modification are in many respects analogous to the ones obtained before, there are significant differences in terms of the debt sustainability thresholds

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of each country.

Proposition 1.2 *For all three types of equilibria (pooling, mixed strategies and separating), the debt thresholds of country x are higher than the ones for country y, implying that countries that belong or are believed to belong to better groups in terms of the institutional quality are able to sustain higher levels of sovereign debt.*

This result is mostly due to the stronger signaling effect that the repayment/default decision has for the country within the better group. To prove Proposition 2, I rewrite the institutional quality within group X as an improvement of size ω over the institutional quality of group Y, i.e. $\theta_B^X = \theta_B^Y + \omega$, and evaluate the change over the limits of the equilibria as we increase this improvement. From this rewriting it is straightforward to see that for the cases where the feasibility constraints determine the limits of the equilibria, i.e. $\overline{S}^P = e_0\theta_B$, $\underline{S}^S = e_0\theta_B$ and $\overline{S}^S = e_0\theta_G$, the sustainability limits are always higher for the countries in the group with average of institutional quality. For the cases when it is the incentive compatibility constraints the ones determining the limits of the equilibria, i.e. $\overline{S}^P = \frac{\theta_B \triangle(\pi(\theta_G),0)}{R^*_{E0}(\pi(\theta_G))}$, $\underline{S}^S = \frac{\theta_B \triangle(1,0)}{R^*_{E0}(1)}$ and $\overline{S}^S = \frac{\theta_G \triangle(1,0)}{R^*_{E0}(1)}$, the derivatives of these limits with respect to ω also increase with the average institutional quality (the detailed steps to prove this last statement are shown in Appendix B).

1.4.2 Optimum Level of Sovereign Debt

In this section I endogenize the sovereign debt with the objective of learning which are the implications of the model both in terms of the optimum level of public good consumption and in terms of the characterization of the sovereign interest rate. In order to allow for the sovereign debt to be endogenous I modify the benchmark case in three main ways. First of all, I incorporate an additional period in the beginning of the model when the decision over the optimum level of sovereign debt is made. Then, I include a positive valuation for public good consumption on the preferences of the entrepreneurs so as to motivate public borrowing. Finally, I specify in the timing that the government learns its type after it has decided on the level of sovereign debt, this simplifies the characterization of the equilibrium since it rules out the possibility that the government would signal its type through the choice over the level of sovereign debt.[6] The new timing is represented in Figure 7 below.

[6] Nevertheless, this last assumption is not necessary, if the government knew from the beginning its type it would still choose not to signal it through the choice of the level of sovereign debt since by doing it sovereign lending would collapse to zero.

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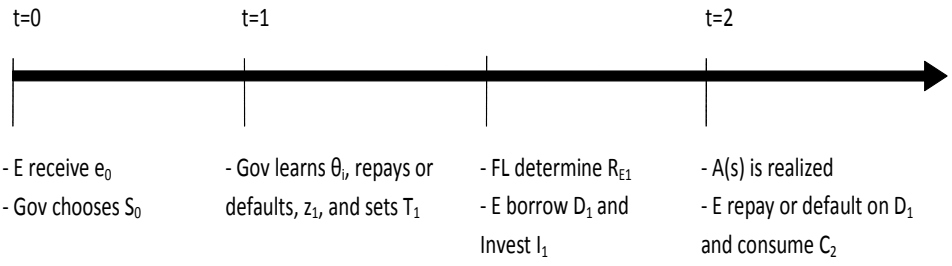

Figure 7: Timing of main events in the economy (with endogenous sovereign debt)

The solution for the benchmark case determines the equilibrium continuation values implied by each level of sovereign debt from $t = 1$ onwards: $\{z_1(\theta_i), T_1(\theta_i), R_{E1}(\pi(\theta_G/z_0)),\ D_1(\pi(\theta_G/z_1)), I_1$ where I have modified the time indexes to take into account the new period. Then, to endogenize the level of sovereign debt it is only necessary to analyze the new problem of the government at $t = 0$ taking into account these continuation values:

$$\max_{S_0} E_0 [W] = v(G_1) + E_0 [C_2(s, \theta_i)],$$

subject to

$$t = 0 : G_1 = \frac{S_0}{R^*_{S0}(S_0)}, \tag{1.15}$$

$$t = 1 : T_1^*(\theta_i) = \tfrac{z_1^*(\theta_i) S_0}{\theta_i}, \text{ and} \tag{1.16}$$

$$t = 2 : E_0 [C_2(s, \theta_i)] = \pi(\theta_G) E_1 [C_2^*(s, \theta_G)] + (1 - \pi(\theta_G)) E_1 [C_2^*(s, \theta_B)]. \tag{1.17}$$

Since the government only receives information about the institutional quality after choosing the level of sovereign debt, the government must maximize the consumption of the entrepreneurs taking expectations over the institutional quality. The most plausible scenario to motivate this timing is to interpret θ_i as a choice of variable of the government that is chosen after the level of sovereign debt has been determined. In the next section, I thoroughly explore this last alternative. In particular, I endogenize θ_i by allowing the government to make (unobservable) investments in the institutional quality. The results from including this extension are completely analogous to the ones from the simpler case where θ_i is exogenous.

The problem of the representative entrepreneur can be generalized by allowing him to borrow, invest and consume in both periods without affecting the main results. Nevertheless, since these extensions obscure the main mechanism without having any value added in terms of the question of interest, I abstain from including them.

The optimum level of sovereign debt is determined by the trade-off between public consumption versus the costs of sovereign repayment or the potential negative effects of default

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through the repayment signaling mechanism. Both the benefits and the costs associated with sovereign debt present discontinuities at specific thresholds. In the next paragraphs, I analyze how R_{S0}, G_1 and $E_0\left[C_2(s,\theta_i)\right]$ change with S_0 with the objective of characterizing as much as possible the optimum level of sovereign debt that the government should choose.

The endogenization of S_0 implies that now it is also possible to characterize the sovereign interest rate as part of the results of the model. In order to determine the interest rate at which foreign lenders lend to the government, R_{S0}, foreign lenders anticipate that the sovereign repayment decision depends on the level of sovereign debt and on the institutional quality. But since they do not observe θ_i they can only set the interest rate as a function of S_0, by taking into account the expected repayment for each level of sovereign debt: $E[z_1/S_0]$. Since foreign lenders face perfect competition, in equilibrium, $R^*_{S0}(S_0)$ must be such that they break even by recovering in expected terms their opportunity cost R_W:

$$R_W = R^*_{S0}(S_0)E[z_1/S_0]. \tag{1.18}$$

Figure 8 illustrates $R^*_{S0}(S_0)$ as a function of S_0 for the case when e_0 is larger than $\overline{e_0}$ (I omit the other case since it is analogous to the one presented with the only difference that in this case the mixed strategies interval does not exist). The characterization of $R^*_{S0}(S_0)$ that results from the model is consistent with the observed behavior of sovereign debt markets: as the level of sovereign debt of a country increases, creditors ask for a higher interest rate to compensate for the increased default risk (Arellano (2008)); however, above a certain critical debt level no premium can compensate investors for the default risk, and credit rationing occurs (Eaton and Gersovitz (1981) and Zoli (2004)).

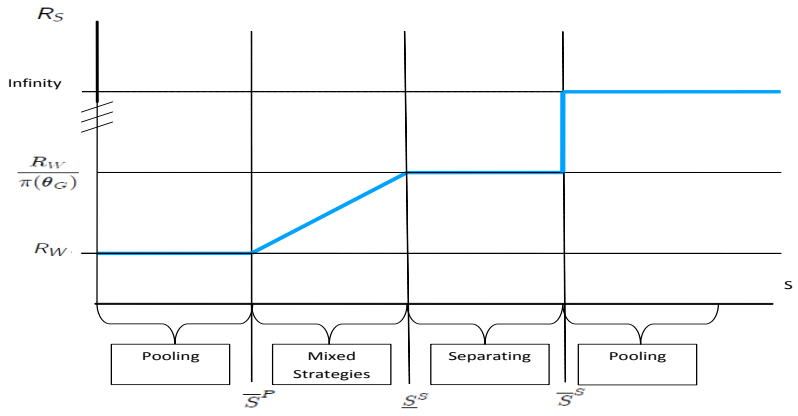

Figure 8: Sovereign interest rate as a function of sovereign debt when $e_1 > \overline{e_1}$

With the objective of stressing the main mechanisms at work in the trade-off between public and private consumption, in the next paragraphs I focus the analysis of these variables on the simpler case of no mixed strategies, i.e. $e_1 \leq \overline{e_1}$. I begin by analyzing public good consumption, which depends both on the level of sovereign debt and on the sovereign interest rate, as can be inferred from (1.15). In particular, as depicted in Figure 9, public good consumption grows continuously within each equilibrium at the rate $\frac{1}{R^*_{S_0}(S_0)}$, but every time the level of sovereign debt crosses one of the thresholds that delimit each equilibrium it experiences discrete reductions as the sovereign interest changes. Finally, public good consumption collapses to zero at $\overline{S}^S + \varepsilon$ when the sovereign interest rate becomes infinity within the second type of pooling.

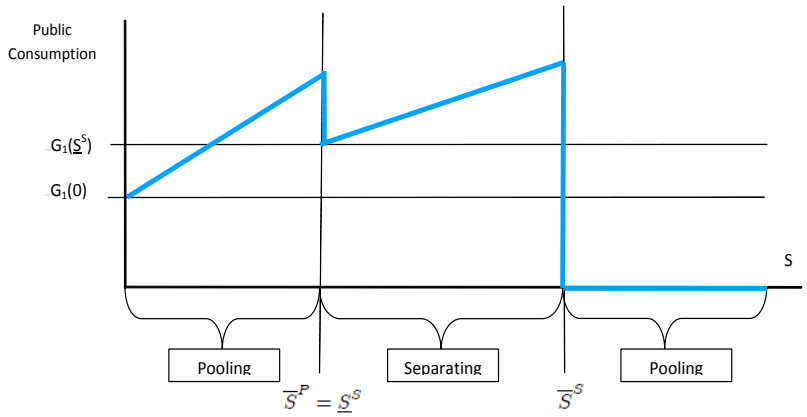

Figure 9: Public good consuption as a function of sovereign debt when $e_1 \leq \overline{e_1}$

The characterization of expected private consumption as a function of sovereign debt is illustrated in Figures 10 and 11. This characterization is determined by two effects: the negative effect of taxes and the positive/negative expected effect of the belief updating, which determines the two possibilities reflected on the figures. Within the fist type of pooling equilibrium expected private consumption decreases continuously with S_0 as taxes grow and the updated beliefs of the foreign lenders remain the same. But at $\underline{S}^S$ expected private consumption can present a discontinuity and jump up or down depending on whether the expected effect of the belief updating is positive or negative. Throughout the separating equilibrium, expected private consumption continues to decrease due to the increasing taxes. Nevertheless, since now taxes are only paid if the institutional quality is good, the negative effect over expected private consumption is smaller. Finally, from $\overline{S}^S$ onwards there is neither belief updating nor sovereign repayment which means that expected private consumption is independent of the institutional quality and equal to the level when sovereign debt is equal to zero: $E_0\left[C_2^*(s)\right]$.

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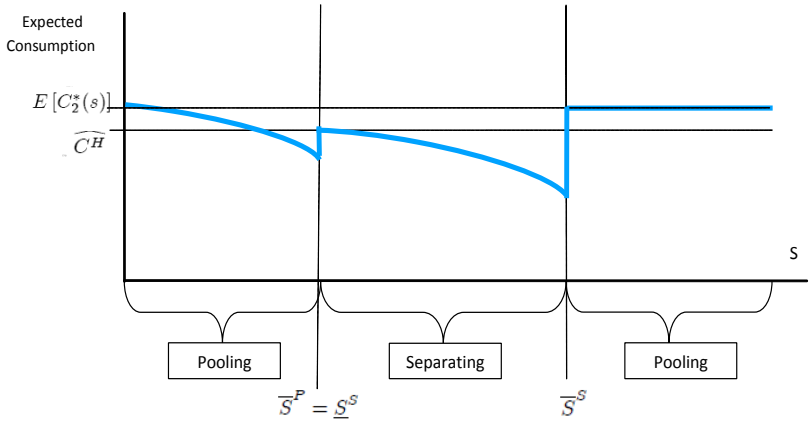

Figure 10: Expected private consumption as a function of sovereign debt (positive effect of belief updating)

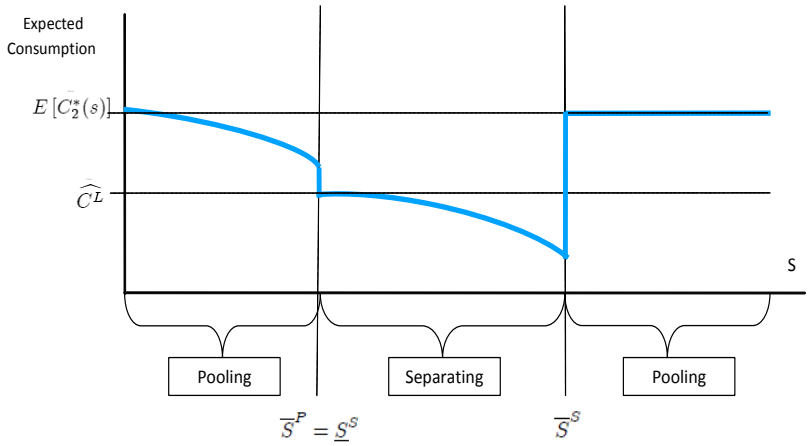

Figure 11: Expected private consumption as a function of sovereign debt (negative effect of belief updating)

Without making further assumptions on the parameters and the entrepreneurs' valuation of public consumption it is not possible to determine the optimum value of S_0. Nevertheless, combining the analysis of public consumption and expected private consumption under each level of sovereign debt it is possible to narrow down the potential equilibrium values and to identify a particularly interesting case. As previously mentioned, expected private consumption can fall or jump at $\underline{S}^S$. In the case when it suffers a reduction (as in Figure 11), since public consumption also falls at that point it is possible to infer that the government never chooses a level of sovereign debt that belongs to the interval $\left(\underline{S}^S, \widehat{S}\right)$ where $\widehat{S} = \underline{S}^S * \pi(\theta_G)$ is the level of sovereign debt that allows public consumption to recover to the same level as it is when $S_0 = \underline{S}^S$. The case when expected private consumption jumps at $\underline{S}^S$ (as in Figure 10) can be very interesting since the positive effect of the signaling on the expected

private consumption can induce governments with relatively higher preference towards private consumption to choose higher levels of sovereign debt, in particular $S_0 > \underline{S}^S$, in order to take advantage of this increment. Finally, beyond $\overline{S}^S$ private expected consumption is again equal to $E_0\left[C_2^*(s)\right]$ since there are neither taxes nor belief updating. Therefore, given the concavity of $v(.)$, welfare is higher for small enough levels of sovereign debt than for levels larger than $\overline{S}^S$. This means that the second type of pooling never arises in equilibrium.

1.4.3 Endogenous Institutional Quality

Allowing for the level of institutional quality to be a choice variable of the government is possibly the most intuitive explanation for the government's private information over θ_i and also for the timing at which this information is learnt in the model once the level of sovereign debt is endogenized. In this section, I propose a reinterpretation and two minor modifications of the environment in order to allow for this possibility. This approach is related to the recent work seeking to explain the institutions that support financial markets and taxation by Rajan and Zingales (2003), Acemoglu (2005) and Besley and Persson (2009). As in that work this section treats institutions as endogenous.[7]

In order to introduce these modifications on the original benchmark case, I first change the time preference parameter of the government, allowing it to differ from the one of the entrepreneurs and making it private information. Then, I allow the government to decide on the uses of S_0, in particular it can choose between public consumption or unobservable investments that improve the institutional quality in the country. These modifications create an equilibrium where more patient governments prefer to invest more in institutional quality since this brings benefits in the last period by reducing the costs of repaying sovereign debt and increasing the chances that the entrepreneurs receive a lower interest rate. On the other hand, impatient governments prefer to invest less on institutional quality and instead use more resources for public good consumption in period one.

Let's consider a government that instead of being benevolent as before maximizes:

$$W_j = \beta_j v(G_0) + \beta_j^2 E_0\left[C_1(s, \theta_{0i}\right],$$

where $\beta_j \leq 1$ is the government's discount factor, which is private information of the government and not necessarily equal to the one of the entrepreneurs. In particular, $\beta_j = \{\beta_H, \beta_L\}$

[7] The closest antecedents to this approach are Acemoglu (2005) and Besley and Persson (2009). In Acemoglu (2005) the government raises taxes to spend on a mixture of transfers to the ruler and on productivity enhancing public goods that increase future tax revenues. Weak states, where rulers have short time horizons, spend too little on productive public goods. Besley and Persson (2009) extend this framework to allow for taxation institutions to be endogenous and for past investment in legal and fiscal capacity to constraint current policy decisions.

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where $\beta_L < \beta_H$ and $\pi(\beta_H)$ is the probability that the government has the high discount rate. As in the benchmark case, at $t = 0$, the government receives an exogenous level of sovereign debt but now, before deciding whether to repay it or not, it can also decide on the use of these resources. In particular, it can use it to finance either public good consumption or investments in institutional quality.

The initial exogenous "stock" of institutional quality is given by θ. Nevertheless, the government can modify this stock by choosing how much to invest in institutional quality at $t = 0$. The level of investment is given by $\theta_{0i} - \theta$ where θ_{0i}, the final "stock", can take two possible values: θ_{0B} or θ_{0G}. In order to simplify the analysis I set $\theta_{0G} > \theta_{0B} = \theta$. The cost of this investment is given by $L(\theta_{0i} - \theta)$, where $L(.)$ is an increasing convex function with $L(0) = L'(0) = 0$. Since there is no depreciation of institutional capacity $\theta_{0i} - \theta$ is always non-negative. The amount invested in the institutional quality is unobserved and determines not only the strength of creditor protection but also the level of corruption and inefficiencies within the tax institutions.

Everything else in the model, decisions, timing and parameters, remains the same. Then, the solution of the model including these modifications follows the same logic as before and it has to be solved by backward induction.

Proposition 1.3 *Let's define $\theta_{0i}(\beta_j)$ as the institutional quality chosen when the discount rate is β_j, then:*

i) $\theta^*_{0i}(\beta_H) = \theta_{0G}$ is the dominant strategy when $\beta_j = \beta_H$, as long as β_H is high enough;

ii) given that $\theta^*_{0i}(\beta_H) = \theta_{0G}$, $\theta^*_{0i}(\beta_L) = \theta_{1B}$ is the dominant strategy when $\beta_j = \beta_L$, as long as β_L is low enough.

More specifically, $\theta^*_{0i}(\beta_H) = \theta_{0G}$ and $\theta^*_{0i}(\beta_L) = \theta_{0B}$ as long as $\{\beta_L, \beta_H\}$ are such that:

$$\begin{aligned}\beta_L &\leq \frac{v(S_0)-v(S_0-L(\theta_{0G}-\theta))}{p\left[-\triangle(\pi(\theta_{0G}/1),\pi(\theta_{0G}/0))-z_0R_{E0}(\pi(\theta_{0G}/1))\frac{S_0}{\theta_{0B}}\right]} \\ &\leq \beta_H \min\left\{1, \frac{p\left[\triangle(\pi(\theta_{0G}/1),\pi(\theta_{0G}/0))-z_0R_{E0}(\pi(\theta_{0G}/1))\frac{S_0}{\theta_{0G}}\right]}{p\left[-\triangle(\pi(\theta_{0G}/1),\pi(\theta_{0G}/0))-z_0R_{E0}(\pi(\theta_{0G}/1))\frac{S_0}{\theta_{0B}}\right]}\right\};\end{aligned}$$

iii) the equilibrium characterization is the same as in Proposition 1.

Proof. See Appendix C. ■

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1.5 Concluding Remarks

This paper represents a step towards a better understanding of the costs of sovereign debt crises. My model is motivated by evidence from developing countries that sovereign defaults trigger a systematic worsening of external financial constraints for the private sector. This paper provides a tractable framework to justify this worsening through a signaling mechanism that offers a new perspective on the links between institutional quality, sovereign default, and the access to credit of private firms in the country.

The repayment behavior of the government affects private interest rates through two effects an "updating effect" and a "risk-transfer effect". The key effect is the "updating effect" which depends on the information released by the repayment decision of the government. This information is used by the foreign lenders to "update" their perception over the institutional quality in the country. If the new information is negative, as it happens after a sovereign default, it triggers a discrete increase on private the interest rate and a sharp reduction in credit and investment. Thus the "updating effect" rationalizes the worsening of the financial conditions for the private sector in international capital markets observed after sovereign defaults. The "risk-transfer effect" is an indirect transfer of risk from the sovereign to the private sector that takes place through the taxes that the government needs to levy in order to repay the sovereign debt, which indirectly increases the leverage and reduces the repayment ability of the private sector when it receives the negative shock. In equilibrium, this second effect generates that, consistently with the empirical evidence, the private interest rate grows monotonically with the level of sovereign debt.

1.6 Appendix

1.6.1 A: Proof of Proposition 1

Let's begin by assuming that the first type of pooling equilibrium, where the government always repays its sovereign debt, does exist. Within this equilibrium, since the government always behaves in the same way there is no information revelation and the foreign lenders' updated beliefs after observing the repayment decision just equals the unconditional beliefs, i.e. $\pi\left(\theta_G/1\right) = \pi(\theta_G)$. This implies that the after-repayment private interest rate and investment of equilibrium are $R^*_{E0}(\pi(\theta_G))$ and $I^*_0(R_{E0}(\pi(\theta_G)))$, respectively. In the off-equilibrium event of default, I assume that the foreign lenders believe that the government has bad institutional quality, that is $\pi(\theta_G/0) = 0$.

If this pooling equilibrium exists, the maximum level of sovereign debt that it can sustain is such that the government is able and willing to repay even if the institutional

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quality is bad. According to (1.14), that means that S_0 should be lower or equal than $\overline{S}^P = \min\left\{e_0\theta_B, \frac{\theta_B \triangle(\pi(\theta_G),0)}{R^*_{E0}(\pi(\theta_G))}\right\}$. A sufficient condition for the interval $\left[0, \overline{S}^P\right]$ to be non empty is to prove that $\triangle(\pi(\theta_G), 0) > 0$. Recall that, for all S_0, $\triangle\left(\pi\left(\theta_G/1\right), \pi\left(\theta_G/0\right)\right)$ can be rewritten as the difference between the expressions: $AI_0^{*\alpha}(R^*_{E0}(\pi(\theta_G/z_0))) + I^*_0(R^*_{E0}(\pi(\theta_G/z_0))) - R^*_{E0}(\pi(\theta_G/z_0))\left(I^*_0(R^*_{E0}(\pi(\theta_G/z_0))) - e_0\right)$ for $z_0 = 0,\ 1$. The derivative of each of these expressions with respect to the updated beliefs $\pi(\theta_G/z_0)$ is given by:

$$\frac{\partial\left[AI_0^{*\alpha}(R^*_{E0}(\pi(\theta_G/z_0))) + \delta I^*_0(R^*_{E0}(\pi(\theta_G/z_0))) - R^*_{E0}(\pi(\theta_G/z_0))\left(I^*_0(R^*_{E0}(\pi(\theta_G/z_0))) - e_0\right)\right]}{\partial R^*_{E0}(\pi(\theta_G/z_0))} \frac{dR^*_{E0}(\pi(\theta_G/z_0))}{d\pi(\theta_G/z_0)},$$

which is positive since the first term equals $-I^*_0(R^*_{E0}(\pi(\theta_G/z_0))) + e_0 < 0$; and the last term, $\frac{dR_{E0}}{d\pi(\theta_G/z_0)}$, is equal to:

$$-\frac{I_0(R_{E0})\left[\frac{\theta_G}{D_0(T_0(\theta_G))} - \frac{\theta_B}{D_0(T_0(\theta_B))}\right]}{\frac{p}{(1-p)} + \frac{1}{1-\alpha}\frac{I_0(R_{E0})}{R_{E0}-\delta}\left[\pi(\theta_G/z_0)\theta_G\frac{I_0(R_{E0})-D_0(T_0(\theta_G))}{D_0^2(T_0(\theta_G))} + \pi(\theta_B/z_0)\theta_B\frac{I_0(R_{E0})-D_0(T_0(\theta_B))}{D_0^2(T_0(\theta_B))}\right]} < 0$$

which is also negative. Since, $\pi(\theta_G) > 0$, then $\triangle(\pi(\theta_G), 0) > 0$ implying that this type of pooling equilibrium always exist.

However, this is not the only possible type of pooling equilibria that can exist. There can also exist a second type of pooling equilibria where the government always defaults independently of its institutional quality. Therefore, there is no information revelation through the repayment decision z_0 and after observing the default, the foreign lender beliefs are again equal to the unconditional beliefs, what implies that the equilibrium interest rate and investment are just equal to the ones in the previous pooling equilibrium. A necessary and sufficient condition for the existence of this equilibrium is that the level of sovereign debt is so high that government never has enough resources or incentives to repay even if the country has good institutional quality.

Now, let's assume the existence of a separating equilibrium where the government repays when the institutional quality in the country is good and defaults otherwise. Then, in this equilibrium, foreign lenders learn the exact value of θ_i from the repayment decision of the government, that is $\pi(\theta_G/1) = 1$ and $\pi(\theta_G/0) = 0$. This implies that the equilibrium private interest rate and the equilibrium level of investment, are $R^*_{E0}(1)$ and $I^*_0(R_{E0}(1))$, respectively.

For this equilibrium to exist the level of sovereign debt has to be such that it makes it too costly for the government with bad institutional quality to repay S_0 while the government with good institutional quality is still able and willing to repay. The fact that it must be too costly for the government with bad institutional quality to repay provides a lower bound on S_0. In particular, from combining the repayment condition with the equilibrium

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values for investment and interest rate under separating, we get that S_0 must be higher than $\underline{S}^S = \min\left\{e_0\theta_B, \frac{\theta_B \triangle(1,0)}{R^*_{E0}(1)}\right\}$ for the government with bad institutional quality to default. On the other hand, the repayment condition of the government with the good institutional quality provides an upper bound on S_0 equal to $\overline{S}^S = \min\left\{e_0\theta_G, \frac{\theta_G \triangle(1,0)}{R^*_{E0}(1)}\right\}$. Visual inspection of the limits of the separating equilibrium $\left(\underline{S}^S, \overline{S}^S\right]$ shows that $\underline{S}^S$ is always lower than $\overline{S}^S$ since $\theta_B < \theta_G$. Then, this equilibrium always exists.

From the comparison of $\overline{S}^P$ and $\underline{S}^S$, it is possible to see that these limits coincide when the feasibility constraint of the government with bad institutional quality is tighter than the incentive compatibility constraint. In particular this happens when the level of endowment of the entrepreneurs is lower or equal than $\frac{A(1-\alpha)\left[I_0^{*\alpha}(\pi(\theta_G/1)) - I_0^{*\alpha}(\pi(\theta_G/0))\right]}{R^*_{E0}(\pi(\theta_G/0))}$. In this case: $\overline{S}^P = \underline{S}^S = e_0\theta_B$, since $\frac{\theta_B \triangle(\pi(\theta_G),0)}{R^*_{E0}(\pi(\theta_G))} < \frac{\theta_B \triangle(1,0)}{R^*_{E0}(1)}$. To prove this inequality, first of all, it is possible to observe that $R^*_{E0}(\pi(\theta_G)) \geq R^*_{E0}(1)$ since the expected loan recovery in the event of a bad shock is lower under pooling:

$$\begin{aligned} E_0\left[\frac{\theta_i}{D_0^*(\pi(\theta_G),\theta_i)}/1\right] &= \left[\pi(\theta_G)\frac{\theta_G}{D_0^*(\pi(\theta_G),\theta_G)} + (1-\pi(\theta_G))\frac{\theta_B}{D_0^*(\pi(\theta_G),\theta_B)}\right] I_0^*(\pi(\theta_G)) \\ &< \frac{\theta_G}{D_0^*(1,\theta_G)} I_0^*(1) = E_0\left[\frac{\theta_i}{D_0^*(1,\theta_i)}/1\right] \end{aligned}.$$

Then a sufficient condition for the interval to exist is to prove that $\triangle(\pi(\theta_G),0) \leq \triangle(1,0)$. Recalling (1.13) and simplifying, the sufficient condition becomes $\triangle(1,\pi(\theta_G)) \geq 0$, which is always true given the same argument used to prove the existence of the pooling equilibrium. Then when $\overline{S}^P = e_0\theta_B$, the upper limit of the pooling equilibrium coincides with the lower limit of the separating equilibrium.

However, when the incentive compatibility constraint of the government with bad institutional quality is tighter than the feasibility constraint, then these limits do not coincide, i.e. $\overline{S}^P = \frac{\theta_B \triangle(\pi(\theta_G),0)}{R^*_{E0}(\pi(\theta_G))} \neq \underline{S}^S$. In this case, there exists a non-empty interval, $\left(\overline{S}^P, \underline{S}^S\right)$, between the pooling and the separating equilibria. Within this interval, the government is still able to repay but if the institutional quality is bad it does not have enough incentives to repay with certainty. Nevertheless, if the private interest rate after repayment is low enough it can still make sense for the government in the country with bad institutional quality to repay with a positive probability lower than one giving rise to a mixed strategies equilibrium. A sufficient condition for this is that : $\theta_G - \theta_B \geq \frac{1}{e_0 - \left[\frac{A\alpha}{R_W - 1}\right]^{\frac{1}{1-\alpha}}}$, which always holds since the LHS is negative given assumption A1. Then, there exists a mixed strategies equilibrium in the interval $\left(\overline{S}^P, \underline{S}^S\right)$ where the government repays with certainty when the institutional quality is high while it only repays with a probability smaller than one $\sigma(\theta_B)$ when the institutional quality is low. This implies that after observing a default, the foreign lenders are

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certain that the country has bad institutional quality, whereas after observing repayment their information is still incomplete, even though they are more informed than under the pooling equilibrium.

The fact that the incentive compatibility constraint of the government with bad institutional quality binds:

$$\begin{aligned} A(1-\alpha)I_0^{\alpha}\left(\tfrac{\pi(\theta_G)}{\pi(\theta_G)+(1-\pi(\theta_G))\sigma(\theta_B)}\right)+R_{E0}\left(\tfrac{\pi(\theta_G)}{\pi(\theta_G)+(1-\pi(\theta_G))\sigma(\theta_B)}\right)\left(e_0-\tfrac{S_0}{\theta_B}\right) \\ =A(1-\alpha)I_0^{\alpha}(0)+R_{E0}(0)e_0, \end{aligned} \tag{1.19}$$

implies that the incentive compatibility constraint of the government with good institutional quality is slack:

$$A(1-\alpha)I_0^{\alpha}(1)+R_{E0}^{P}(1)\left(e_0-\tfrac{S_0}{\theta_G}\right)>A(1-\alpha)I_0^{\alpha}(0)+R_{E0}^{P}(0)e_0$$

and that the respective repayment probabilities are $0<\sigma(\theta_B)<1$ and $\sigma(\theta_G)=1$. Given these probabilities the updated beliefs of the foreign lenders conditional on repayment and default become $\pi(\theta_G/1)=\frac{\pi(\theta_G)}{\pi(\theta_G)+(1-\pi(\theta_G))\sigma(\theta_B)}$ and $\pi(\theta_G/0)=0$, which implies the following expected recovery rates per dollar of observed investment:

$$\begin{aligned} E\left[\tfrac{\theta_i}{D_0^*(\pi(\theta_G),\theta_i)}/1\right]&=\left[\pi(\theta_G/1)\tfrac{\theta_G}{D_0^*(\pi(\theta_G),\theta_G)}+(1-\pi(\theta_G/1))\tfrac{\theta_B}{D_0^*(\pi(\theta_G),\theta_B)}\right]I_0^*(\pi(\theta_G)) \\ E\left[\tfrac{\theta_i}{D_0^*(\pi(\theta_G),\theta_i)}/0\right]&=\tfrac{\theta_B}{D_0^*(1,\theta_B)}I_0^*(0) \end{aligned}$$

By totally differentiating (1.19) it is possible to observe that $\sigma(\theta_B)$ is always decreasing in S_0.

1.6.2 B: Proof that sustainability thresholds increase with ω

In order to be able to obtain closed form solutions of the derivatives I have simplified the private loan contract. Throughout this section I assume that $\delta=0$ and that when the entrepreneurs default on their private debt, the foreign lenders can only seize from a proportion θ_i of what the entrepreneur owed him D_0 and the difference between I_0 and D_0 is lost in the process. This way the private interest rate becomes: $R_{E0}(\pi(\theta_G/z_0))=\frac{R_W-(1-p)\widetilde{\theta}(z_0)}{p}$, where $\widetilde{\theta}(z_0)=\pi(\theta_G/z_0)\theta_G+(1-\pi(\theta_G/z_0))\theta_B$. This simplification does not change the direction of the effects nor changes the equilibrium in any substantial way, it only makes the model more tractable allowing to obtain closed form solutions.

The derivatives of the limits of the equilibria with respect to ω lead to the following

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expressions:

$$\frac{\partial \overline{S}^P}{\partial \omega} = \left[\frac{1}{R_{E0}(1)} + \frac{\theta_B(1-p)}{(R_{E0}(1)-1)^2 p}\right] \triangle(\pi(\theta_G),0) + \frac{\theta_B(1-p)}{R_{E0}(1)} (A\alpha)^2 \left[\frac{I_0^{\alpha-1}(1)}{(R_{E0}(1)-1)^2 p} - \frac{I_0^{\alpha-1}(0)}{(R_{E0}(0)-1)^2 p}\right] > 0,$$

$$\frac{\partial \underline{S}^S}{\partial \omega} = \left[\frac{1}{R_{E0}(1)} + \frac{\theta_B(1-p)}{(R_{E0}(1)-1)^2 p}\right] \triangle(1,0) + \frac{\theta_B(1-p)}{R_{E0}(1)} (A\alpha)^2 \left[\frac{I_0^{\alpha-1}(1)}{(R_{E0}(1)-1)^2 p} - \frac{I_0^{\alpha-1}(0)}{(R_{E0}(0)-1)^2 p}\right] > 0,$$

$$\frac{\partial \overline{S}^S}{\partial \omega} = \left[\frac{1}{R_{E0}(1)} + \frac{\theta_G(1-p)}{(R_{E0}(1)-1)^2 p}\right] \triangle(1,0) + \frac{\theta_G(1-p)}{R_{E0}(1)} (A\alpha)^2 \left[\frac{I_0^{\alpha-1}(1)}{(R_{E0}(1)-1)^2 p} - \frac{I_0^{\alpha-1}(0)}{(R_{E0}(0)-1)^2 p}\right] > 0.$$

While the first term of the right hand side is trivially positive, the sign of the second term is not so clearly determined and deserves further exploration. In particular, if the expression between brackets is positive, then the whole expression is also positive. The condition for the expression between brackets to be positive can be written as:

$$\left(R_W - (1-p)\left(\widetilde{\theta}^Y(0)+\omega\right) - p\right)^2 \left[\frac{A\alpha p}{R_W-(1-p)\left(\widetilde{\theta}^Y(1)+\omega\right)-p}\right]^{\frac{\alpha}{1-\alpha}} > \left(R_W - (1-p)\left(\widetilde{\theta}^Y(1)+\omega\right) - p\right)^2 \left[\frac{A\alpha p}{R_W-(1-p)\left(\widetilde{\theta}^Y(0)+\omega\right)-p}\right]^{\frac{\alpha}{1-\alpha}}.$$

Which is equivalent to:

$$\left[\frac{R_W-(1-p)\left(\widetilde{\theta}^Y(0)+\omega\right)-p}{R_W-(1-p)\left(\widetilde{\theta}^Y(1)+\omega\right)-p}\right]^2 > \left[\frac{R_W-(1-p)\left(\widetilde{\theta}^Y(0)+\omega\right)-p}{R_W-(1-p)\left(\widetilde{\theta}^Y(1)+\omega\right)-p}\right]^{\frac{\alpha}{1-\alpha}},$$

where the inequality holds since the ratios are higher than one.

Since $\frac{\partial \overline{S}^P}{\partial \omega} < \frac{\partial \underline{S}^S}{\partial \omega} < \frac{\partial \overline{S}^S}{\partial \omega}$ it is also possible to infer that the separating equilibrium interval is increasing proportionally more than the mixed strategies equilibrium interval, which is on its own increasing proportionally more than the pooling equilibrium interval.

1.6.3 C: Proof of Proposition 2

The proof of Proposition 2 involves two steps: i) a proof that $\theta_{0i}(\beta_H) = \theta_{0G}$ is always a dominant strategy; and ii) a proof that $\theta_{0i}(\beta_L) = \theta_{0B}$ is a dominant strategy given $\theta_{0i}(\beta_L) = \theta_{0G}$. For both cases it is necessary to verify that this is the case at each relevant interval of S_0.

The proof of (i) for the case of $\theta_{0i}(\beta_L) = \theta_{0B}$ requires that:

$$W_H(\theta_{0G}/\theta_{0i}(\beta_L) = \theta_{0B}) \geq W_H(\theta_{0B}/\theta_{0i}(\beta_L) = \theta_{0B}), \tag{1.20}$$

which implies the following: a) if $\theta_{0i}(\beta_H) = \theta_{0G}$ the equilibrium characterization is the same as in Proposition 1; and b) if $\theta_{0i}(\beta_H) = \theta_{0B}, \forall S_0$, there is a pooling equilibrium where both governments always default and $\pi(\theta_{0G}/z_0) = 0$. Replacing the corresponding levels of public

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and private consumption into (1.20) for each of the intervals implies that the necessary and sufficient condition for the patient government to choose θ_{0G} given $\theta_{0i}(\beta_L) = \theta_{0B}$ is:

$$\beta_H \geq \frac{v(S_0)-v(S_0-L(\theta_{0G}-\theta))}{p\left[\triangle(\pi(\theta_{0G}/1),\pi(\theta_{0G}/0))-z_0R_{E0}(1)\frac{S_0}{\theta_{0G}}\right]}. \tag{1.21}$$

The proof of (i) for the case of $\theta_{0i}(\beta_L) = \theta_{0G}$ requires that:

$$W_H(\theta_{0G}/\theta_{0i}(\beta_L) = \theta_{0G}) \geq W_H(\theta_{0B}/\theta_{0i}(\beta_L) = \theta_{0G}), \tag{1.22}$$

which implies the following: a) if $\theta_{0i}(\beta_H) = \theta_{0B}$ the equilibrium characterization is the same as in Proposition 1; and b) if $\theta_{0i}(\beta_H) = \theta_{0G}$, $\forall S_0$, there is a pooling equilibrium where both governments always default and $\pi(\theta_{0G}/z_0) = 1$.Replacing the corresponding levels of public and private consumption into (1.22) for each of the intervals implies that the necessary and sufficient condition for the patient government to choose θ_{0G} given $\theta_{0i}(\beta_L) = \theta_{0G}$ is:

$$\beta_H \geq \frac{v(S_0)-v(S_0-L(\theta_{0G}-\theta))}{p\left[\triangle(\pi(\theta_{0G}/1),\pi(\theta_{0G}/0))-z_0R_{E0}(1)\frac{S_0}{\theta_{0B}}\right]}. \tag{1.23}$$

Combining (1.21) and (1.23):

$$\beta_H \geq \max\left\{\frac{v(S_0)-v(S_0-L(\theta_{0G}-\theta))}{p\left[\triangle(\pi(\theta_{0G}/1),\pi(\theta_{0G}/0))-z_0R_{E0}(1)\frac{S_0}{\theta_{0B}}\right]}, \frac{v(S_0)-v(S_0-L(\theta_{0G}-\theta))}{p\left[\triangle(\pi(\theta_{0G}/1),\pi(\theta_{0G}/0))-z_0R_{E0}(1)\frac{S_0}{\theta_{0G}}\right]}\right\}. \tag{1.24}$$

The proof of (ii) requires that:

$$W_L(\ \theta_{0B}/\theta_{0i}(\beta_H) = \theta_{0G}) > W_L(\theta_{0G}/\theta_{0i}(\beta_H) = \theta_{0G}). \tag{1.25}$$

This combination implies the following: a) if $\theta_{0i}(\beta_L) = \theta_{0B}$ the equilibrium characterization is the same as in Proposition 1; and b) if $\theta_{0i}(\beta_L) = \theta_{0G}, \forall S_0$, there is a pooling equilibrium where both governments always default and $\pi(\theta_{0G}/z_0) = 1$.Replacing the corresponding levels of public and private consumption into (1.25) for each of the intervals implies that the necessary and sufficient condition for the impatient government to choose θ_{1B} given $\theta_{0i}(\beta_H) = \theta_{0G}$ is:

$$\beta_L \leq \frac{v(S_0)-v(S_0-L(\theta_{0G}-\theta))}{p\left[-\triangle(\pi(\theta_{0G}/1),\pi(\theta_{0G}/0))-z_0R_{E0}(1)\frac{S_0}{\theta_{0B}}\right]}. \tag{1.26}$$

Combining (1.24) and (1.26) gives the final condition for the β_js:

$$\beta_L \leq \frac{v(S_0)-v(S_0-L(\theta_{0G}-\theta))}{p\left[-\triangle(\pi(\theta_{0G}/1),\pi(\theta_{0G}/0))-z_0R_{E0}(1)\frac{S_0}{\theta_{0B}}\right]} \leq \beta_H \min\left\{0, \frac{p\left[\triangle(\pi(\theta_{0G}/1),\pi(\theta_{0G}/0))-z_0R_{E0}(1)\frac{S_0}{\theta_{0G}}\right]}{p\left[-\triangle(\pi(\theta_{0G}/1),\pi(\theta_{0G}/0))-z_0R_{E0}(1)\frac{S_0}{\theta_{0B}}\right]}\right\}.$$

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European University Institute DOI: 10.2870/46401

BIBLIOGRAPHY

[1] Acemoglu, D. 2005. Politics and economics in weak and strong states. Journal of Monetary Economics, Elsevier, vol. 52(7), pages 1199-1226, October.

[2] Alfaro, L.; S. Kalemli-Ozcan and V. Volosovych. 2007. Capital Flows in a Globalized World: The Role of Policies and Institutions. NBER Chapters, in: Capital Controls and Capital Flows in Emerging Economies: Policies, Practices and Consequences, pages 19-72 National Bureau of Economic Research, Inc.

[3] Alfaro, L.; S. Kalemli-Ozcan and V. Volosovych. 2008. Why Doesn't Capital Flow from Rich to Poor Countries? An Empirical Investigation. The Review of Economics and Statistics, MIT Press, vol. 90(2), pages 347-368, 01.

[4] Arellano, C. 2008. Default Risk and Income Fluctuations in Emerging Economies. American Economic Review, vol. 98(3), pages 690-712, June.

[5] Arteta, C. and H. Galina. 2008. Sovereign debt crises and credit to the private sector. Journal of International Economics, Elsevier, vol. 74(1), pages 53-69, January.

[6] Besley, T. and T. Persson. 2009. The Origins of State Capacity: Property Rights, Taxation, and Politics. American Economic Review, American Economic Association 99, pages 1218-44.

[7] Bulow, J.; Rogoff, K., 1989. Sovereign debt: is to forgive to forget? American Economic Review 79, pages 43–50.

Andreasen, Eugenia (2012), Essays on Sovereign Default and the Link with the Domestic Economy
European University Institute DOI: 10.2870/46401

[8] Caballero, R. and A. Krishnamurthy. 2001. International and domestic collateral constraints in a model of emerging market crises. Journal of Monetary Economics 48, 513-48.

[9] Celasun, O and S. Agca. 2009. How Does Public External Debt Affect Corporate Borrowing Costs in Emerging Markets?. IMF Working Papers, Vol. , pp. 1-36, 2009

[10] Cole, H. L.; J. Dow and W. English. 1995. Default, Settlement, and Signaling: Lending Resumption in a Reputational Model of Sovereign Debt. International Economic Review, , vol. 36(2), pages 365-85.

[11] Cole, H. L. and P. J. Kehoe. 1996. Reputation Spillover Across Relationships with Enduring and Transient Beliefs: Reviving reputation Models of Debt. NBER Working Papers 5486, National Bureau of Economic Research, Inc.

[12] Cole, H. L. and P. Kehoe. 1998. Models of Sovereign Debt: Partial versus General Reputations. International Economic Review, vol. 39(1), pages 55-70.

[13] Chang, R. and A. Velasco. 2001. A Model of Financial Crises in Emerging Markets. Quarterly Journal of Economics 116, 489-517.

[14] Djankov, S.; O. Hart; C. McLiesh; and A. Shleifer. 2008. Debt Enforcement around the World. Journal of Political Economy, University of Chicago Press, vol. 116(6), pages 1105-1149.

[15] Djankov, S.; C. McLiesh; and A. Shleifer. 2007. Private credit in 129 countries. Journal of Financial Economics, Elsevier, vol. 84(2), pages 299-329.

[16] Eaton, J., and M. Gersovitz. 1981. Debt with Potential Repudiation: Theoretical and Empirical Analysis. Review of Economic Studies, 48(2):289-309.

[17] Eichengreen, B. and A. Mody. 2000. What Explains Changing Spreads on Emerging Market Debt?, NBER Chapters, in: Capital Flows and the Emerging Economies: Theory, Evidence, and Controversies, pages 107-136 National Bureau of Economic Research, Inc.

Andreasen, Eugenia (2012), Essays on Sovereign Default and the Link with the Domestic Economy
European University Institute DOI: 10.2870/46401

[18] Gennaioli, N., M. Alberto and S. Rossi. 2010. Sovereign Default, Domestic Banks and Financial Institutions. CEPR Discussion Papers 7955, C.E.P.R. Discussion Papers.

[19] Gertler, M. and K. Rogoff. 1990. North-South Lending and Endogenous Domestic Capital Market Inefficiencies. Journal of Monetary Economics, 26 (2), pp. 245-266.

[20] Grossman H. and J. Van Huyck. 1989. Sovereign Debt as a Contingent Claim: Excusable Default, Repudiation, and Reputation. NBER Working Papers 1673, National Bureau of Economic Research, Inc.

[21] Guembel, A. and O. Sussman. 2009. Sovereign Debt Without Default Penalties. Review of Economic Studies, Vol. 76, Issue 4, pp. 1297-1320, October.

[22] Kraay, A. and V. Nehru. 2006. When Is External Debt Sustainable?. World Bank Economic Review, Oxford University Press, vol. 20(3), pages 341-365.

[23] La Porta, R.; F. Lopez-de-Silanes; A. Shleifer and R. Vishny. 1997. Legal Determinants of External Finance. Journal of Finance, American Finance Association, vol. 52(3), pages 1131-50, July.

[24] La Porta, R.; F. Lopez-de-Silanes; A. Shleifer and R. Vishny. 1998. Law and Finance. Journal of Political Economy, University of Chicago Press, vol. 106(6), pages 1113-1155, December.

[25] Mendoza, E. and V. Z. Yue. 2008. A Solution to the Default Risk-Real Business Cycle Disconnect. International Finance Discussion Papers 924, Board of Governors of the Federal Reserve System (U.S.).

[26] Murphy, K.; A. Shleifer; and R. Vishny. 1993. Why Is Rent Seeking So Costly to Growth?. American Economic Review 83 (2): 409–14.

[27] Rajan, R. and L. Zingales. 2003. The great reversals: the politics of financial development in the twentieth century. Journal of Financial Economics, Elsevier, vol. 69(1), pages 5-50, July.

Andreasen, Eugenia (2012), Essays on Sovereign Default and the Link with the Domestic Economy
European University Institute DOI: 10.2870/46401

[28] Reinhart C.; K. Rogoff and M. Savastano. 2003. Debt Intolerance. Brookings Papers on Economic Activity, Economic Studies Program, The Brookings Institution, vol. 34(2003-1), pages 1-74.

[29] Sandleris, G. 2008. Sovereign defaults: Information, investment and credit. Journal of International Economics, Elsevier, vol. 76(2), pages 267-275, December.

[30] Sandleris, G. 2010. Sovereign Defaults, Domestic Credit Market Institutions and Credit to the Private Sector. Business School Working Papers 2010-01, Universidad Torcuato Di Tella.

[31] Schneider, M., and A. Tornell. 2004. Balance Sheet Effects, Bailout Guarantees, and Financial Crises. Review of Economic Studies 71, 889-913.

[32] Shleifer, A. and R. Vishny. 1993. Corruption. Quarterly Journal of Economics 108 (3): 599–617.

[33] Tomz M. and M. Wright. 2007. Do Countries Default in "Bad Times"? Journal of the European Economic Association, MIT Press, vol. 5(2-3), pages 352-360, 04-05.

[34] Trebesch, C. 2010. Inexcusable Sovereign Default.

[35] Trebesch, C., U. Das, and M. Papaioannou. 2010. Sovereign Default Risk and Private Sector Access to Capital in Emerging Markets. IMF Working Papers 10/10, International Monetary Fund.

[36] Zoli, E. 2004. Credit Rationing in Emerging Economies' Access to Global Capital Markets. IMF Working Papers 04/70, International Monetary Fund.

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CHAPTER 2

THE POLITICAL ECONOMY OF SOVEREIGN DEFAULTS

2.1 Introduction

In the months prior to the Argentine sovereign default of 2001 and, more recently, during the debt crises in Greece and Portugal, the governments of these countries faced tough political battles when they tried to implement the fiscal adjustments, required to avoid sovereign default. Greece, for example, has implemented several fiscal austerity packages since 2009. Nevertheless, these adjustments have been insufficient to bridge the budget gap and solve the debt crisis. Furthermore, the austerity packages have been met by growing civil unrest and political opposition that might make further adjustments politically unfeasible.[1] In the case of Portugal, in March 2011, the government proposed a package of austerity measures to restore fiscal balance and debt sustainability. However, opposition parties refused to back the proposal. This led the Portuguese Prime Minister to resign and prompted the need for a European Union - International Monetary Fund rescue package in order to enable Portugal to meet the €4.9 billion of bond redemptions due in mid-June 2011.

Another example of political battles bringing a country close to default is what happened in the US in mid 2011. At the time, the US government risked defaulting on its debt as a result of disagreements between Democrats and Republicans regarding the characteristics of a fiscal package that aimed to reduce the deficit.

The presence of political constraints that limit the margin of action of governments during the run-ups to sovereign debt crises seems the rule rather than the exception. Furthermore, it is noteworthy that in all of the above mentioned cases these political constraints limited the actions of governments that had been recently appointed by democratic elections. Nevertheless, the political support that these governments had, considerably shrunk once they needed to implement the costly fiscal adjustment required by the crisis.

[1] In a recent report Roubini Global Economics View, stated that: "*...the consensus of the population is an indispensable ingredient when attempting to stick to the plan and seeing the necessary but painful reforms through. Without it, the risk of political collapse, disorderly default (...) increases significantly*".(Roubini Global Economics View, 21 June 2011)

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However, the literature on sovereign default has abstracted both from the political constraints and from the fact that the distributional implications of the required adjustments can put a previously widely supported government on a very difficult position. In particular, the literature has assumed that governments have unlimited access to the country's resources.[2] This implies that the default or repayment decision is essentially determined by the government's will. Nevertheless, the real world sovereign default universe is richer than this traditional theoretical depiction of it. In many circumstances, sovereign defaults are not the result of the governments' unwillingness to repay but of the tough political opposition they face when trying to raise the funds necessary to repay the debt.

This paper analyzes how the presence of political constraints affects sovereign governments' borrowing and default decisions. We do this by introducing in a standard dynamic stochastic general equilibrium (DSGE) model with endogenous sovereign default risk, as the ones developed in Aguiar and Gopinath (2006) and Arellano (2008), two novel features: heterogeneous households and a requirement that the government garners some of their support to repay its sovereign debt. Heterogeneity across households generates different opinions regarding the convenience of repaying the sovereign debt. The second feature gives households the power to reject a government policy and reflects the fact that the government does not have unlimited access to the country's resources, it can only access these resources if it has enough political support (i.e. enough households that support repayment).

The introduction of these two novel features in a standard sovereign debt model allows us to understand why individuals might disagree on the funding policy the government should implement in order to repay sovereign debt and how these disagreements can affect the government's repayment capacity.

This framework also generates a richer typology of sovereign default events[3]. In contrast with the standard sovereign debt literature, in this framework, sovereign defaults are not exclusively determined by the government's **unwillingness** to repay. Moreover, two new types of default events arise in our model that capture situations in which the government is **unable** to repay. These events can occur either because the government cannot raise sufficient funds to repay even if it could access all the resources in the economy, or, alternatively, because the fiscal programs that raise sufficient funds are not politically feasible.

The basic structure of the model is the following. There is a small open economy inhab-

[2] These resources are also assumed to be sufficient to repay the debt in the case the government decides to do so.

[3] In their reputational model of sovereign default, Grossman and Van Huyck (1988) do consider a different typology where (in theory) defaults can be either excusable or inexcusable. However, in equilibrium al defaults in their model are excusable which rules out the possibility of classifying observed defaults with this typology.

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ited by a benevolent government and a continuum of households. Households differ in the share that they receive from the stochastic aggregate income. The government borrows from foreign creditors using non-contingent bonds with the objective of smoothing households' consumption paths. The non-contingent nature of the debt contracts captures the actual terms of international financial markets for sovereign debt.

The political economy restriction becomes relevant when the government needs to repay its debt. If the government wants to repay, it needs to propose a fiscal program to raise the necessary funds. The fiscal program must achieve a minimum level of political support from the households in order to be implemented. As households are heterogeneous in their income levels, the fiscal program may have a different impact on the consumption of each household, leading some of them to reject the program and others to support it. If the minimum level of political support is not reached the government is forced to default. Both if the default is due to the political economy constraint or the government's preferences, it triggers a temporary exclusion from international financial markets and direct output costs. The interest rate specified in the bond contracts reflects the endogenous default probabilities.

We calibrate the model to the Argentine economy and estimate the quantitative consequences of the political constraint. Among other things, we analyze how the default set grows as the political constraint becomes more stringent, how is the bond price schedule affected by this higher default probability and which is the range of debt to GDP for which the political constraint becomes more relevant in determining the default. In terms of the matching with the data, the quantitative analysis shows that the equilibrium level of sovereign debt is lower, defaults are less frequent and interest rates are lower in our model than in standard sovereign debt models. This is an expected consequence of including the political constraint. From an ex-post perspective, the presence of the political constraint expands the set of sovereign debt levels for which the government defaults. However, from an ex-ante perspective the country is better off avoiding default. As a result, the government chooses lower levels of sovereign debt, which eventually trigger fewer defaults reducing the interest rate. All in all, this means that the matching with the data of the standard sovereign debt model, once the political constraint is taken into account, is actually weaker than the one showed by Aguiar and Gopinath (2006) and Arellano (2008). Since the empirical evidence calls for the need to include this constraint, our paper shows that the understanding of the links between sovereign default, sovereign spreads rate and business cycles is less thorough than previously thought and further analysis on the topic is required.

By incorporating political considerations as a potential cause for sovereign default, our model speaks to a large literature on endogenous sovereign defaults. Part of this literature

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focuses on the role of political turnover in triggering sovereign defaults by analyzing the alternation of different governments and the effects of political turnover itself on the discount factor of the incumbent government (Amador (2006), Cuadra and Sapriza (2008) and Hatchondo et al. (2007)). On the other hand, the work of Cole et al. (1995), Cole and Kehoe (1997), Cuadra and Sapriza (2008), Sandleris (2008), and D'Erasmo (2011) focus more specifically on the implications of different types of governments being in office in terms of the intertemporal optimum debt/default choice and the information that these decisions reveal to the markets in the cases where the type of the government is private information. Unlike this literature, our paper does not have governments alternating in power or different types of governments but only one benevolent government that during bad times might find out that the policy that maximizes total welfare cannot be implemented due to the discontent it generates in a sufficiently high proportion of society. This feature is useful to explain why democratic leaders, supported by a wide majority during the ballots, can lose their political support once a crisis hits and they need to implement tough fiscal adjustments.

The limited access to the country's resources imposed by the political constraint incorporated in the model relates the paper to the work of Chang (2007). However the nature of the discrepancy that detemines the default decision is very different between the two papers. In Chang (2007) sovereign default can be triggered by divergent preferences between a representative agent and a non-benevolent government. Quite on the contrary, in this paper the political constraint can trigger a default due to the divergent preferences between the heterogeneous agents and the aggregate welfare maximizing decision of a benevolent government. The fact that we do not need to impose non-benevolent governments to generate a default equilibrium highlights the destabilizing effects of the distributional consequences of the repayment/default decision. Additionally, this focus on the distributional aspect connects the paper with the literature that analyzes the costs of sovereign defaults due to the fact that a fraction of sovereign debt is usually held by locals. Among them are Dixit and Londregan (2000), Tabellini (1991) and Guembel and Sussman (2009), D'Erasmo and Mendoza (2012). While this literature sheds light on potential distributional aspects of the sovereign default, it does not analyze out the distributional aspects of the sovereign repayment decision, an area in which our paper makes an original contribution.

Finally, it is worth noting that all the models just mentioned share the following common features: i) the government has unlimited access to the economy's resources (which are always sufficient to repay the sovereign debt); and ii) a default is a consequence of the government being unwilling to repay. In this regard, the main contribution of our paper to the existing literature is to relax the assumption that the government is always able to repay and to allow

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for equilibria where the government is forced to default even though it would have preferred to repay. As previously mentioned these novelties generate a richer typology of sovereign defaults.

The paper is organized as follows: Section II presents the theoretical model and characterizes the equilibrium, Section III classifies the different types of defaults that arise in our model, Section IV calibrates the model to the Argentine and Greek economies and assesses its quantitative implications and Section V concludes.

2.2 The model

2.2.1 Environment

Consider a small open economy inhabited by a continuum of households and a benevolent government. Households are risk averse and have the same preferences. Each household's income is equal to $y_i^r = \alpha_i y$, where α_i is the constant share of the aggregate endowment y that household i receives. The aggregate endowment follows a Markov process with transition density $f(y', y)$ defined on a compact subset $Y \subset \mathbb{R}_+$. Households derive utility from consumption:

$$U(c_i) = E_0 \sum_{t=0}^{\infty} \beta^t u(c_{it})$$

where the function $u(c)$ denotes the strictly concave and increasing Bernoulli utility function and β refers to the subjective discount factor.

The government is benevolent and thus maximizes aggregate well-being (i.e. social welfare). Social welfare is defined as the sum of utility levels across individual households. Formally:

$$W = \int_{\Omega} E_0 \sum_{t=0}^{\infty} \beta^t u(c_{it}) di$$

where Ω refers to the households' population set, which has unit measure.

The government has the technology to set uniform subsidies or taxes, τ, across individual households.[4] In addition, the government is the only agent within the small economy who has access to international credit markets. In each period, the government issues one period

[4] As households cannot have negative consumption, we restrict the taxes not to exceed the income of the poorest household, i.e.:

$$\tau \leq \min_{i \in \Omega} y_i^r = y_{\min}^r$$

With some additional notation, one can think of $y_{\min}^r$ as the income of the household with lowest income among those that pay taxes.

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zero-coupon bonds and sells them to the foreign lenders. We denote by B' the amount of debt that the government has issued in the current time period and that promises a payment to bond holders of B' units of consumption in the following period. If $B' < 0$ the government is a debtor, otherwise it holds assets. When the government issues debt, it obtains $B'q(B', y)$ units of current consumption, where $q(B', y)$ refers to the unitary price of sovereign bonds given current aggregate output endowment, y, and the amount of debt to be issued, B'.

Sovereign bonds are assumed to be non-collateralized and defaultable. To repay its sovereign bonds, the government proposes a fiscal program, i.e. a combination of new bond issuances, B', and taxes τ, that households have to approve or reject. For the government to be able to repay the debt, there must exist a fiscal program that satisfies two conditions. First, the fiscal program must generate enough resources. That is, given outstanding bonds issued in the previous period, B, the government must be able to issue new bonds, B', and to set taxes, τ, such that:

$$\tau - B'q(B', y) \geq -B \tag{2.1}$$

Second, the fiscal program must garner sufficient support from individual households. Households express their approval or rejection for a given fiscal program through a referendum (i.e. voting for or against the program). Given current aggregate output y, the political support function that collects the households' approval over a fiscal program (B', τ) proposed by the government is defined as:

$$p(B', \tau; y) = \int_{\Omega} p_i(B', \tau; y)\, di \tag{2.2}$$

where $p_i = 1$ if household i votes in favor of the fiscal program and $p_i = 0$ otherwise.[5] The fiscal program is approved only if:

$$p(B', \tau; y) \geq p^r \tag{2.3}$$

where $p^r \in [0, 1]$ refers to the minimum level of households' approval required to implement a fiscal program.

The parameter p^r captures the political independence that the government has in terms of the set of policies it can implement to raise funds. If $p^r = 0$, households cannot veto any fiscal program proposed by the government, thus, the government faces no political constraint. In contrast, if $p^r > 0$, households can affect both the choice of the fiscal program that the government makes and the repayment/default outcome.

[5] We assume individual households responses to be equally weighted within the political support aggregator mechanism.

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Note that if there are fiscal programs that satisfy the resource constraint, (2.1) , and the political constraint, (2.3), the government is **able** to repay. However, it might still **choose** not to do it.

If the government defaults, regardless of the cause, it is temporarily excluded from international credit markets. We take the exclusion period to be exogenous and stochastic. Specifically, the reentry time follows an exogenous Poisson process with flow probability equal to θ. Once the economy randomly regains market access, without loss of generality, we assume that it does so with zero debt. While in autarky, the economy suffers an output loss in its aggregate endowment and households consume their individual financial autarky endowments, y_i^d, defined as:

$$y_i^d = \alpha_i h(y) \leq y_i^r$$

where $h(y)$ stands for the output loss function.

Foreign lenders have risk neutral preferences, behave competitively and can trade both the sovereign bond and a risk-free asset that yields $r > 0$. Consequently, they are willing to lend to the government as long as they break even in expected value**.** Foreign lenders are fully aware of the resource and the political economy constrains the government faces. Besides, they recognize the government's incentives to default on the sovereign bonds. Then, in equilibrium, the sovereign bond price perfectly captures the sovereign default risk prevailing in the economy.

2.2.2 Value Functions and Recursive Equilibrium

The timing of events in the economy is as follows. At the beginning of each period, the government observes the current aggregate endowment, y, and, given the amount of sovereign debt, B, it proposes a fiscal program, (B', τ), or it declares a default. If the government proposes a fiscal program, each household then decides whether to approve or reject the proposal.[6] Households' individual responses are aggregated by the political support function, $p(B', \tau; y)$. If their aggregated political support exceeds the threshold p^r and the fiscal program raises at least B, the government can implement the proposal and repay the debt. Otherwise, the government is forced to default. Finally, consumption takes place. If the government defaults, household i consumes her financial autarky output endowment, y_i^d, while if the government repays, consumption for household i is $y_i^r - \tau$.

[6]For simplicity, we assume that households cannot enter into cooperative arrangements, and that the government cannot commit to ex-post transfers to compensate households.

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2.2.2.1 Government's problem

In every period in which the government is current on its debt, it may be able or unable to repay the debt, depending on the level of outstanding debt and on the aggregate income shock. If there is no fiscal program for which both the resource and political constraints are satisfied, then the government is unable to repay and forced to default. Otherwise, it is able to repay and, therefore, it can choose, with the objective of maximizing households' aggregate welfare, whether to do it or not. Let $v_g^0(B,y)$ be the value function for the government at the beginning of the period:

$$v_g^0(B,y) = \begin{bmatrix} v_g^d(y) & \text{if } \nexists\,(B',\tau) \text{ with } \tau \leq y_{\min}^r : (2.1) \text{ and } (2.3) \text{ hold} \\ v_g^a(B,y) & \text{otherwise} \end{bmatrix}$$

where $v_g^d(y)$ and $v_g^a(B,y)$ refer to the value of being unable and able to repay respectively. The value function when the government is able to repay, $v_g^a(B,y)$, is given by:

$$v_g^a(B,y) = \max_{\{r,d\}} \left\{ v_g^r(B,y), v_g^d(y) \right\} \tag{2.4}$$

where $v_g^r(B,y)$ is the value associated with repayment. Note that the value function of default in this model is the same regardless of the cause of the default. Formally, this value is given by:

$$v_g^d(y) = \int_\Omega u\left(y_i^d\right) di + \beta \int_Y \left[\theta v_g^0(0,y') + (1-\theta) v_g^d(y')\right] f(y',y)\, dy' \tag{2.5}$$

When the government repays, it must be the case that its fiscal program satisfies its budget constraint, raising enough funds to honor current debts, and that it achieves enough political approval across households. Then, the government's value function satisfies:

$$\begin{aligned} v_g^r(B,y) \;=\; & \max_{(B',\tau)} \int_\Omega u\left(y_i^r - \tau\right) di + \beta \int_Y v_g^0(B',y') f(y',y)\, dy', \\ & \text{subject to (2.1) and (2.3)} \end{aligned} \tag{2.6}$$

and the fiscal program it proposes is the solution to this problem.

Since the government anticipates the voting strategy of the households, without loss of generality, we assume that it only proposes fiscal programs that end up being approved. Then, we characterize the default set $D(B)$ and repayment set $R(B)$ as:

$$D(B) = \left\{ y \in Y : \begin{array}{l} \text{if } \nexists\,(B',\tau) \text{ with } \tau \leq y_{\min}^r : (2.1) \text{ and } (2.3) \text{ hold} \\ \text{or } v_g^r(B,y) < v_g^d(y) \end{array} \right\}$$

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and:

$$R(B) = \left\{ y \in Y : v_g^r(B, y) \geq v_g^d(y) \right\},$$

When repaying, the proposed fiscal program $(B'(B, y), \tau'(B, y))$ is the one that solves problem (2.6).

2.2.2.2 Households' problem

Households maximize their utility by choosing whether to approve or reject the government fiscal program. A household that approves the proposal wants the government to repay while a household that rejects it wants the government to default. Let $p_i(B', \tau; y)$ be the optimal voting decision for household i, given current aggregate output y and the government fiscal program (B', τ):[7]

$$p_i(B', \tau; y) = \begin{bmatrix} 1 \text{ if } v_i^r(B', \tau; y) \geq v_i^d(y) \\ 0 \text{ if } v_i^r(B', \tau; y) < v_i^d(y) \end{bmatrix} \tag{2.7}$$

where 1 stands for voting in favor and 0 for voting against, and $v_i^r(B', \tau; y)$ and $v_i^d(y)$ are the value functions, from household i perspective, of the government repaying by implementing a fiscal program (B', τ) and defaulting, respectively. Formally, these value functions are given by:

$$v_i^r(B', \tau; y) = u(y_i^r - \tau) + \beta \int_Y v_i^0(B', y') f(y', y) dy'$$

$$v_i^d(y) = u\left(y_i^d\right) + \beta \int_Y \left[\theta v_i^0(0, y') + (1 - \theta) v_i^d(y')\right] f(y', y) dy' \tag{2.8}$$

where $v_i^0(B, y)$ denotes the value, from household's i point of view, of living in an economy where the government has access to credit markets, given outstanding debts B and aggregate output y.

Since households anticipate the government behavior, $v_i^0(B, y)$ is:

$$v_i^0(B, y) = \begin{bmatrix} v_i^r(B'(B, y), \tau'(B, y); y) & \text{if } y \in R(B) \\ v_i^d(y) & \text{if } y \in D(B) \end{bmatrix} \tag{2.9}$$

2.2.2.3 Foreign lenders' problem

Foreign lenders understand that default can happen with a positive probability when they lend to the government. Since foreign lenders behave competitively and have risk-neutral preferences, the expected return of lending to the government should equal the risk

[7] We assume that indifferent households approve the government's proposal.

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free interest rate. This implies that the sovereign bond price satisfies:

$$q\left(B',y\right)=\frac{1-\Pr\left[D\left(B'\right)|Y=y\right]}{1+r} \tag{2.10}$$

2.2.2.4 Recursive Equilibrium

A Recursive Equilibrium for this economy is: i) a government policy set, $\{(B'(B,y),\tau'(B,y));R(B);D(B)\}$; ii) a household's i voting strategy, $p_i\left(B',\tau;y\right)$, iii) a sovereign bond price function, $q\left(B',y\right)$ and iv) a political support function, $p\left(B',\tau;y\right)$, such that:

1. Given the sovereign bond price function $q\left(B',y\right)$ and the political support function $p\left(B';B,y\right)$, the government's policy set $\{(B'(B,y),\tau'(B,y));R(B);D(B)\}$ satisfies the government's optimization problem.

2. Given the government's policy set $\{(B'(B,y),\tau'(B,y));R(B);D(B)\}$, the household's voting strategy $p_i\left(B',\tau;y\right)$ satisfies the household's optimization problem.

3. The sovereign bond price function $q\left(B',y\right)$ reflects the government's default probability and satisfies the foreign lenders' break-even condition.

4. The political support function $p\left(B',\tau;y\right)$ is consistent with households voting strategies.

2.3 A classification of sovereign defaults

Standard sovereign default models have focused on default episodes in which the government is unwilling to repay. In effect, in most of these models, the government has full access to the resources of the economy, which are assumed to be sufficient to repay the debt, and it does not face political restrictions. Then, a sovereign default can only arise if the government prefers to default rather than to repay (i.e. if the government is unwilling to repay its debts).

In the real world, the sovereign default universe is richer than the traditional theoretical depiction of it. In particular, a distinctive feature is that in many circumstances sovereign defaults are not the result of the government being unwilling to repay but of the tough political opposition that governments sometimes face when trying to implement fiscal programs in order to raise funds to repay. The literature so far has been silent about these different types of default. Indeed, by only focusing on "unwillingness to repay" defaults, the literature has been silent about the notion of different types of sovereign defaults altogether.

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The political economy model developed above generates different types of sovereign default episodes and allows us to distinguish between them. Three different types of sovereign defaults may arise. First, we have the "pure inability to repay" type of default. In this situation the default occurs because the government cannot generate enough revenues through taxes and new debt issues to repay its debt. We can formalize this situation for a given level of debt B and aggregate output y as follows:

$$\tau - q\left(B', y\right) B' < -B \; \forall \left(B', \tau\right) \text{ with } \tau \leq y^r_{\min}$$

Second, we have the "politically constrained inability to repay" type of default. This type of default is intimately related to the presence of a political constraint. In this case, if the government were required to only meet the resource constraint, it would be able to raise enough funds to repay its debts. However, the presence of the political constraint makes the government unable to find a combination of taxes and debt issuance that raises enough funds to repay and, at the same time, garners sufficient political support so as to be implementable. As in the previous type of default, in this situation, the government does not face a choice on whether to default or repay, instead, it has no option but to default. Formally, this type of default is one in which:

$$\exists \left(B', \tau\right) \text{ with } \tau \leq y^r_{\min} : \tau - q\left(B', y\right) B' \geq -B$$

but, $\forall \left(B', \tau\right)$ for which the previous equations is satisfied, $p\left(B', \tau; y\right) < p^r$.

The third and last type is the "unwillingness to repay" default. In this type of default, repayment is both economically and politically feasible, but the government still prefers to default as this decision maximizes aggregate welfare from the government perspective. That is, there are fiscal programs, $\left(B', \tau\right)$, that generate enough revenues to repay the sovereign debt and, at the same time, would garner sufficient political support to satisfy the political constraint; nevertheless, the government would rather default than implement such a fiscal program. In our model, this type of defaults is formally characterized as:

$$\begin{aligned} &\exists \left(B', \tau\right) \text{ with } \tau \leq y^r_{\min} : \tau - q\left(B', y\right) B' \geq -B \text{ and } p\left(B', \tau; y\right) \geq p^r, \\ &\text{but } v^r_g\left(B, y\right) < v^d_g\left(y\right). \end{aligned}$$

Note that the sovereign debt literature only analyzes a particular case of this latter type of default. One in which the political constraint does not exist (i.e. $p^r = 0$) and the government always has enough resources to make a repayment if it chooses to do so. As a result, in traditional models, sovereign defaults are always due to a government "unconstrained unwillingness to repay".

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We can also distinguish our three types of default episodes by partitioning the default set in the following way:

$$A(B) = \{y \in Y : (2.1) \text{ does not hold}\}$$

$$A_c(B) = \{y \in Y : (2.1) \text{ holds but } (2.3) \text{ does not }\}$$

$$W(B) = D(B) - \{A(B) \cup A_c(B)\}$$

where the first set stands for the "pure inability to repay" type of default; the second, for the "politically constrained inability to repay" and the third, for the "unwillingness to repay".

Foreign lenders fully understand how the economy works, so they take into account all possible default events when pricing the sovereign bond. It follows that the sovereign bond price captures the probability of occurrence of the three types of default described above. In this sense, our model shows that foreign lenders consider both the government risks as well as the political economy risks when pricing sovereign debt.

2.4 Discussion: key ingredients of the model

Our model departs from standard sovereign debt models in two crucial ways: we assume that households are heterogeneous in their income and that the government needs some amount of households' support (i.e. the political constraint) to implement its desired policy. The first assumption allows us to capture the divergent effects that a given repayment program might have on the utilities of households that belong to different income groups. These divergent effects give rise to potential disagreements both among households and between households and the government regarding the optimal policy to be implemented.

The empirical evidence on the distributional effects of sovereign defaults is very scarce and it is even scarcer for analyzing the effects of avoiding a sovereign default once a country is facing a sovereign debt crisis. But this paper provides a framework to analyze how different distributions of these costs can interact in determining the final repayment/default decision. In particular the agreement or disagreement regarding the repayment decision depends on the interaction between the distribution of income; the preferences of the household; how the government aggregates these preferences; and the structure of taxes implemented by the government. Trivially, if households were all identical in receiving the same income endowment, they would all perfectly agree on the optimal policy to implement. In this case we are back to the traditional environment with homogeneous agents. On the other hand, if the distribution of income becomes more unequal, divergences both among households and between households and the government become more and more probable.

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Regarding the preferences of the households, the standard utility function used in DSGE model is the CRRA, which implies strict concavity and constant relative risk aversion with respect to income. Regarding the aggregation of the households' preferences by the government, we are interested in focusing on benevolent governments in order to highlight the fact that it is not necessary to step away from this simplifying assumption to generate disagreements between the government and its heterogeneous constituencies. Furthermore, we show how that these disagreements can arise with a benevolent government that maximizes the sum of utility levels across individual households: since households sometimes disagree among themselves, the government preferred policy will sometimes be different from some of the households' preferred one.

Finally, the assumption that taxes are uniform[8] across households leaves us with two potential tax systems: lump-sum or proportional taxes. The combination of lump-sum taxes with the CRRA utility function means that wealthy households are willing to tolerate higher lump-sum taxes than poorer households in order to repay the debt. In other words, wealthy households would prefer to repay more often than poorer ones. On the other hand, if taxes were proportional, after-tax income endowments would be proportional across individual households, and hence all of them would display the same preference order over fiscal programs and over the repayment/default decision. Any combination of the two would lead to intermediate situations.[9]

The second assumption, i.e. the political constraint, captures the fact that governments need some degree of political support to implement a proposed fiscal program. This support typically materializes itself through the congress or parliamentary approval of the government's budget. In times of sovereign debt crises, this support becomes critical since if the fiscal program is rejected the government can be forced to default. By capturing this feature, we could say that our model departs from standard sovereign debt models by leaving behind the assumption that governments are autocracies, i.e. the assumption that governments can always implement the policies they desire to without facing any kind of resource or politi-

[8]Note that if taxes were not uniform, households might still have different opinions on the policies the government should implement. However, in this case, the government would not only have incentives to borrow from abroad to smooth households' consumption paths across states of nature but would also have incentives to implement redistributional policies. Since in this paper we are not interested in dealing with redistributional issues, we restrict the analysis to uniform tax schemes.

[9]In many countries, the poorest segment of the population typically works informally what keeps them outside the formal economy. This way it is very difficult for the government to tax them. Then it could be interesting to explore the scenario where we combine either lump-sum or proportional taxes with the assumption that the poorest households cannot be taxed due to the "invisibility" of their income to the government. In principle, such a situation could lead to a higher support to the repayment decision, since the segment that is now exempted from the taxes would also support repayment. But since it would also mean higher taxes for all the other segments, this could make some households that supported repayment before to reject it now.

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cal constraints. In our model, the presence of the political constraint is key since it gives households a way to veto the government desired policies.

To sum up, in our model, differences in opinion across households regarding the optimal policy to be implemented follow from the combined effect of households' income distribution, the assumed utility function and the type of taxes that the government can levy. In every period, these differences in opinion interact with the political constraint and determine whether the sovereign debt is repaid or not.

2.5 Calibration and quantitative analysis

2.5.1 Calibration

In this section we calibrate our theoretical model with the objective of analyzing the quantitative implications of the previously discussed mechanisms under the specific assumptions of CRRA utility function, lump-sum taxation and simple majority rule for the political constraint. We chose these assumptions with the objective of keeping the exercise as simple as possible and to highlight the quantitative implications of the original features of the model. We calibrate our model to the Argentine economy, focusing on the 2001 debt crisis in order to be able to compare our results with the vast majority of studies in the endogenous default sovereign debt literature.

As it is standard in sovereign default studies, we choose a CRRA functional form for the Bernoulli utility function in the numerical simulations:

$$u(c) = \frac{c^{1-\sigma} - 1}{1 - \sigma}$$

with a coefficient of relative risk aversion σ equal to 2.

We set the model at the quarterly frequency. We assume the aggregate output to follow an AR(1) stochastic process:

$$\ln y_t = \rho \ln y_{t-1} + \varepsilon_t$$

with $|\rho| < 1$ and $\varepsilon_t \sim N(0, \sigma_\varepsilon^2)$. To estimate these parameters, we use GDP data taken from the Argentine Ministry of Finance ranging from the first quarter of 1980 to the second quarter of 2001. The GDP time series is in quarterly frequency, in real terms and seasonally adjusted; it is logged and then detrended using a linear filter. Our estimates of ρ and σ_ε are 0.945 and 0.025, respectively.

A relevant feature of our analysis is how we calibrate households' income heterogeneity. We do it using the Argentine income distribution in 1998 as measured by the Center for

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Distributive, Labor and Social Studies (CEDLAS).[10] This year is the first one in which they provide information for the whole country. We assume that aggregate output is distributed across three different households' types (poor, middle income and rich) according to:

Table I. Income Distribution for the Argentine economy

α_1	α_2	α_3
12%	34%	54%

where α_1 equals the total share of the income distribution for deciles 1, 2, 3 and 4; α_2 for deciles 5, 6, 7 and 8 and α_3 for the remaining two deciles.

In order to specify the value of the political support threshold p^r, as a first pass, we assume a simple majority voting process and set $p^r = 0.5$.[11] We analyze how our results change for a variety of parameter values, including $p^r = 0$ in which case our results are more similar to those of standard sovereign default models.

As in Arellano (2008), we choose an asymmetric output loss function:

$$h(y) = \min\{y, (1-\lambda) E(Y)\}$$

where $E(Y)$ stands for the aggregate output unconditional mean and λ refers to the percentage aggregate output loss during a sovereign default episode.

The subjective discount factor β, the re-entry to credit markets probability θ and the percentage aggregate output loss λ are set as in Arellano (2008) for comparability.[12] Finally, the risk-free interest rate r is set to 1.7%, just to equal the average quarterly interest rate of a 5 year U.S. treasury bond from the first quarter of 1980 to the second quarter of 2001.

Table II summarizes this discussion:

Table II. Parameter Values for Argentina

σ	ρ	σ_ϵ	β	θ	λ	r
2	0.945	0.025	0.953	0.282	0.96	1.7%

2.5.2 Quantitative analysis

In this section, we explore the quantitative implications of the theoretical model. First we explain how the presence of the political constraint affects both the government borrowing

[10] The CEDLAS is an independent research organization at the Universidad de La Plata, Argentina.

[11] Given that we divide the population in three groups, the first two with 40% of the population each and the other one with 20%, our results would be the same for any $0.4 < p^r < 0.6$. This changes once we do a finer partition of the population (see section Business Cycle Frequencies).

[12] Arellano (2008) uses a θ consistent with the empirical findings of Gelos et al (2011) and sets λ and β to match in her model the standard deviation of the current account and the ratio of debt service to GDP.

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decision as well as and the repayment/default outcome. Then, we describe some relevant properties of the sovereign bond price function and, finally, we study the simulated business cycle frequencies for the model calibrated to the Argentine economy and compare them to the ones in the data and in standard sovereign default models.

2.5.2.1 Effects of the political constraint

As previously explained, the introduction of a political constraint reduces the feasible set of fiscal programs available to the government. In doing so, it makes the default set larger and reduces the maximum amount of resources the government can borrow from abroad in any given period.

Figure 1 shows the effect on the default set of increasing the political threshold. Higher levels of the political threshold (i.e. higher p^r) imply a reduced set of fiscal programs available to the government and hence more difficulties, and also less incentives, to repay its debt. Thus, the default set grows with p^r. In particular, the default set is relatively larger for those levels of sovereign debt where repayment is still economically feasible but undesired, or unfeasible due to the political constraint.

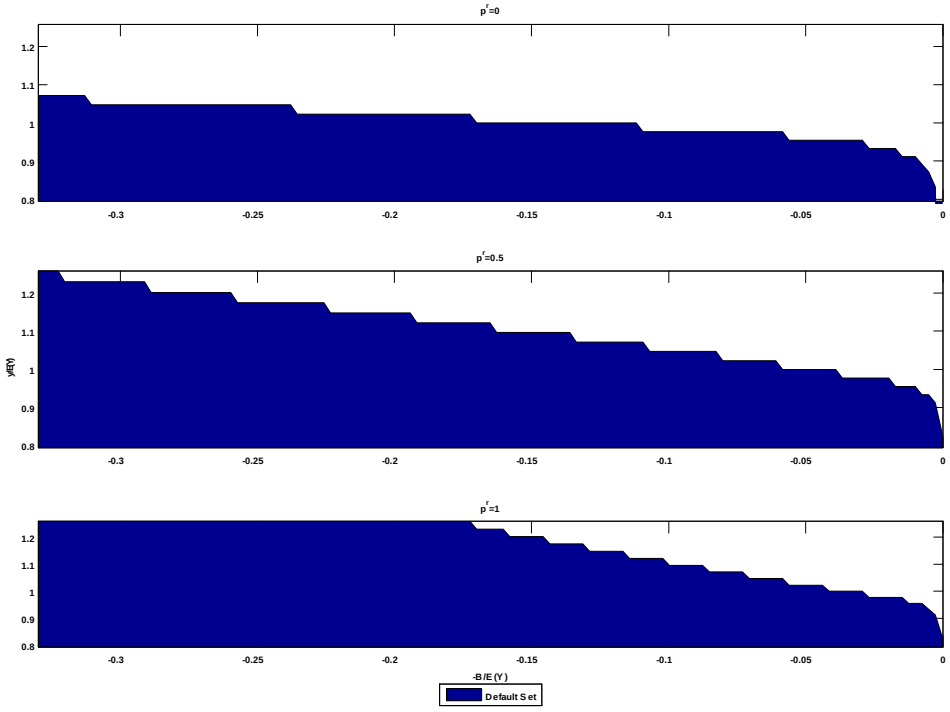

FIGURE 1

Figure 2 shows the effect of p^r on the maximum amount of resources that the government can borrow from abroad. Higher p^r affects the total resources that the government can borrow as foreign lenders discount the sovereign bond price by its endogenous probabilities of default, and as we explained above, the default set is larger with the constraints.

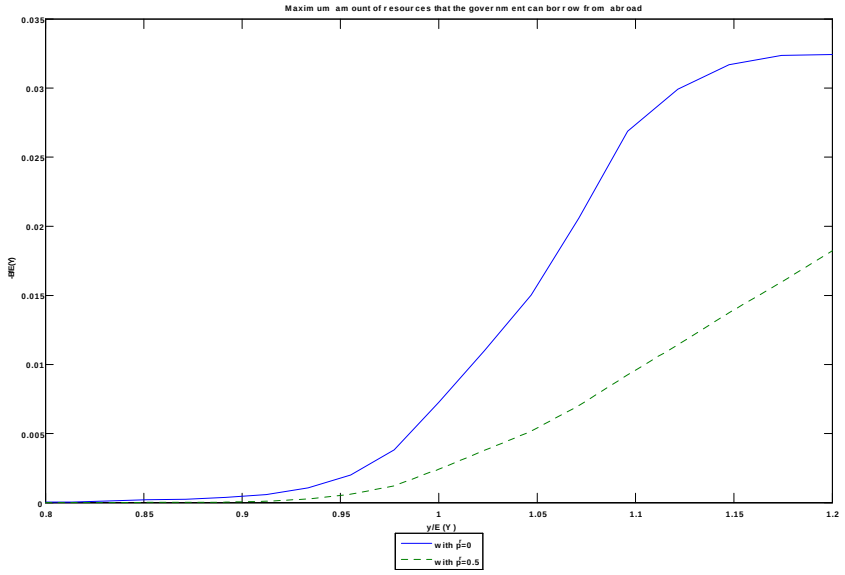

FIGURE 2

We can distinguish two related effects of the political constraint on the government borrowing decision and on the default/repayment outcome: the first one, the direct effect, is the result of the government having access to a reduced set of feasible fiscal programs, while the second one, the indirect effect, follows from the lower sovereign bond price function the government faces. Both effects operate in the same direction, namely, both of them make the default set larger and, as a result, reduce the government borrowing capacity. Moreover, both of them reinforce each other: since the government faces a reduced set of feasible fiscal programs, the bond price turns to be lower, and for this reason, the government faces an even more reduced set of feasible fiscal programs.

2.5.2.2 Relevant properties of the sovereign bond price function

As it is standard in this literature, the sovereign bond price $q\left(B', y\right)$ decreases as the ratio of debt to GDP goes up. This decline is the result of the increase in the default probability. We can decompose the default probability as a function of the debt to GDP ratio among all the default types that can arise in our model.

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In Figure 3 we show the probability of each type of default and the sovereign bond price for $p = 0.5$. Reasonably, for large debt issuances the likelihood of the "pure inability to repay" type of default episodes predominates over the likelihood of the "politically constrained inability to repay" events. However, for ratios of debt to GDP low enough this relationship is reversed. When the government issues lower levels of debt (but not sufficiently low), foreign lenders mostly fear a situation where the government is just unwilling to repay. As the government issues less debt, the overall likelihood of the three types of default episodes decreases. In particular, as the debt to GDP ratio goes to zero, the probability of default goes to zero and the sovereign bond price approaches the price of the risk-free bond.

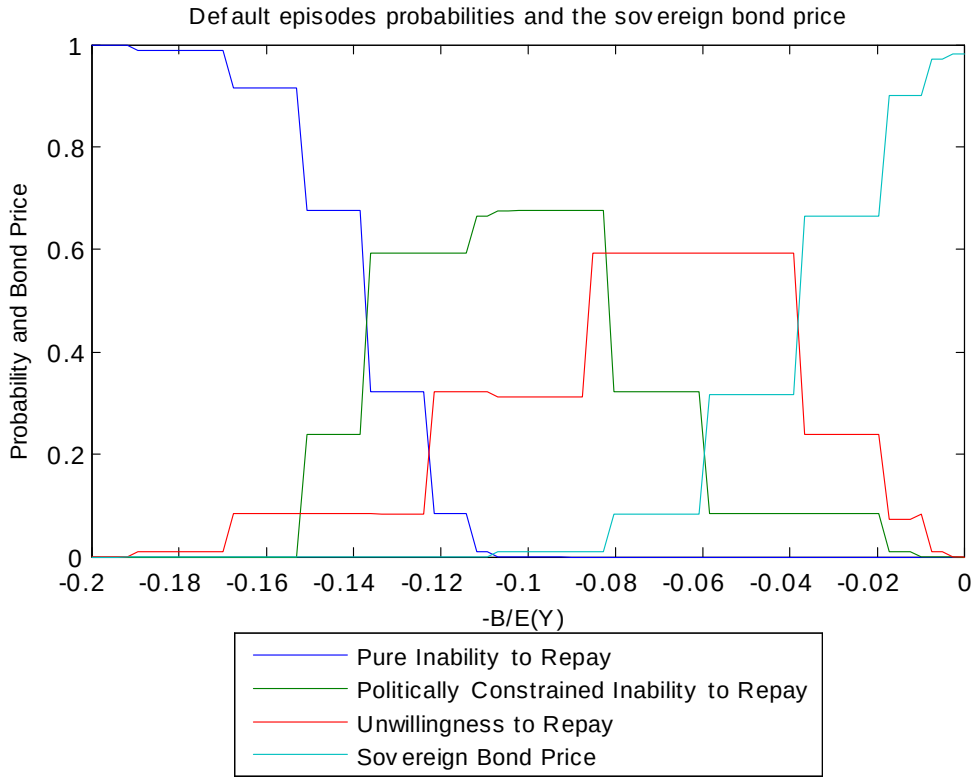

FIGURE 3

Figure 4 shows that range of debt to GDP ratios for which the price is positive is smaller the higher is p^r. In particular, in the extreme case where $p^r = 1$, the sovereign bond becomes worthless for output-debt ratios higher than 7% when the aggregate output is at trend level. In this case, foreign lenders demand very high returns since they know that in future the

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government will either be unable or have little incentives to repay. When $p^r = 0.5$, the sovereign bond price is zero debt to GDP ratios higher than 11%, while when $p^r = 0$ this happens for ratios higher than 31%.

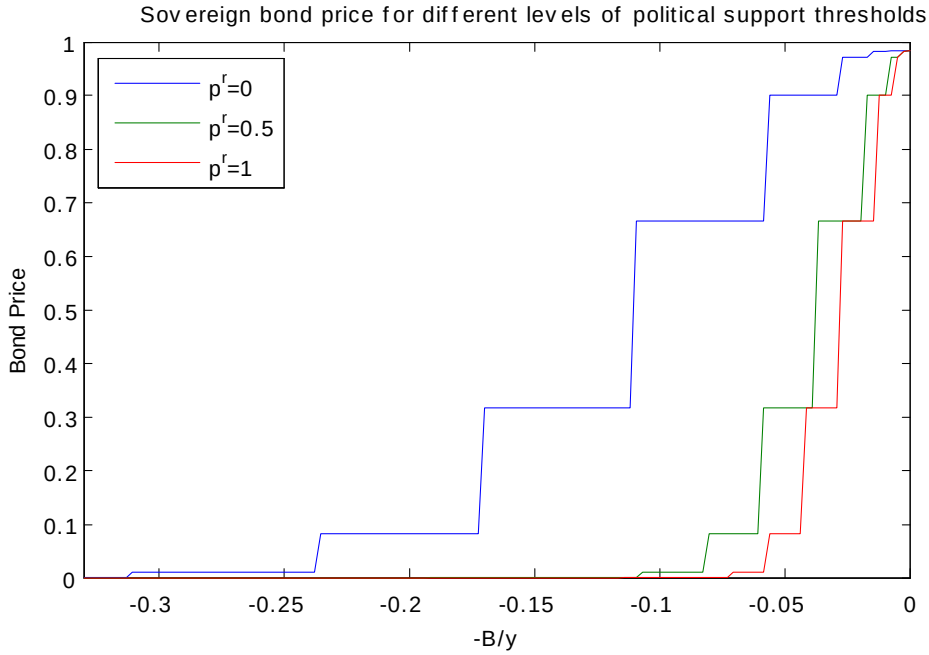

FIGURE 4

Finally, in line with standard sovereign default models, in our model the sovereign bond price rises with aggregate output (keeping constant the level of sovereign debt). This result follows from both the positive serially autocorrelation of aggregate output as well as the positive correlation between individual and aggregate output: when current aggregate output is high, foreign lenders expect individual outputs to remain high in the next period, and making the government more able and willing to repay its debts.

2.5.2.3 Business cycle frequencies

In the late December of 2001, the Argentine government defaulted on its debt. Following this default, the Argentine economy suffered a deep recession. In the first quarter of 2002, both output and consumption suffered a massive contraction, falling by 14% and 16% below their linear trend, respectively. In addition, in this same quarter, interest rate spreads spiked to almost 30% per year.

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Table IV. Business Cycle Statistics for Argentina

Decline from trend during default episode			
Output (y)	-16.01		
Consumption	-14.21		
Standard deviations and correlations			
	σ	$corr$ with y	$corr$ with sr
Output (y)	7.81	1	-0.88
Consumption	8.60	0.98	-0.89
Trade Balance	1.75	-0.62	0.70
Interest Rate Spread (sr)	5.58	-0.88	1
Mean Debt/Output ratio	-43.30		
Mean Interest Rate Spread	10.35		

Table IV presents the main statistics for the business cycle of Argentina. Consumption, output and trade balance data are taken from the Ministry of Finance (MECON). All time series are in quarterly frequency, in real terms and seasonally adjusted. Consumption and output series begin in the first quarter of 1980; they are logged and then detrended using a linear filter. Trade balance series begin in the first quarter of 1993; they are divided by output and are expressed in percentage units. For the interest rates we use the Emerging Markets Bond Index (EMBI), taken from Neumeyer and Perri (2005).[13] Interest rates spread are computed by subtracting the yield of the 5 year U.S. treasury bond from the EMBI. Debt levels are taken from Global Development Finance database.

During the time interval we focus on, Argentine business cycle frequencies were consistent with the usual business cycle frequencies documented for emerging market economies. As Table IV shows, domestic output, consumption and real interest rates displayed high volatility levels; consumption was more volatile than domestic output; real interest rates anticipated the cycle and moved countercyclically, shrinking when domestic output expanded and spiking when output collapsed; and net exports and the current account also displayed a countercyclical behavior. In the default episode, all variables' deviations notably exacerbated. In particular, in this single period, both output and consumption dropped by almost

[13]The EMBI is an interest rate index composed of mostly long term maturity Argentina's dollar bonds that starts in the third quarter of 1983.

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two times their standard deviations.

To produce business cycle frequencies comparable to the ones documented for the Argentine economy we selected from our simulations time intervals consisting of 74 quarters and ending up in a default episode. Then, we detrended the time series using a linear filter, and we took the average across selected time intervals for the relevant statistics.[14]

Table V reports the model business cycle frequencies for different levels of p^r both for homogenous and heterogeneous households. In the first case, our model and its business cycle frequencies are equivalent to Arellano (2008). We use the case of homogenous households as the benchmark case with which we compare our results with heterogenous households.

Table V. Model Business Cycle Frequencies for Argentina

	Households		
	Homogenous	Heterogeneous	
		$p^r = 0.5$	$p^r = 1$
Output Decline	-9.59	-9.02	-10.32
Consumption Decline	-9.48	-8.99	-10.31
Std(Output)	5.78	5.82	5.90
Std(Consumption)	6.29	5.95	5.93
Std(Trade Balance)	1.39	0.45	0.21
Std(Spread)	6.68	7.01	1.02
Corr(Output, Cons)	0.97	0.99	0.99
Corr(Output, TB)	-0.23	-0.22	-0.13
Corr(SR, Output)	-0.29	-0.23	-0.10
Corr(SR, Cons)	-0.36	-0.25	-0.09
Corr(SR, TB)	0.39	0.40	0.34
Mean Debt/Output	-5.54	-1.7	-0.38
Mean Spread Rate	4.17	3.68	0.45

When the political constraint only requires the approval of half of households' for the government to be able to implement fiscal programs, i.e. when $p^r = 0.5$, our model performs

[14] The almost 3000 time intervals selected in our computational experiment match our sample interval for the Argentine economy.

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reasonably well at the business cycle frequencies. In particular, aggregate consumption and interest rates volatilities are as much as 75% and 69% of actual volatilities, respectively; aggregate consumption is more volatile than aggregate output and strongly procyclical; and both interest rates as well as the trade balance are countercyclical.

However, in other dimensions, our model displays some mismatches with data (the average debt to GDP ratio and the average spread rate predicted in our model accounts for only 4% and 36% of the ones documented in the data, respectively). Failure to match these dimensions of the data is a feature shared with most sovereign debt models in the literature. The fact that the performance of our model is slightly weaker on this regard than other sovereign debt models is the direct result of the larger default set that the presence of the political constraint generates. In effect, from an ex-post perspective, the presence of the political constraint expands the set of sovereign debt levels for which the government will default. Nevertheless, the equilibrium level of sovereign debt is lower, defaults are less frequent and interest rates are lower in our model than in standard sovereign debt models. This happens because from an ex-ante perspective the country is better off avoiding sovereign defaults. As a result, the government chooses lower levels of sovereign debt, which eventually trigger fewer defaults reducing the interest rate.

When the political constraint requires the approval of all households for the government to be able to implement fiscal programs (i.e. when $p^r = 1$), our model performance is weaker than in the previous case. As Table V evidences, both consumption and interest rates display lower volatility levels and correlations are even weaker. Moreover, during the default episode, the consumption collapse is less significant and the model does not predict the current account reversal. Finally, under this parametrization our model considerably under estimates the average debt to output ratio and the average spread rate (if $p^r = 1$, the former is only equal to -0.38% while the latter is 0.45%).

Increasing households heterogeneity does not alter much our quantitative results. Table VII reports the numerical results for the model simulated for the case of $p^r = 0.5$ and in which aggregate output is distributed among five different households types according to:

Table VI. Shares in aggregate output

α_1	α_2	α_3	α_4	α_5
4%	8%	13%	21%	54%

where α_1 equals the total share of the income distribution for deciles 1 and 2; α_2 for deciles 3 and 4; and so on.

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Table VII. Model Business Cycle Frequencies with 5 Households' Types

	Heterogeneous Households $p^r = 0.5$
Output Decline	-9.61
Consumption Decline	-9.58
Std(Output)	5.58
Std(Consumption)	5.95
Std(Trade Balance)	0.29
Std(Spread Rates)	6.57
Corr(Output, Cons)	0.99
Corr(Output, TB)	-0.23
Corr(SR, Output)	-0.24
Corr(SR, Cons)	-0.25
Corr(SR, TB)	0.38
Mean Debt/Output	-0.66
Mean Spread Rate	3.19

As in the case with only three different households types, differences in the business cycle frequencies between our model and that in Arellano (2008) are not substantial.

2.6 Conclusion

This paper analyzes how the presence of political constraints affects sovereign governments' borrowing and default decisions. We do this by introducing in a standard dynamic stochastic general equilibrium (DSGE) model with endogenous sovereign default risk two novel features: heterogeneous households and a requirement that the government garners some of their support to repay its sovereign debt.

The introduction of these two novel features in a standard sovereign debt model allows us to understand why individuals might disagree on the funding policy the government should implement in order to repay sovereign debt and how these disagreements can affect the government's repayment capacity.

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This framework also generates a richer typology of sovereign default events. In contrast with the standard sovereign debt literature, in this framework, sovereign defaults are not exclusively determined by the government's **unwillingness** to repay. Moreover, two new types of default events arise in our model that capture situations in which the government is **unable** to repay. These events can occur either because the government cannot raise sufficient funds to repay even if it could access all the resources in the economy, or, alternatively, because the fiscal programs that raise sufficient funds are not politically feasible.

We calibrate the model to the Argentine economy and estimate the quantitative consequences of the political constraint. Among other things, we analyze how the default set grows as the political constraint becomes more stringent, how is the bond price schedule affected by this higher default probability and which is the range of debt to GDP for which the political constraint becomes more relevant in determining the default.

We believe that taking into account the presence of political constraints is crucial to gain a better understanding of sovereign debt crises. Our paper constitutes a first step in this direction but more work needs to be done.

2.7 Appendix

2.7.1 A: Additional default costs for the government

As evidenced in many sovereign default episodes, after declaring a default, most government officials faced a large number of additional costs which almost did not affect individual households' well-being. For example, after defaulting, most government officials lost their international prestige, their right to participate in international meetings, their influence over the international community, their close ties with other government officials, and so on.[15] Due to the presence of these additional default costs, government officials may be less eager to default than individual households. In addition, the government, comprised as a whole entity, may display a higher aversion towards default episodes than that usually considered in standard sovereign default models.

To analyze the situation described above we need to depart from the benevolent government assumption. In this section, we assume that the government not only cares about individual households' well-being but also about the additional default costs it faces after defaulting. In particular, we suppose that after defaulting and while in financial autarky the

[15] For an extensive survey on the cost of defaulting from governments perspective see Hatchondo and Martinez (2010).

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government flow utility is given by:

$$w^d = \int_\Omega u\left(y_i^d\right) di - c$$

where $c > 0$ stands for the loss in the government utility due to the additional costs it faces. When having access to international credit markets, we assume the government flow utility remains the same as in the baseline model.

Proposition 2.1 *The Default Set is decreasing in the additional default costs c. Moreover, if c exceeds a finite cut off c^*, the government only defaults when it has no other alternative, that is:*

$$D(B) = \{y \in Y : (2.1) \text{ or } (2.3) \text{ do not hold } \forall (B', \tau) \text{ with } \tau \leq y^r_{\min}\}$$

(Omitted).

Reasonably, the proposition above states that the government aversion to default outcomes increases when it faces higher additional costs. More importantly, this proposition shows that if c is sufficiently high, the government will do as much as it can to honor its outstanding debts. In particular, the government only defaults when it is unable to repay. The latter feature may shed light on some extravagant Greek President announcements such that he is even willing to sell his family jewelry to honor current sovereign bonds.

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BIBLIOGRAPHY

[1] Aguiar, M. & Gopinath, G., 2006. "Defaultable debt, interest rates and the current account," Journal of International Economics, Elsevier, vol. 69(1), pages 64-83, June.

[2] Amador, M., 2003. "A Political Economy Model of Sovereign Debt Repayment." Stanford University mimeo.

[3] Arellano, C., 2008. "Default Risk and Income Fluctuations in Emerging Economies." American Economic Review 98 (June): 690–712.

[4] Cuadra, G., and Sapriza. H., 2008. "Sovereign Default, Interest Rates and Political Uncertainty in Emerging Markets." Journal of International Economics 76 (September): 78–88.

[5] Dixit, A., and Londregan, J., 2000. "Political Power and the Credibility of Government Debt." Journal of Economic Theory 94 (September): 80–105.

[6] Eaton, J., and Gersovitz, M., 1981. "Debt with potential repudiation: theoretical and empirical analysis". Review of Economic Studies 48, 289–309.

[7] Gelos, G., Sahay, R. and Sandleris, G., 2011. "Sovereign Borrowing by Developing Countries: What Determines Market Access?" Journal of International Economics, Vol. 83(2), March 2011 .

[8] Guembel, A., and Sussman, O., 2009. "Sovereign Debt without Default Penalties." Review of Economic Studies 76 (October): 1,297–320.

[9] Hatchondo, J., Martinez, L. and Sapriza, H., 2009. "Heterogeneous Borrowers in Quanti-

Andreasen, Eugenia (2012), Essays on Sovereign Default and the Link with the Domestic Economy
European University Institute DOI: 10.2870/46401

tative Models of Sovereign Default." International Economic Review 50 (October): 1,129–51.

[10] Hatchondo, J., Martinez, L., 2010. "The politics of sovereign defaults," Economic Quarterly, Federal Reserve Bank of Richmond, Issue 3Q, pages 291-317.

[11] Neumeyer, A. and Perri, F. 2005."Business Cycles in Emerging Economies: The Role of Interest Rates." Journal of Monetary Economics, 52(2): 345–80.

[12] Tabellini, G., 1991. "The Politics of Intergenerational Redistribution". The Journal of Political Economy Vol. 99, No. 2 (Apr., 1991), pp. 335-357

[13] Tauchen, G. and Hussey, R., 1991. "Quadrature-Based Methods for Obtaining Approximate Solutions to Nonlinear Asset Pricing Models." Econometrica, 59(2): 371–96.

Andreasen, Eugenia (2012), Essays on Sovereign Default and the Link with the Domestic Economy
European University Institute DOI: 10.2870/46401