The Political Economy of Sovereign Defaults

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Abstract

The literature on sovereign default has assumed that governments have unlimited access to the resources of the economy if they decide to repay their sovereign debts. However sovereign debt repayment typically depends on the implementation of fiscal programs that require a minimum level of political support. In the buildup of sovereign debt crises, this political support has proved difficult to achieve for many governments. In this paper, 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 garners some of their support to implement a fiscal program needed to repay the debt. In this framework, we show that there can be different types of sovereign default events. Default can arise because the government is unwilling to repay, in the best tradition of the sovereign debt literature, but also due to insufficient political support even if a benevolent government would prefer to repay. We calibrate the model to the Argentine and Greek economies and show that once political constraints are taken into account the matching with the data of standard sovereign debt models is weaker than previously understood.

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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.[2]

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 literature on sovereign default has abstracted from them, assuming that governments have unlimited access to the economy's resources.[3] This implies that the default or repayment decision is essentially determined by the government's will.[4]

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, as the ones developed in Aguiar and Gopinath

[1] In a recent report Roubini Global Economics View, 21 June 2011 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*".

[2] 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.

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

[4] Papers that analyze the political economy of sovereign defaults can be classified in two main groups. First, there is a set of studies that illustrate the political costs of sovereign defaults related to the fact that a fraction of sovereign debt is usually held by local voters. Among them are Dixit and Londregan (2000), Tabellini (1991) and Guembel and Sussman (2009). The other group of papers analyzes how political turnover affects the government´s incentives to borrow from foreign lenders and to repay the debt. Amador (2003), Cuadra and Sapriza (2008), and Hatchondo, Martinez and Sapriza (2009) are the main references of this group.

(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, while the second one gives households a way to reject a government policy. This latter feature 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 the standard sovereign debt model allows us to develop 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. This can occur because the government cannot raise sufficient funds to repay even if it could access all the resources in the economy, or, alternatively, because the politically feasible fiscal programs that the government could implement do not raise sufficient funds.

This framework also 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.

The basic structure of the model is the following. There is a small open economy inhabited 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 funds to do so. 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 and Greek economies. From an ex-post perspective, the presence of the political constraint enlarges the set of sovereign debt levels for which the government defaults. Nevertheless, 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 happens because 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 Arellano (2008) and Aguiar and Gopinath (2006). Since the empirical evidence calls for the need to include this constraint, our paper shows that the understanding of the links between sovereign default, sovereing spreads rate and business cycles is less thorough than previously thought and further analysis on the topic is required.

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 The model

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 lump-sum subsidies or taxes, τ, across individual households.[5] 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 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 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 $B'q\left(B', y\right)$ units of current consumption.[6]

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 lump sum 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 debts B issued in the previous period, the government must be able to issue new bonds, B', and to set taxes, τ, such that:

$$\tau - B'q\left(B', y\right) \geq -B \tag{1}$$

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 agains 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:

$$p\left(B', \tau; y\right) = \int_{\Omega} p_i\left(B', \tau; y\right) di \tag{2}$$

where $p_i = 1$ if household i votes in favor of the fiscal program and $p_i = 0$ otherwise.[7] The fiscal program is approved only if:

$$p\left(B', \tau; y\right) \geq p^r \tag{3}$$

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 $p^r = 0$,

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

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

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. Note that if the population had a measure $|\Omega|$, larger than one, total tax revenues are bounded from above by $|\Omega| y_{\text{min}}^r$

[6] The symbol $q\left(B', y\right)$ refers to the unitary price of sovereign bonds given current aggregate output endowment, y, and the amount of debt to be issued, B'.

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

households cannot veto any fiscal program proposed by the government, thus, the government faces no political support 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.

Note that if there are fiscal programs that satisfy the resource constraint, (1), and the political constraint, (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. 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 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.[8] 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. Afterwards, 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 $y_i^r - \tau$.

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

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, 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:

$$v_g^0(B,y) = \begin{bmatrix} v_g^d(y) & \text{if (1) or (3) do not hold } \forall (B',\tau) \text{ with } \tau \leq y_{\min}^r \\ v_g^a(B,y) & \text{otherwise} \end{bmatrix}$$

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

$$v_g^a(B,y) = \max_{\{r,d\}} \left\{ v_g^r(B,y), v_g^d(y) \right\} \tag{4}$$

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:

$$v_g^d(y) = \int_\Omega u\left(y_i^d\right) di + \beta \int_Y \left[\theta v_g^0(0,y') + (1-\theta) v_g^d(y')\right] f(y',y)\, dy' \tag{5}$$

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:

$$\begin{aligned} v_g^r(B,y) \quad = \quad & \max_{(B',\tau)} \int_\Omega u\left(y_i^r - \tau\right) di + \beta \int_Y v_g^0(B',y') f(y',y)\, dy', \\ & \text{subject to (\textbf{??}) and (3)} \end{aligned} \tag{6}$$

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

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

$$D(B) = \left\{ y \in Y : \begin{array}{c} \text{(1) or (3) do not hold } \forall (B',\tau) \text{ with } \tau \leq y_{\min}^r \\ \text{or } \; v_g^r(B,y) < v_g^d(y) \end{array} \right\}$$

and as:

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

When repaying, the proposed fiscal program $(B'(B,y), \tau'(B,y))$ is the one that solves problem (6).

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):[9]

$$p_i(B', \tau; y) = \begin{bmatrix} 1 \text{ if } v_i^r(B', \tau; y) \geq v_i^d(y) \\ 0 \text{ if } v_i^r(B', \tau; y) < v_i^d(y) \end{bmatrix} \tag{7}$$

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:

$$v_i^r(B', \tau; y) = u(y_i^r - \tau) + \beta \int_Y v_i^0(B', y') f(y', y) dy' \tag{8}$$

$$v_i^d(y) = u\left(y_i^d\right) + \beta \int_Y \left[\theta v_i^0(0, y') + (1-\theta) v_i^d(y')\right] f(y', y) dy' \tag{9}$$

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:

$$v_i^0(B, y) = \begin{bmatrix} v_i^r(B'(B, y), \tau'(B, y); y) & \text{if } y \in R(B) \\ v_i^d(y) & \text{if } y \in D(B) \end{bmatrix} \tag{10}$$

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

$$q(B', y) = \frac{1 - \Pr\left[D(B') | Y = y\right]}{1 + r} \tag{11}$$

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, $p_i(B', \tau; y)$, $iii)$ a sovereign bond price function, $q(B', y)$ and $iv)$ a political support function, $p(B', \tau; y)$, such that:

[9] We assume that indifferent households approve the government proposal.

1. Given the sovereign bond price function $q(B', y)$ and the political support function $p(B'; B, y)$, 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 $p_i(B', \tau; y)$ satisfies the household's optimization problem.

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

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

2.3 Discussion: key ingredients of the model

Our model departs from standard sovereign debt models in two crucial ways: we assume that households are heterogenous and that the governments needs some amount of households´ support to implement its desired policy (i.e. the political constraint). The first assumption gives rise to potential disagreements between households and the government regarding the optimal policy to be implemented (and also among households themselves). These disagreements are key in our model since they give households a reason to reject the government desired policies.

The second assumption captures the fact, observed in real sovereign debt crises, that the government needs some degree of political approval to implement a fiscal program to repay its debts. The presence of such a political constraint is also key in our model since it gives households a way to veto the government desired policies.[10]

Technically, in our model, differences in opinion across households regarding the optimal policy to be implemented, follows from the combined effect of households' income distribution, the uniform lump-sum taxes assumption and the assumed CRRA Bernoulli utility function.[11] Due to the strictly concave property of this function and the assumption that relative risk aversion does not change with the level of income, wealthy households are willing to tolerate higher lump-sum taxes than poorer households to repay the debt. In other words, wealthy households would prefer to repay more often than poorer ones.

[10] More generally, 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 political constraints. For a government not to be an autocracy in an Eaton and Gersovitz type of model, two key ingredients are needed: first, households must have a reason to veto the government desired policies and second, they must have a way to do so. Households heterogeneity and the political threshold generate these two ingredients in our model. Of course, there are other ways to generate them.

[11] We choose this functional form in our calibration to be consistent with most studies in sovereign defaults episodes.

To better understand the mechanism at play in our model, we can think what would happen if the aforementioned assumptions were not to hold. For example, if households were all identical receiving the same income endowment, they would all perfectly agree on the optimal policy to implement. On the other hand, if taxes were uniform but ad-valorem, 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 repaying/defaulting decision.[12]

More importantly, differences in opinion between households and the government follow from the aforementioned disagreements across individual households and the assumption that the government maximizes social welfare. Since households sometimes disagree among them, the government preferred policy will sometimes be different from some of the households preferred one.

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 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.

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 issuing new debt to repay its debt. We can formalize this situation for a given level of debt B and aggregate output y as follows:

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

[12] 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 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.

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 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 as well as 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, but the government would rather default than implement such a fiscal program. In our model, this type of defaults is formally characterized as:

$$\exists \left(B', \tau\right) \text{ with } \tau \leq y^r_{\min} : \tau - q\left(B', y\right) B' \geq -B \text{ and } p\left(B', \tau; y\right) \geq p^r \text{, but } y \in D\left(B\right).$$

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".[13]

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 sovereing bond price captures the probability of occurrence of the three types of default described above.[14] In this sense, our model shows that foreign

[13] In other words, in traditional sovereign debt models the "unwillingnes to repay" type of default constitutes the whole default set.

[14] We can also distinguish our three types of default episodes by partitioning the default set in:

$$A\left(B\right) = \left\{y \in Y : (1) \text{ does not hold}\right\}$$
$$A_c\left(B\right) = \left\{y \in Y : (1) \text{ holds but not } (3)\right\}$$
$$W\left(B\right) = D\left(B\right) - \left\{A\left(B\right) \cup A_c\left(B\right)\right\}$$

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". By replacing the default set with the sets in the above partition in the sovereign bond price equation (11), it is straightforward to see that when pricing the sovereign bond, foreign lenders accounts for the probability of occurrence of the three types of defaults described above.

lenders consider both the goverment risks as well as the political economy risks when pricing sovereign debt.

4 Calibration and quantitative analysis

4.1 Calibration

We calibrate our theoretical model to both the Argentine and Greek economies. We focus on the 2001 Argentine debt crisis episode to be able to compare our results with the vast majority of studies in the endogenous default sovereign debt literature. In addition, we study the current Greek debt crisis episode because it is a clear example of the presence of political economy constraints: while the government has been trying to implement fiscal adjustments to avoid a sovereign default the increasing social pressure and ever diminishing political support are making this objective very difficult.

4.1.1 Argentina

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

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

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 $\varepsilon_t \sim N\left(0, \sigma_\varepsilon^2\right)$. To estimate these parameters, we use GDP data taken from the Ministry of Finance (MECON) 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 househoulds income heterogeneity. We do it using the Argentine income distribution in 1998 as measured by the Center for Distributive, Labor and Social Studies (CEDLAS).[15] 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:

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

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 $p^r = 0.5$.[16] 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 assymmetric output loss funtion:

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

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.[17] 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%

4.1.2 Greece

To calibrate the model to the Greek economy, we set a quarterly frequency. We choose the same functional forms as the ones chosen for the model calibrated to the Argentine economy. That is, we assume the Bernoulli utility function to have a CRRA functional form; the aggregate output to follow an AR(1) stochastic process and the output loss function to be assymetric. As above, we set the coefficient of relative risk aversion equal to 2. To estimate the parameters ρ and σ_ε, we use GDP data taken from Organisation for Economic Co-operation and Development (OECD). The GDP time series is in quarterly frequency, in real terms and seasonally adjusted; it ranges from the first quarter of 1980 to the first quarter of 2011. GDP is logged and then detrended using a linear filter.

[16] 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).

[17] Arellano (2008) uses a θ consistent with the empirical findings of Gelos et al (2010) 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.

Our estimates of ρ and σ_ε are 0.95 and 0.011, respectively. We compute the income distribution shares $\alpha_1, \alpha_2, \alpha_3$ using the Greek income distribution of the year 2000 as published by the World Bank. The subjective discount factor β, the re-entry to credit markets probability θ and the percentage aggregate output loss λ are set as in the Argentine case. Finally, the risk-free interest rate r is set to 1.55%, just to equal the average quarterly interest rate of a 3 year U.S. treasury bond from the first quarter of 1980 to the first quarter of 2011.

Table III summarizes parameter values:

Table III. Parameter Values for Greece

σ	ρ	σ_ϵ	α_1	α_2	α_3	β	θ	λ	r
2	0.95	0.011	19%	40%	41%	0.953	0.282	0.96	1.55%

4.2 Quantitative analysis

In this section, we first explain how the presence of the political constraint affects the government borrowing decision as well as 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 and Greek economies and compare them to the ones in the data and in standard sovereign default models.

4.2.1 Effects of the political constraint

As we explained, the presence of a political constraint leads to a reduction on the feasible set of fiscal programs that the government faces. In particular, situations may arise where the government is forced to default because no fiscal program that raises enough funds to repay can be implemented. Furthermore, other situations may arise where the reduction in the feasible set of fiscal programs generates a reduction on the value function of repaying relatively to that of defaulting.

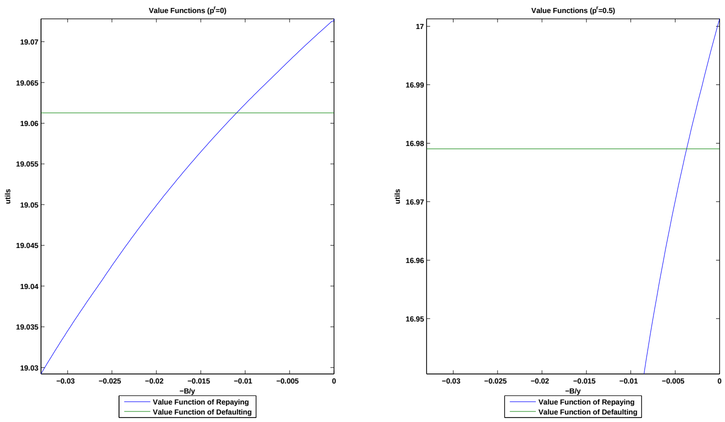

Figure 1

As the political threshold increases (i.e. p^r rises), the government has less means to finance a repayment and hence it has more difficulties, and also less incentives, to repay its debt. Thus, the default set enlarges as p^r goes up. In particular, more default arises for relatively large debt levels (but not excesively large) since in such situations repayment is economically feasible but not politically.

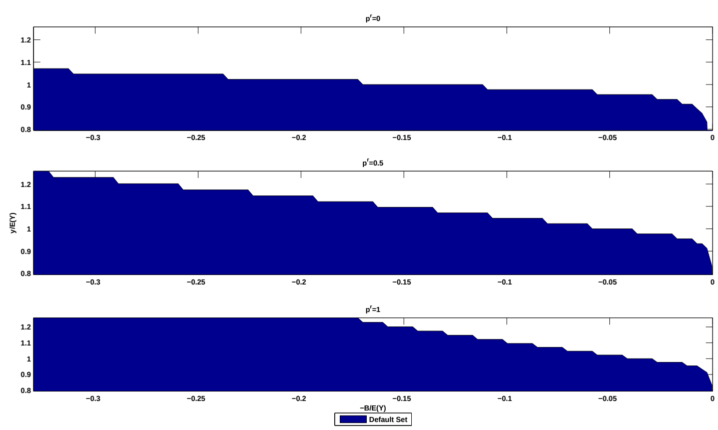

Figure 2

As the default set enlarges when the government faces a political constraint, the maximum amount of resources the government can borrow from abroad falls as p^r goes up, since foreign lenders discount the sovereign bond price by its endogenous probabilities of default.

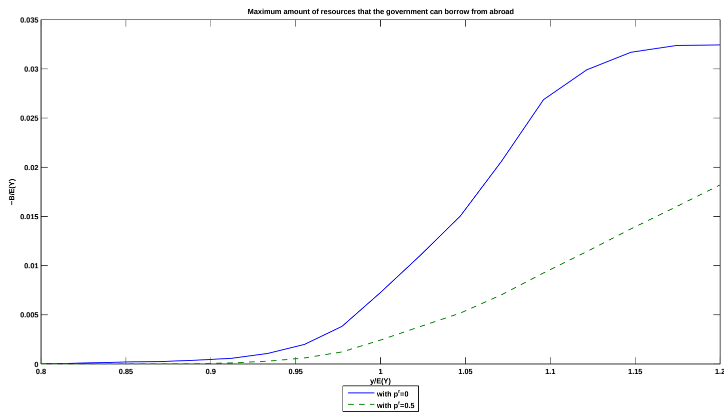

Figure 3

Interesting, note that the amount of resources the government can borrow from abroad not only falls because the government can implement a reduced number of fiscal programs, but also because the sovereign bond price turns to be lower.

4.2.2 Sovereign bond price function

As it is standard in this literature, the sovereign bond price function $q(B', y)$ decreases as the ratio of debt to GDP goes up. As Figure 4 shows, when the government issues more debt, most of the drop in the sovereign bond price is explained by the fear that in the future the government will be unable to repay. Reasonably, for extremely 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, this relationship changes as debt issuances decrease. When the government issues lower levels of debt (but not sufficiently low), foreign lenders mostly fear a situation where the government might lack enough incentives 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.

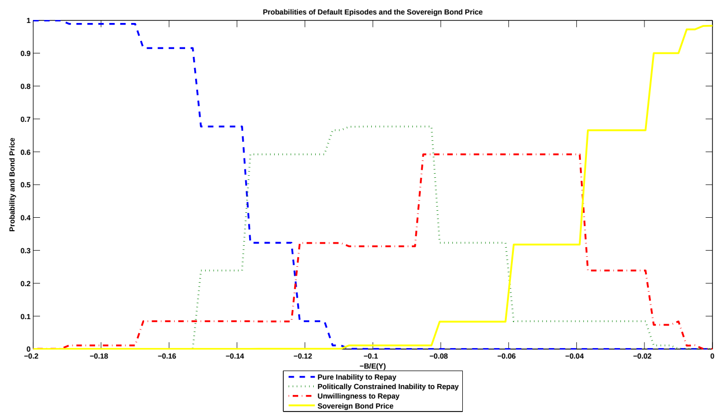

Figure 4

For greater p^r, the bond price function decreases and the range of debt to GDP levels for which the bond price is positive, in our calibration, becomes smaller.

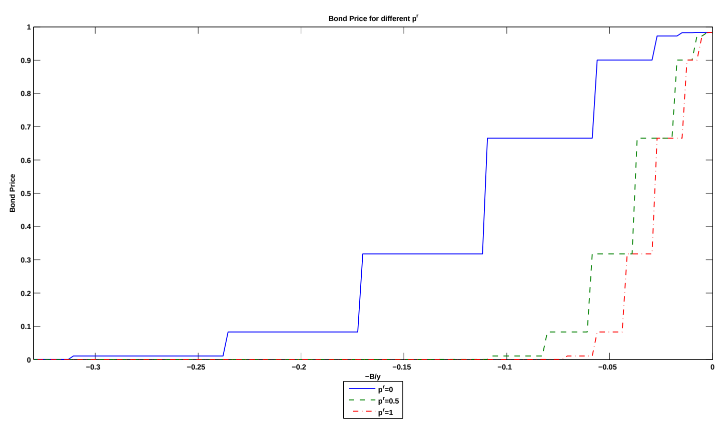

Figure 5

Figure 5 shows that 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 government will either be unable or have little incentives to repay.

Interesting, note the government inability and unwillingness to repay is indeed strenghten by the lower sovereign bond prices. When $p^r = 0.5$, the sovereign bond price suffers smaller drops as the government increases its debts. However, this drop is much larger than in the case where $p^r = 0$ (while in the former case the sovereign bond turns to be worthless for output-debt ratios higher than 11% when the aggregate output is at trend level, in the latter this happens for output-debt ratios higher than 31%). As p^r goes up, the sovereign bond price $q(B', y)$ decreases since, as evidenced in Figure 5, more stringent political constraint turns repayment more difficult and hence enlarges the default set.

Finally, we highlight that in line with standard sovereign default models, in our model the sovereign bond price rises as aggregate output rises, when 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 time period, and hence they expect that the government will be able as well as eager to repay its debts.

4.2.3 Business cycle frequencies

Argentina 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.

Table IV reports declines with respect to trend during the 2001 Argentine default episode as well as standard deviations and correlations with output and with spread rates during the time interval ranging from the first quarter of 1980 to the first quarter of 2002.

Table IV. Business Cycle Statistics for Argentina

Decline from trend during default episode	Decline from trend
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
Spread Rates (sr)	5.58	-0.88	1
Mean debt/output ratio	-43.30		
Mean spread rates	10.35		

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. Interest rates are the Emerging Markets Bond Index (EMBI), taken from Neumeyer and Perri (2005).[18] Spread rates are computed by substracting the yield of the 5 year U.S. treasury bond from the EMBI. Table IV also reports the average debt to output ratio from 1980 to 2001. Debt levels are taken from Global Development Finance.

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 exarcerbated. In particular, in this single period, both output and consumption dropped by near twice of their standard deviations.

To produce business cycle frequencies comparable to the ones documented for the Argentine economy we select from our simulations time intervals consisting of 74 quarters and ending up in a default episode; then, we detrended the model time series using a linear filter; afterwards, we compute relevant statistics; and finally, we average computed statistics across selected time intervals.[19] Table

[18] 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.

[19] The time intervals we select match our sample interval for the Argentine economy. We select about 3000 time intervals in our computational experiment.

V reports the model business cycle frequencies for different levels of p^r when households are homogenous and when they are heterogenous. In the former case, our model is equivalent to Arellano (2008) and so are their business cycle frequencies. We use the case of homogenous households as the benchmark model to which compare our results with heterogenous households.

Table V. Model Business Cycle Frequencies for Argentina

	Households		
	Homogenous	Heterogenous	
		$p^r = 0.5$	$p^r = 1$
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 Rates)	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 government needs at least half of households' approval to implement fiscal programs, i.e. when $p^r = 0.5$, our model performs 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 it is 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 within our model accounts for only 4% and 36% of the ones documented in data, respectively). Failure to match these dimensions of the data is common to most sovereign debt models in the literature.

The weak performance of our model in matching the debt to GDP ratio and average spreads is the direct result of the enlarged default set that the presence of the political constraint generates. In effect, from an ex-post perspective, the presence of the political constraint enlarges 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 default, as a result, the government chooses lower levels of sovereign debt, which eventually trigger fewer defaults reducing the interest rate.

When the government needs all households approval, 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 low volatility levels and correlations are even weaker. Moreover, at the default episode, the consumption collapse is slighter and the model does not predict the current account reversal. Finally, our model understimates 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 to 0.45%.

Increasing households heterogeneity almost does not alter our quantitative results. In Table VII, we compute the model simulated results when $p^r = 0.5$ for the case 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.

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

	Heterogenous 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. In addition, our model with five households types also underestimates the average debt to output ratio and the spread rate.

Greece The Greek debt crisis was triggered at the outset of 2010 by the news that past government officials had misreported the country's official economic statistics to meet the Maastricht criteria. Following this event, interest rates skyrocketed: during 2010 they rose by 122% and in December of 2010 they reached their maximum level of 11% per year. New estimations of the public debt to GDP ratio put it as high as 120% by the onset of 2011, the highest in Europe and one of the highest in the world. This crisis deepened the economic slowdown that the Greek economy has been suffering since mid 2007.

Table VIII reports average declines from trend from the second quarter of 2010 to the first quarter of 2011 as well as volatilities and correlations with output and interest rate spreads from the first quarter of 1980 to the first quarter of 2011.

Table VIII. Business Cycle Statistics for Greece

Average decline during the debt crises			
	Average decline		
Output	-8.12		
Consumption	-5.16		
Standard Deviations and Correlations			
	σ	*corr* with y	*corr* with sr
Output (y)	5.99	1	-0.65
Consumption	3.84	0.80	-0.47
Trade Balance	0.46	-0.23	0.43
Spread Rates (sr)	5.64	-0.65	1
Mean debt/output ratio	-109.8		
Mean spread rates	4.76		

Consumption, output and trade balance data are taken from Organisation for Economic Co-operation and Development (OECD). Time series are in quarterly frequency, in real terms and seasonally adjusted; the first two series start in 1980 while the latter in 2000. [20] Consumption and output are logged and then detrended using a linear filter. The trade balance is divided by output and is expressed in percentage units. Interest rates time series are taken from the International Financial Statistics (IFS). We use the Government Bond Yield time series for long term Greek government bonds which starts in the fourth quarter of 1992. To compute interest rate spreads, we substract from the Government Bond Yield the the yield of the 3 year U.S. treasury bond. In addition, Table IV reports the average debt to output ratio from 1993 to 2011, taken from Global Development Finance.

[20] From 1980 to 2000, quarterly time series are estimates from annual time series.

To produce business cycle frequencies comparable to the ones documented for the Greek economy, we assume that in the first quarter of 2011 the Greek government declared a sovereign default and we proceed in a similar way as for the Argentine case.[21] Table IX presents the simulated results for the Greek economy.

Table IX. Model Business Cycle Frequencies for Greece

	Households		
	Homogenous	Heterogenous	
		$p^r = 0.5$	$p^r = 1$
Output Decline	-7.37	-4.50	-5.12
Consumption Decline	-7.33	-4.43	-5.09
Std(Output)	3.61	3.33	3.26
Std(Consumption)	3.65	3.61	3.40
Std(Trade Balance)	0.20	0.88	0.53
Std(Spread Rates)	5.20	4.27	3.27
Corr(Output, Cons)	0.97	0.96	0.98
Corr(Output, TB)	-0.11	-0.17	-0.14
Corr(SR, Output)	-0.58	-0.32	-0.28
Corr(SR, Cons)	-0.57	-0.33	-0.28
Corr(SR, TB)	0.13	0.18	0.12
Mean Debt/Output	-4.15	-1.3	-1.02
Mean Spread Rate	8.39	4.12	1.96

To end this section, we assess whether the model calibrated to the Greek predicts a sovereign default episode in the first quarter of 2010 , being this episode a "politically constrained inability to repay" default.[22]

5 Conclusion

This paper focuses on some of the difficulties that governments face when trying to raise funds to repay their debts. In particular, we focus on the importance of political constraints that may limit a government´s ability to access the resources required to avoid a default.

In a standard DSGE model with endogenous sovereign debt and default, we introduced two novel features: household heterogeneity and a requirement that the government obtains the support of some of them to implement a fiscal

[21] The only difference is that we select time intervals consisting of 125 periods which corresponds to the sample time window chosen for the Greek economy.

[22] To carry on this experiment, we study the case where $p^r = 0.5$ and feed the model we actual GDP data

program to repay the debt. In this framework, a new classification of default episodes arises. First, as it is traditional in this literature, we have defaults that are chosen by the government (i.e. the government is unwilling to repay). However, we have other situations that may lead to a default. In particular, defaults could be the result of the government being unable to repay either because there are not enough resources in the economy, or because there is not enough political support for any fiscal program that could generate enough resources to repay.

When we calibrate the model to the Argentine and Greek economies, we find that in many dimensions the model matches the data. However, in others its performance is weak. In particular, as most models in this literature, we have trouble matching the debt to GDP ratio.

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

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7 Appendix

7.1 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.[23] 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 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 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:*

$$D(B) = \{y \in Y : (1) \ \ \textit{or} \ \ (3) \ \ \textit{do not hold} \ \forall (B', \tau) \ \ \textit{with} \ \tau \leq y^r_{\min}\}$$

(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 rapay. 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.

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