The Political Economy of Sovereign Defaults*

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Abstract

This paper studies how the income distribution and the tax system affect sovereign borrowing and default decisions. Does a more regressive tax system or a more unequal income distribution make a government more prone to default? Do they affect the amount of sovereign borrowing? We analyze these issues paying special attention to the political constraints faced by governments in raising funds to repay the debt. In doing so, we make progress towards understanding the political economy of sovereign defaults. We perform our analysis by introducing in a standard DSGE model with endogenous sovereign default risk, two novel features: (i) income and tax heterogeneity across households; and (ii) a restriction that the government can only access the resources needed to repay the debt if a sufficient proportion of the population votes in favor of the proposed fiscal program. We solve our model numerically and find that: (i) inequality is bad for sovereign borrowing (i.e.higher income inequality or a more regressive tax system make a government more prone to default); (ii) political constraints may force a government to default even if it is willing to repay; and (iii) political constraints become more relevant when the income distribution is more unequal or the tax system more regressive. The second of these findings allows us to present a new typology of sovereign default events.

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1 Introduction

In the months prior to Argentina's 2001 sovereign default, the government tried to lower public wages and pensions to be able to repay the debt. This plan met strong political opposition and, in December 2001, in the midst of a popular revolt, President De la Rúa resigned and the country defaulted on its debt. In Greece, the government implemented several austerity packages along these lines since 2009. The measures were met by social unrest and it all ended up in a sovereign debt restructuring and the resignation of Prime Minister Papandreu in 2011. In March 2011, the Portuguese government also proposed a package of austerity measures to restore fiscal balance and debt sustainability. However, opposition parties refused to back the proposal which led to the resignation of the Prime Minister and prompted the need for a European Union - International Monetary Fund rescue package.

These examples highlight two issues. First, the distribution of the burden of debt repayment across society can involve conflict. Second, in the build up of sovereign defaults, governments face strong political constraints when they try to raise revenues to repay the debt.

The way the burden of public debt repayment is shared across society is the result of the interaction between the tax system and the income distribution. It is natural to wonder then whether the income distribution and the tax system affect the probability of sovereign default.

A few papers provide a partial answer to this question. They showed that empirically higher income inequality is associated with a higher default risk.[1] However, we still lack an understanding of the mechanisms through which this happens, and there is no empirical evidence on the effect of alternative tax systems on the probability of default. Existing models of sovereign debt are ill-fitted to study these issues theoretically as agents are typically assumed homogeneous and, as a result, there is no role for distributional issues.

The role of political constraints restricting the ability of governments to raise resources for public debt repayment has not received much attention in the sovereign debt literature either. Indeed, in standard sovereign debt models the government has unrestricted access to the resources needed to repay the debt.

Our paper studies how the income distribution and tax system affect sovereign borrowing and default decisions. Does a more regressive tax system or a

[1] Berg and Sachs (1988) find that higher income inequality is a significant predictor of a higher probability of debt rescheduling and attribute this to the difficulties of political management in economies with extreme inequality. More recently, Aizenman and Jinjarak (2012) find that a one standard deviation increase of the Gini coefficient is associated with a rise of around 500 to 700 basis points of the sovereign spread.

more unequal income distribution affect debt sustainability and the amount of sovereign borrowing? We analyze these issues paying special attention to the political constraints faced by governments in raising funds to repay the debt. This allows us also to evaluate whether political constraints can have a role in determining sovereign defaults.

Analyzing the interaction between the distribution of the repayment burden across society and political constraints, allows to make progress towards understanding the political economy of sovereign defaults. We do so in a standard dynamic stochastic general equilibrium (DSGE) model with endogenous sovereign default risk that has two novel features: heterogeneity across households and political constraints.

In our model households differ in the share they receive from the stochastic aggregate income and in the way they are affected by the fiscal policy. This heterogeneity generates different opinions regarding the convenience of repaying and contracting sovereign debt. The second feature, the political constraint, captures the fact that governments do not have unlimited access to the country's resources. We assume that the government can only access the resources needed to repay the debt if a sufficient proportion of the population votes in favor of the fiscal program it proposed. The fiscal program establishes a total amount of taxes to be collected and new debt to be issued (the distribution of taxes across society is taken as given).

Our assumption regarding a voting process to determine whether a fiscal program can be implemented should not be taken literally. One could think of Congress as intermediating this vote. However, the recent 2010-2011 Icelandic default triggered by a popular binding referendum seems very close to a literal interpretation of our model.[2]

The basic structure of the model is the following. There is a small open economy inhabited by a benevolent government and a continuum of heterogeneous households. 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 constraint becomes relevant when the government needs to repay its debt. If the government wants to repay, it proposes 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. If the minimum level of political support is not reached the government is forced to default.[3] A default triggers a temporary exclusion from international financial markets and direct output costs.

[2] In 2010 and 2011, Icelanders were requested to vote on a binding referendum regarding the repayment of the sovereign obligations in which the government had incurred in order to rescue the domestic financial system. While the Icelandic government was in favor of repaying and had proposed a fiscal program to implement the repayment, the people expressed through the referendum their preferences against repayment leading the country into default.

[3] This approval can be thought of as a formal one, related to passing legislation through Congress, or an informal one, required to avoid protests, demonstrations and riots.

We calibrate the model to the Argentine economy to analyze the effects on the sovereign borrowing and default decisions of the interactions between income distribution, the tax system, and the political constraints faced by the government. We find that the three elements are key in determining the equilibrium level of borrowing and the default/repayment decision.

We find three main results:

- Inequality is bad for sovereign borrowing: for a given income distribution, a more regressive tax system increases default probability and sovereign spreads. For a given tax system, a more unequal income distribution generates the same effect.
- Political constraints matter: Two types of defaults arise in equilibrium in our model. Some sovereign defaults are due to the government's **unwillingness** to repay as it is usually the case in the sovereign debt literature. However, in other cases defaults capture situations in which the government is **unable** to repay because it cannot obtain sufficient political support for the proposed tax plan.
- Inequality potentiates political constraints: political constraints have a stronger impact the more unequal is the sharing of sovereign repayment.

The reason why a more regressive tax system increases the default probability and sovereign spreads is that with it, the poor shoulder a disproportionate share of the repayment burden. Even without political constraints, this type of situations tilts the incentives of a social welfare maximizer government towards default. A similar intuition applies to more unequal income distributions for a given tax system.

In order to understand why political constraints have a stronger impact the more unequal is the sharing of sovereign repayment, it is useful to analyze the extreme case where all households are homogeneous in their income and tax burden. In this case, they all share the preferences regarding the repayment decision, which coincides with the government's preferences. Then, the political constraint plays no role. However, as the income distribution and the tax burden become more unequal, households diverge in their preferences making political support a potential issue for debt repayment.

The political economy literature connecting distributional issues with sovereign default has focused on the relative power of domestic bond holders and the agents that bear the burden of repayment.[4] Unlike these papers, our mechanism does not depend in assuming that a fraction of the sovereign debt is in the hands of domestic agents. In a recent paper, Azzimonti et al. (2013), analyze the effect of income inequality on the optimal level of sovereign debt in a model without defaults. Unlike them, the sovereign default decision is a key element in our model and we have sovereign defaults in equilibrium.

[4] See for example, Tabellini (1991), Aghion and Bolton (1990) and Dixit and Londregan (2000) or, more recently, Guembel and Sussman (2009) and D'Erasmo and Mendoza (2013).

By incorporating political considerations as a potential cause for sovereign default, our model speaks to a large literature on endogenous sovereign defaults. Typically, this literature focuses on the role of political turnover or different government types in triggering sovereign defaults.[5] Unlike this literature, our paper does not have governments alternating in power nor different types of governments but only one benevolent government that needs political support to repay the debt.

The paper is organized as follows: Section II presents the theoretical model, Section III characterizes the equilibrium, Section IV presents the main numerical results and Section V concludes.

2 The model

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 given by $y_i^r = \alpha_i y$, where α_i is the constant share of the aggregate endowment y that household i receives, with $i = 1, 2, ..., n$. 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 with a standard utilitarian social welfare function in which the utility of each household type i is weighted according to the parameter ω_i, with $\int_\Omega \omega_i di$:

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

where Ω refers to the households' population set. Without loss of generality, we assume that Ω has unit measure.

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 issues 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

[5] See Amador (2006), Cuadra and Sapriza (2008) or Hatchondo et al. (2009) for examples of papers focusing on political turnover; Cole et al. (1995), Cole and Kehoe (1998), Sandleris (2008), D'Erasmo (2011) or Andreasen (2013) for examples of papers with different government types.

consumption, where $q(B', y)$ refers to the unitary price of sovereign bonds given current aggregate endowment, y, and the amount of debt to be issued, B'. Sovereign bonds are assumed to be non-collateralized and defaultable.

Then, the budget constraint faced by the government each period is given by:

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

where τ represents the transfers from the government to the agents, which can be positive (taxes) or negative (subsidies) depending on the net result of the sovereign debt operations. Transfers can differ across households types in the following way: $\tau_i = \chi_i \tau$, with $\int_\Omega \chi_i \omega_i di = 1$, where χ_i denotes the share of transfers that household type i faces. We assume χ_i to be exogenous. As households cannot have negative consumption, we restrict total taxes to be less or equal than:

$$\inf_{i \in \Omega} \{y_i^r / \chi_i\} = y_{\min}^r \tag{2}$$

For the government to be able to repay the debt, there must exist a fiscal program, i.e. a combination of new bond issuances, B', and transfers, τ, 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 raise taxes, τ, such that (1) holds.

Second, the fiscal program must garner sufficient support from individual households. Households express their approval or rejection for a given fiscal program 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:

$$p(B', \tau; y) = \int_\Omega p_i(B', \tau; y) \omega_i di \tag{3}$$

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

$$p(B', \tau; y) \geq p^r \tag{4}$$

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 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, (4), 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.

3 Value Functions and Recursive Equilibrium

Before analyzing the equilibrium of the model it is convenient to make clear the timing of events in the economy. At the beginning of each period, the current aggregate endowment, y, is observed and, given the amount of sovereign debt, B, the government proposes a fiscal program, (B', τ), or 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 the 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.

3.1 Government's problem

In every period in which the government is current on its debt, it chooses whether to repay or default on the sovereign debt:

$$v_g^0(B, y) = \max_{\{r,d\}} \left\{ v_g^r(B, y), v_g^d(y) \right\} \tag{5}$$

where $v_g^r(B, y)$ is the value associated with repayment and $v_g^d(y)$ is the value associated with default. The government's payoff functions are assumed to be

[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.

in the class of utilitarian social welfare functions, in which each agent's utility is weighed using ω_i.[7]

If the government chooses not to default, it proposes the fiscal program, (B', τ), that it will implement in the next period subject to the feasibility and political constraints:

$$v_g^r(B, y) = \max_{(B', \tau)} \int_\Omega u(y_i^r - \tau_i)\, \omega_i di + \beta \int_Y v_g^0(B', y')\, f(y', y)\, dy', \quad (6)$$

subject to (1) and (4)

The value function of default is given by:

$$v_g^d(y) = \int_\Omega u\left(y_i^d\right) \omega_i di + \beta \int_Y \left[\theta v_g^0(0, y') + (1-\theta)\, v_g^d(y')\right] f(y', y)\, dy' \quad (7)$$

From the government's problem we can characterize the default set $D(B)$ and repayment set $R(B)$ as:

$$D(B) = \left\{ y \in Y : \begin{array}{l} \text{if } \nexists (B', \tau) : (1) \text{ and } (4) \text{ hold} \\ \text{or } v_g^r(B, y) < v_g^d(y) \end{array} \right\}$$

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 (6).

3.2 Households' problem

Households maximize their utility by choosing whether to approve or reject the fiscal program proposed by the government. The utility of household i under repayment, $v_i^r(B', \tau; y)$, is given by:

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

and under default, $v_i^d(y)$, by:

$$v_i^d(y) = u\left(y_i^d\right) + \beta \int_Y \left[\theta v_i^0(0, y') + (1-\theta)\, v_i^d(y')\right] f(y', y)\, dy' \quad (8)$$

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

$$v_i^0(B, y) = \begin{bmatrix} v_i^r(B'(B, y), \tau'(B, y); y) & \text{if } y \in R(B) \\ v_i^d(y) & \text{if } y \in D(B) \end{bmatrix} \quad (9)$$

[7] If ω_i coincides with the weights of each household type in the population, the government will be maximizing average welfare. This is how we are going to do it in the calibration of the model later on.

We define the optimal voting decision for household i, given current aggregate output y and the government's fiscal program (B', τ) as follows:

$$p_i\left(B', \tau; y\right) = \begin{bmatrix} 1 \text{ if } v_i^r\left(B', \tau; y\right) \geq v_i^d\left(y\right) \\ 0 \text{ if } v_i^r\left(B', \tau; y\right) < v_i^d\left(y\right) \end{bmatrix} \tag{10}$$

where 1 stands for voting in favor and 0 for voting against the fiscal program.

3.3 Foreign lenders' problem

Foreign lenders behave competitively and have risk-neutral preferences. Then, their expected return of lending to the government should equal the risk free interest rate. Foreign lenders understand that default can happen with a positive probability when they lend to the government, this implies that the sovereign bond price satisfies:

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

3.4 Recursive Equilibrium

A Recursive Equilibrium for this economy is: i) a government's 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:

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.

4 Income distribution, tax system and political constraints: a quantitative analysis

In this section we present the main results of the model by solving it numerically. We begin by calibrating our model to the Argentine economy, focusing on the 2001 debt crisis. Then, we analyze in detail the interaction between the income distribution, the tax regime and political constraints in our framework. This allows us to understand how the above affect sovereign borrowing and default decisions, spreads and bond prices.

In order to isolate the effects of the income distribution, the tax system and the political constraints, we begin by analyzing one at the time. First, we shut down the political constraint, take as given the income distribution and evaluate how alternative tax systems affect sovereign borrowing, spreads, bond prices and default decisions. Second, again without political constraints, we take as given the tax system and evaluate the effect of different degrees of income inequality on these variables. Third, we incorporate the political constraint, take as given the income distribution and the tax system and explore the role of political constraints in triggering sovereign defaults. Finally, we consider the interaction between the tax system, income inequality and political constraints.

4.1 Calibration

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 and 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 quarterly GDP data taken from the Argentine Ministry of Finance ranging from the first quarter of 1980 to the second quarter of 2001. Our estimates of ρ and σ_ε are 0.945 and 0.025, respectively. Following Arellano (2008), we choose an asymmetric output loss function: $h(y) = \min\{y, \lambda E(Y)\}$, where $E(Y)$ stands for the aggregate output unconditional mean and λ represents the aggregate output loss during a sovereign default episode.

We follow Arellano (2008) for comparability in setting the rest of the parameters.[8] We set $\theta = 0.282$ consistent with the empirical findings of Gelos et al. (2011), the subjective discount factor $\beta = 0.953$ and the percentage aggregate output loss $\lambda = 0.96$. 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 I summarizes the parameter values:

Table I. Parameter Values

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

[8] Arellano (2008) sets this parameters to target the following moments: a default probability of 3%, an average debt service to GDP ratio of 5.53%, and the standard deviation of the trade balance.

We also need to define the weights on the welfare function of the government. A natural way to define these weights is to think about a benevolent government that cares about all its citizens in the same way. Such a government would assign equal weights to the welfare of each group. In particular we consider five household's types corresponding to each quintile of the population. To calibrate each quintile income we use data from the Center for Distributive, Labor and Social Studies (CEDLAS):

Table II. Income distribution (1998)

α_1	α_2	α_3	α_4	α_5
3.6%	8.1%	12.2%	20.1%	56.0%

where α_1 represents the poorest quintile.

For the tax burden calibration, we use the estimates of Gasparini and Cruces (2010). The following table summarizes them:

Table III. Tax share per quintile

χ_1	χ_2	χ_3	χ_4	χ_5
7.1%	10.7%	14.9%	20.1%	47.2%

In terms of the political support threshold p^r, we consider three possible values: $p^r = (0,\ 0.5,\ 1)$.While the first case represents the standard scenario in the literature without a political constraint, the second one corresponds to a simple majority voting process and the third one to a case that requires unanimous consensus.

It is worth pointing out that the focus of this paper is in achieving a better understanding of the political struggles and the distributional issues that arise during sovereign debt crises and not in the quantitative predictions of the model. However, as shown in detail in Appendix 7.2 the model does a proper job in matching the real business cycle frequencies of the Argentine 2001 crisis. In particular, output and aggregate consumption volatilities are as much as 74% and 71% 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.

4.2 The effect of alternative tax systems with a given income distribution and no political constraints

In this section, we explore in detail the effect of the alternative tax systems on sovereign borrowing, defaults, spreads and bond prices. We do so taking as given the income distribution and assuming no political constraints. Besides considering the case of Argentina (a slightly regressive tax system), we evaluate the impact of two alternative polar tax systems:

- Proportional taxes: $\chi_i = \alpha_i$
- Uniform taxes:$\chi_i = \frac{\tau}{n}$, where in our case $n = 5$

Proportional taxes are more progressive than the case of Argentina, while uniform taxes are more regressive. We characterize first the default set for each alternative tax system and compare them to the case of Argentina. The default set for each tax system corresponds to the area below each line in Figure I. As we can see in the Figure, more progressive taxes reduce the default set. That is, governments are less likely to default for a given level of debt when the tax system is more progressive.

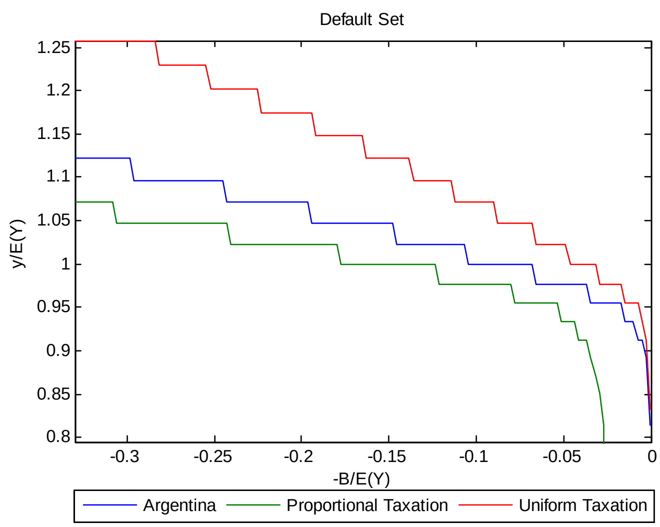

Figure I

A complementary way to analyze the effect of alternative tax systems is to look at the sovereign bond price schedule, $q\left(B', y\right)$. As we can observe in Figure II, the sovereign bond price decreases as the ratio of debt over GDP goes up. This is a consequence of foreign lenders correctly anticipating that the default probability increases with the ratio of debt over GDP.

We can also see in the graph thata for a given ratio of debt over GDP, more regressive tax systems are associated with lower bond prices (and higher sovereign spreads) all else equal. This is consistent with regressive tax systems generating larger default sets (and probabilities of default).

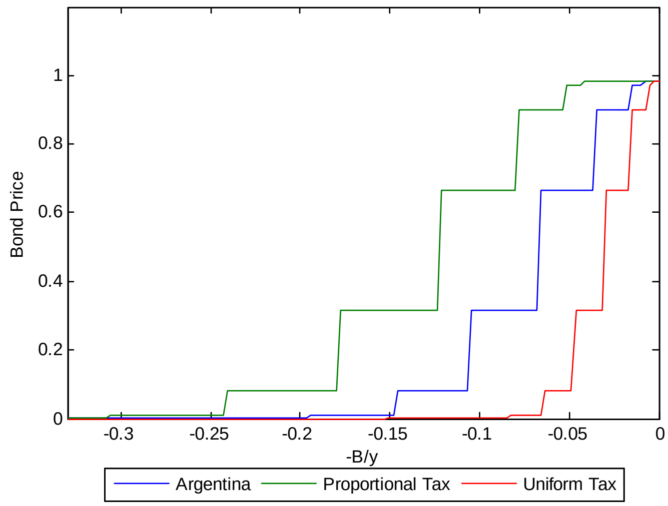

Figure II

The intuition behind these results is the following. Taking the income distribution as given, if the tax system is regressive, the poorer quintiles will shoulder a larger share of the sovereign debt repayment. Since the poorer quintiles have a larger marginal utility, repaying becomes costlier for the benevolent government. As a result, default becomes more likely for a given level of debt.

Therefore, changes that make the tax system more progressive increase sovereign debt sustainability by reducing the probability of default. In doing so, the equilibrium ratio of sovereign debt to GDP also goes up, as can be observed in Table IV.

Table IV. Equilibrium ratio of Debt to GDP

Uniform Tax	Argentina	Linear Tax
-1.64	-3.30	-5.35

4.3 The effect of income inequality with a given tax system and no political constraints

The second experiment we conduct is to explore the effects on the government's repayment/default decision of considering alternative distributions of income. Again we take as our benchmark case the calibration to the Argentine economy, and consider two alternatives where we redistribute income across quintiles. In the first alternative we transfer 1 percent of income of each of the two lowest quintiles, to the two top quintiles, therefore increasing the Gini coefficient. In the second alternative we do the opposite. We transfer 1 percent of income of each of the two top quintiles, to the two lowest quintiles, therefore reducing the Gini coefficient. Figure IV compares the default set under each of these alternatives. As expected, a more unequal income distribution increases the default set while a more equal one reduces it.

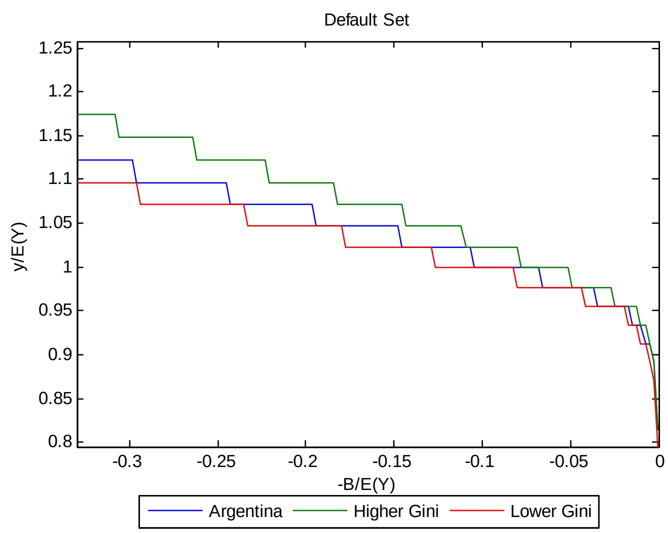

Figure IV

In Figure V we can observe the effects in terms of the sovereign bond price. Sovereign bond prices (sovereign spreads) are higher (lower) when the distribution of income is less (more) unequal. The intuition for these results is similar to that of the previous subsection.

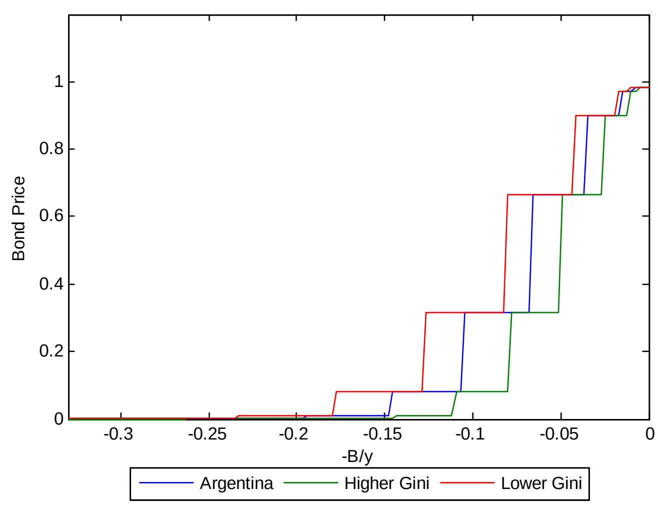

Figure V

4.4 The effect of political constraints

4.4.1 A new typology of sovereign defaults

Standard sovereign default models have focused on default episodes in which the government is unwilling to repay. In those models, the government has full access to the resources of the economy, which are assumed to be sufficient to repay the debt. 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).

The real world sovereign default universe is richer than the traditional theoretical depiction of it. In particular, as we discussed in the examples presented in the introduction, a distinctive feature of many sovereign defaults is that they are not the result of the government being unwilling to repay but of political constraints that governments sometimes face when trying to implement fiscal programs in order to raise funds to repay.

The introduction of political constraints allows us to generate a new typology of sovereign defaults. In our model three types of sovereign defaults can potentially arise. First, we have the pure "inability" to repay type of default, which happens if the government is unable to raise enough revenues through taxes and new debt issues in order to repay its debt. We can formalize this situation 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" type of default. In this case, if the government was only required to meet the resource constraint, it would be able to repay. However, the presence of the political constraint makes the government unable to find a combination of taxes and new debt that raises enough funds while garnering sufficient political support. As a result, the government has no option but to default. Formally:

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

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 maximizes aggregate welfare from the government's perspective. This type of default is characterized as:

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

This last type of default, in which the government defaults because it chooses to do so, is similar to the ones usually analyzed in the sovereign debt literature. In fact, this is the only type of default that can arise in traditional models. This is the case because in those models there are always enough resources to repay and there are no political constraints that could limit the ability of the government to obtain those resources.

4.4.2 The effect of political constraints with a given income distribution and tax system

In this subsection we analyze how the presence of political constraints affects the probability of default and the types of default that arise in equilibrium. We do so taking as given the tax system and the income distribution, but under three alternative scenarios regarding the political constraint. The first scenario assumes no political constraints. The second one assumes that simple majority of the votes is required for a fiscal program to be implemented ($p^r = 0.5$). The last one requires absolute consensus for a fiscal program to be implemented (i.e. unanimity, $p^r = 1$).

Figure VI presents the default probability for each level of debt over GDP under these alternative scenarios and shows which type of default would arise.[9] Trivially, when there is no political constraint there are no defaults driven by political considerations and all the defaults are due to the government being unwilling to repay (see first graph in Figure VI). Once we require a simple majority of the votes for the fiscal program to be implemented, we observe that many defaults are triggered by the political constraint, particularly for higher levels of debt over GDP (see second graph of Figure VI).

The reason for these new defaults is the uneven distribution of the sovereign debt repayment burden across the groups of households. In particular, in the case of Argentina, relatively poorer households are shouldering a disproportionate amount of the burden. Therefore, when they are given the chance they veto the repayment fiscal program proposed by the government.

Finally, if we impose the full consensus requirement, the probability of a default triggered by the political constraint becomes even higher (see last graph of Figure VI).

The "pure inability" to repay type of default does not arise in the benchmark case of our model (the one calibrated to the Argentine economy) because in equilibrium the government never chooses levels of debt that are so high as for resources not to be enough.[10]

[9] This analysis is equivalent to the one performed with default sets in the previous subsections.

[10] However, when we perform this same exercise assuming a uniform tax system, this type of default does arise in equilibrium.

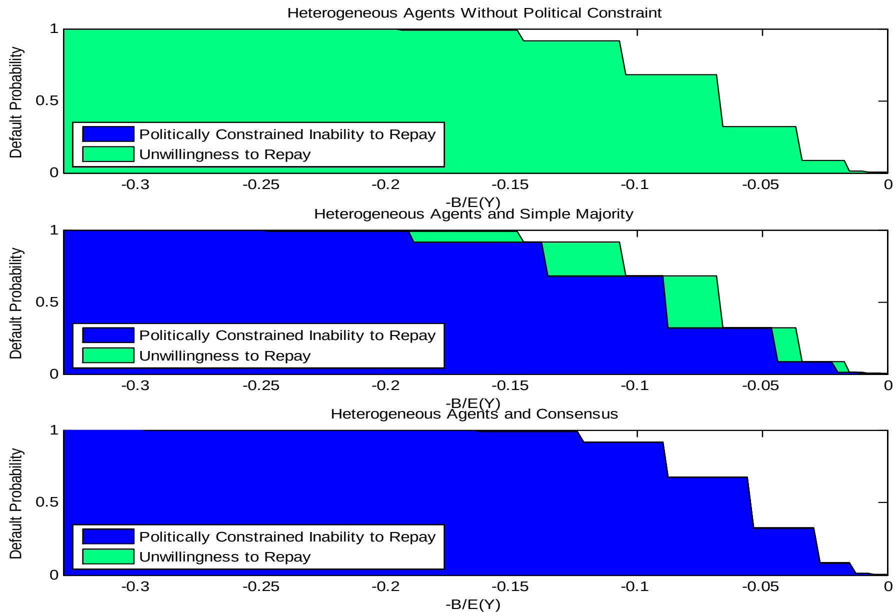

Figure VI

4.4.3 The interaction of political constraints, tax systems and the income distribution

In the previous subsections, we moved only one of our elements of interest at a time, keeping the other two constant. In this subsection, we interact them and evaluate the impact of different political constraint under alternative tax systems.[11]

Figure VII presents the default sets for the two polar cases of no political constraints and full consensus under alternative tax regimes (the case of Argentina, linear taxes and uniform taxation). As we can see in the graphs, political constraints become more (less) relevant when the tax system becomes more regressive (progressive). This happens because as the system becomes more regressive, households diverge more in their opinions regarding the convenience to repay. In one extreme, with linear taxes, all households have the same opinion regarding the convenience to repay and, as a result, the political constraint becomes irrelevant. In the other extreme, with uniform taxes, the political constraint becomes very relevant as households' opinions diverge a lot.

[11] For reasons of space we will just discuss the interaction between political constraints and the tax system. Similar results yield when we change the income distribution instead of the tax system, or both at the same time.

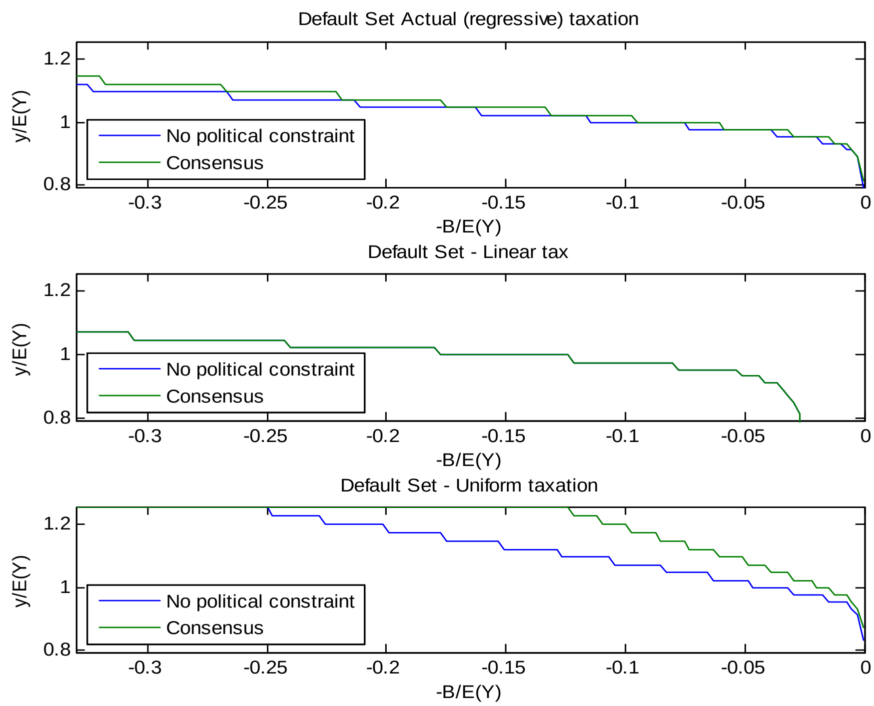

Figure VII

5 Conclusion

This paper analyzes the interactions between income distribution, the tax system and the political constraints faced by the government when raising revenues in the sovereign borrowing and default decisions.

We show that income inequality and regressive tax systems increase the probability of default and that political constraints can force a government to default even if it would prefer to repay. We also show that political constraints become more relevant when the income distribution is more unequal or the tax system more regressive. Finally, we presented a new typology of default events.

Our model fills a gap in the literature by incorporating political economy considerations in the sovereign default decision, through heterogenous agents and political constraints on the fiscal programs that the government can implement. We believe that understanding the role of the tax system, the income distribution and political constraints is crucial to gain a better understanding of the political economy of sovereign debt crises. However, our work should be seen as a first step in this direction. Further work remains to be done.

Our assumption regarding a voting process to determine whether a fiscal program can be implemented should not be taken literally. We could think of a vote in Congress as capturing this process indirectly. The recent 2010-2011 Icelandic default triggered by a popular binding referendum seems very close to a literal interpretation of our model. In spite of this real world example of our model, one can thought of alternative ways in which the political constraints could be formalized. A full analysis of this issue could be the subject of future research.

Introducing household heterogeneity and political constraints allowed us to explore how the differentiated impact of repayment across households affected the repayment/default decision of the government. The government maximized a welfare function where all agents were equally weighted. However, this is not the only possible welfare function. Many different weights could be considered once we have agents being heterogenous. Considering the results under all these alternative welfare functions was beyond the scope of this paper and merits further work.

6 References

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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.[12] 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's 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's utility due to the additional costs it faces. When having access to international credit markets, we assume the government's 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:*

$$D\left(B\right) = \{y \in Y : (1) \;\; or \;\; (4) \;\; do\ not\ hold\ \forall\left(B', \tau\right) \;\; with\ \tau \leq y^{r}_{\min}\}$$

Proof. (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.

7.2 Business cycle frequencies

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

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 V presents the main statistics for the business cycle of Argentina. Consumption, output and trade balance data are taken from the Ministry of Finance. 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). 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.

Table V. 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		

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 V 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 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.[13]

The first column of Table VI reports the model business cycle frequencies for our baseline scenario of Argentina. The model performs reasonably well at the business cycle frequencies. In particular, output and aggregate consumption volatilities are as much as 74% and 71% 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 8% 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 second and third columns of Table VI report the business cycle frequencies when we consider the alternative tax systems.

Table VI. Business Cycle Frequencies ($p^r = 0$)

	Argentina	Linear Tax	Uniform Tax
GDP Decline	-8.44	-7.68	-8.25
Consumption Decline	-8.35	-6.85	-8.17
Std(GDP)	5.83	5.83	5.70
Std(Consumption)	6.12	6.35	5.96
Std(Trade Balance)	0.87	1.45	1.14
Std(Spread)	6.59	6.21	11.3
Corr(GDP, Cons)	0.98	0.97	0.98
Corr(GDP, TB)	-0.22	-0.23	-0.24
Corr(SR, GDP)	-0.19	-0.14	-0.23
Corr(SR, Cons)	-0.24	-0.22	-0.25
Corr(SR, TB)	0.39	0.42	0.37
Mean Debt/GDP	-3.30	-5.35	-1.64
Mean Spread Rate	3.76	3.62	5.51

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