

Hermann, Tim; Scholl, Almuth

**Conference Paper**

## The Political Economy of Domestic and External Sovereign Debt

Beiträge zur Jahrestagung des Vereins für Socialpolitik 2023: Growth and the "sociale Frage"

**Provided in Cooperation with:**

Verein für Socialpolitik / German Economic Association

*Suggested Citation:* Hermann, Tim; Scholl, Almuth (2023) : The Political Economy of Domestic and External Sovereign Debt, Beiträge zur Jahrestagung des Vereins für Socialpolitik 2023: Growth and the "sociale Frage", ZBW - Leibniz Information Centre for Economics, Kiel, Hamburg

This Version is available at:

<https://hdl.handle.net/10419/277632>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# The Political Economy of Domestic and External Sovereign Debt\*

Tim Hermann<sup>†</sup>

Almuth Scholl<sup>‡</sup>

February, 2023

**Preliminary and Incomplete**

## Abstract

This paper explores the political and distributional consequences of sovereign debt and default and studies how optimal fiscal policy choices are affected by redistributive concerns, the composition of sovereign debt, and political constraints. We develop a quantitative macroeconomic model in which heterogeneous households face idiosyncratic income risk and save in non-state-contingent government bonds. Debt contracts are not enforceable and the government is politically constrained in its policy choices: A fiscal plan is required to receive the support of the majority of households. If neither fiscal plan is approved, the government is forced to renegotiate with its creditors and to restructure domestic and external debt. We highlight that debt crises are characterized by a political conflict. In the run-up to a sovereign default, the government has to reduce redistributive transfers to pay for increasing debt service costs. While wealthy households prefer the government to fulfill the debt contract as they benefit from high interest rates, poorer households are in favor of a default. Consequently, the approval of the fiscal plan decreases and the likelihood of a political default rises.

**Keywords:** sovereign debt and default, inequality, political economy, fiscal policy

**JEL Codes:** F34, H63, E62, F41, D72

\*We are grateful to seminar participants at the CEF 2022 (Dallas), the EEA 2022 (Milan), and the University of Konstanz for useful comments. This research was funded by the Deutsche Forschungsgemeinschaft (DFG – German Research Foundation) under Germany’s Excellence Strategy – EXC-2035/1 – 390681379. The usual disclaimer applies.

<sup>†</sup>University of Konstanz and Cluster of Excellence “The Politics of Inequality”, [tim.hermann@uni-konstanz.de](mailto:tim.hermann@uni-konstanz.de)

<sup>‡</sup>University of Konstanz, CEPR, and Cluster of Excellence “The Politics of Inequality”, [almuth.scholl@uni-konstanz.de](mailto:almuth.scholl@uni-konstanz.de)

# 1 Introduction

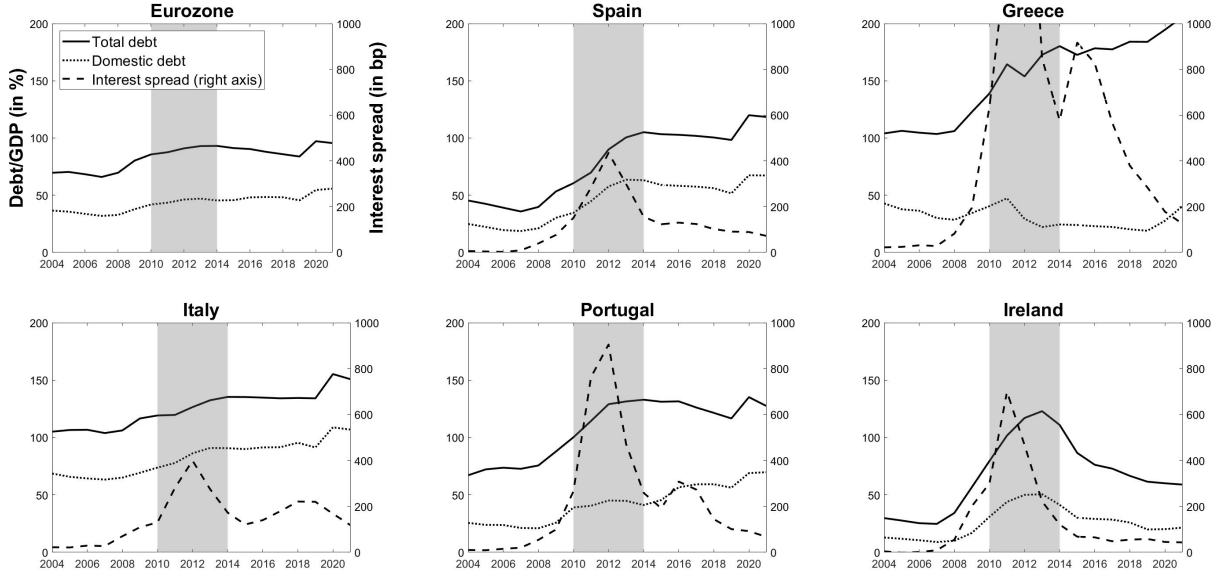
During the European sovereign debt crisis public debt to GDP ratios and interest rates on European government bonds increased substantially. Importantly, a sizable share of European public debt is held by domestic creditors (Figure 1). To pay for increasing debt service costs, governments are forced to cut spending and to raise taxation with important distributional and political implications: Wealthy households who hold government bonds support austerity measures, whereas poor households may prefer a sovereign default. This political conflict is strengthened in economies with large shares of domestic debt and high wealth inequality.

This paper aims to understand the political and distributional consequences of sovereign debt and default. Specifically, we study how optimal fiscal policy choices are affected by redistributive concerns, the composition of sovereign debt, and political constraints.

We answer the research question within a quantitative macroeconomic model of sovereign debt and default with heterogeneous households in which the government needs political support for the implementation of fiscal policies. We build on [D'Erasmus and Mendoza \(2021\)](#) and consider an infinite-horizon small open endowment economy inhabited by a continuum of households who face idiosyncratic income risk. Households are borrowing-constrained but can save in government bonds. The government of the small open economy finances stochastic government spending and lump-sum transfers by taxing income and by issuing non-state-contingent bonds. Debt contracts are not enforceable and are subject to sovereign default risk. In addition to domestic creditors, there is a pool of risk-neutral, perfectly competitive foreign creditors. We assume that the government cannot discriminate between domestic and foreign creditors. The government's political preferences are characterized by weights imposed on the welfare of individual households across income and wealth. A government exhibits a creditor bias if the welfare weights are increasing in the households' bond holdings. However, as in [Andreasen et al. \(2019\)](#), the government is politically constrained in its fiscal policy choices: A fiscal plan is required to receive the support of the majority of households. If neither fiscal plan is approved by the households, the government is forced to default. In default, the government bargains with the creditors and reschedules its debt.

Solving the model for the optimal policies is challenging because the aggregate approval of a fiscal plan depends on the distribution of income and wealth which itself is affected by the fiscal policies chosen by the government. To solve this issue, we assume that the government uses a forecasting rule to predict the aggregate vote share. The forecasting rule depends on two variables that are the main determinants of the individual approval: transfers and the

Figure 1. The European Sovereign Debt Crisis



Notes: The figure shows consolidated government debt (solid line) and the share of government debt held by domestic residents (dotted line) as fractions of GDP. The dashed lines display the long term government bond yield spreads of the respective country vs. Germany. The shaded areas mark the Eurozone debt crisis. Data are taken from the ECB Government Finance Statistics and from Eurostat.

bond price. On the one hand, individuals assess the government’s fiscal plan by evaluating the size of transfers in comparison with the size of transfers in case of a sovereign default. On the other hand, the bond price shapes the individual approval since it captures the rate of return a household receives when saving in bonds. We propose an iterative procedure in which the forecast rule is estimated using simulated model-based approval rates.

We calibrate the model to the Italian economy motivated by the large share of Italian public debt held by domestic creditors. Our analysis highlights the following trade-off: On the one hand, the government can borrow to finance redistribution. On the other hand, higher debt raises the interest rate on bonds forcing the government to cut down transfers. To implement a fiscal plan, the government needs the support of the majority of the households. However, if interest rates are too high, households at the bottom of the wealth distribution do not support the fiscal plan and prefer the government to renegotiate debt. In contrast, wealthier households benefit from the higher interest rate on their savings.

To highlight the impact of political constraints on sovereign debt and default, we provide a comparison with a counterfactual economy in which the government is politically unconstrained in its fiscal policy choices. It turns out that the political constraint makes fiscal plans infeasible already for intermediate levels of debt. Compared to the counterfactual economy, the default set is enlarged by politically motivated defaults. In turn, the greater sovereign default risk is reflected in high interest rates imposing a severe borrowing constraint

on the government. In equilibrium, the government accumulates less debt compared to the counterfactual economy, which, in turn, dampens sovereign default risk in the long run. Our analysis highlights that the likelihood of a political default is larger if the government's political preferences are characterized by a creditor bias.

In the model, political conflicts generate sovereign defaults. Our model simulations suggest that prior to a typical default, the economy is characterized by favorable economic conditions allowing the government to issue more debt. Wealth inequality is affected by two opposing forces. On the one hand, the government borrows more and redistributes progressively by providing transfers. On the other hand, higher debt increases the interest rate on government bonds and raises the return on household savings. Thus, households with a large bond position are becoming richer. Our quantitative findings shows that the second effect dominates such that wealth inequality increases prior to the default. The default is triggered by an adverse aggregate shock. Since the government has accumulated a substantial amount of debt, the interest spread increases strongly. Debt repayment becomes very costly implying low transfers, such that a political conflict occurs. While wealthy households prefer the government to honor outstanding debt obligations, poor households are in favor of debt renegotiation. Consequently, the approval rate of the fiscal plan decreases substantially forcing the government to default.

With its focus on the distributional consequences of sovereign default risk, our paper is closely related to [D'Erasmus and Mendoza \(2021\)](#) and [Andreasen et al. \(2019\)](#). [D'Erasmus and Mendoza \(2021\)](#) allow for heterogeneous agents and domestic creditors in a quantitative model of sovereign debt and default.<sup>1</sup> We extend their model by adding a political constraint that restricts the set of feasible fiscal plans. Our approach is in the spirit of [Andreasen et al. \(2019\)](#) who explore political defaults in an economy with hand-to-mouth households.<sup>2</sup> While they abstract from domestic debt, our model allows us to study the rich dynamics between wealth inequality, the composition of sovereign debt, and political conflict. A distinctive feature of our model is that the equilibrium allocation *endogenously* reflects the preferences of the population across income and wealth. In contrast, in [D'Erasmus and Mendoza \(2021\)](#) the equilibrium allocation is determined by the *exogenous* preferences of the government.

Our paper builds on quantitative macroeconomic models with heterogeneous agents and incomplete markets that focus on the role of public debt, see among others [Aiyagari and McGrattan \(1998\)](#), [Flodén \(2001\)](#), [Heathcote \(2005\)](#), [Azzimonti et al. \(2014\)](#), [Röhrs and Winter \(2017\)](#). While these studies abstract from sovereign defaults, [Ferriere \(2015\)](#), [Jeon](#)

---

<sup>1</sup>A stylized two-period version of the model can be found in [D'Erasmus and Mendoza \(2016\)](#).

<sup>2</sup>Building on [Andreasen et al. \(2019\)](#), [Novelli \(2021\)](#) and [Azzimonti and Mitra \(2012\)](#) analyze the role of political constraints in the form of legislative bargaining in models of external debt.

and Kabukcuoglu (2018), Deng (2021), and Scholl (2022) study the distributional implications of sovereign default risk within quantitative models of sovereign debt and default pioneered by Aguiar and Gopinath (2006) and Arellano (2008). These papers focus on external debt and assume that domestic households are hand-to-mouth. Similar to D’Erasmus and Mendoza (2021), Tran-Xuan (2022) allows for domestic creditors in a model of sovereign debt with limited commitment but she focuses on constrained-efficient allocations abstracting from default in equilibrium.

Our paper contributes to the literature that studies political aspects in models of public debt pioneered by Tabellini (1991), Aghion and Bolton (1990), Dixit and Londregan (2000). Dovis et al. (2016) consider an overlapping generation model in which current and future governments disagree on redistributive policies and debt. In their setting, boom-bust cycles arise in which the current government issues debt to redistribute via transfers, followed by a future government cutting transfers to reduce debt. Similarly, Aguiar and Amador (2011) study the interaction of political economy frictions and sovereign default risk, but as in Dovis et al. (2016), allocations are subject to enforceability constraints. In contrast, we allow the government to default on external as well as domestic debt. Guembel and Sussman (2009) analyze a stylized two-period endowment economy with domestic and external debt in which households differ in terms of income and bond savings such that a political conflict arises. In a two-party setting, the government’s debt and default decisions are taken by majority voting. Guembel and Sussman (2009) highlight that debt is only supportable if the government cannot discriminate between different classes of creditors. We use this result and assume that the government cannot differentiate between domestic and foreign creditors. Our modeling choices of the debt renegotiation process follow Yue (2010), Chatterjee and Eyigungor (2015) and Sunder-Plassmann (2018).

Our paper is also related to Hatchondo et al. (2009), Cuadra and Sapriza (2008), Scholl (2017), Chatterjee and Eyigungor (2019), Prein and Scholl (2021) who focus on the interaction between political turnover and sovereign default in models of external debt. While these studies focus on the impact of fiscal policy choices on electoral outcomes, they abstract from domestic debt and wealth inequality, which is the focus of our paper.

The remainder of the paper is structured as follows. Section 2 describes the model environment and defines the recursive equilibrium. Section 3 deals with the solution algorithm and the calibration. Section 4 presents the quantitative results and discusses the economic mechanisms and the impact of political constraints in the short and long run. Section 5 concludes.

## 2 A Political Economy Model of Domestic and External Debt

### 2.1 Environment

We build on [D’Erasmus and Mendoza \(2021\)](#) and consider an infinite-horizon small open endowment economy inhabited by a continuum of households of measure one who face idiosyncratic income risk. Households are borrowing-constrained but can save in bonds. The government of the small open economy finances government spending and lump-sum transfers by taxing income and by issuing non-state-contingent bonds. Government spending  $G_t$  is stochastic and follows a Markov process with the transition function  $\psi(G_{t+1}|G_t)$  and compact support  $\mathbb{G} = [\underline{G}, \bar{G}]$ . Debt contracts are not enforceable and are subject to sovereign default risk. The government cannot discriminate between domestic and foreign creditors. Foreign creditors are risk-neutral, act in perfect competition, and borrow at the risk-free rate. If the government defaults, the economy is hit by exogenous default costs and the government negotiates over debt reduction with its creditors. After one period, debt is rescheduled and the government regains access to financial markets. Following [Andreasen et al. \(2019\)](#), the government is politically constrained in its fiscal policy choices: A fiscal plan is required to receive the support of the majority of the households. If neither fiscal plan is approved by the households, the government is forced to default.

The household’s preferences are given by

$$E_0 \sum_{t=0}^{\infty} \beta^t u(c_t),$$

where  $\beta \in (0, 1)$  denotes the rate of time preference and  $c_t$  refers to consumption of an individual household.  $u(c_t)$  is continuous, twice differentiable, strictly increasing and satisfies the Inada conditions. Households face stochastic idiosyncratic income  $y_t$  which follows a discrete Markov process with a transition function  $\pi(y_{t+1}|y_t)$  and compact support  $\mathbb{Y} = [\underline{y}, \bar{y}]$ . We follow [D’Erasmus and Mendoza \(2021\)](#) and assume that idiosyncratic income shocks have a zero mean across households such that aggregate income  $Y$  is deterministic. Moreover, idiosyncratic income shocks and aggregate government spending shocks are independent. To insure against idiosyncratic income fluctuations, households can save in government bonds but face an exogenous borrowing constraint,  $b_{t+1} \geq 0$ .

In the absence of a sovereign default, the date  $t$  budget constraint of an individual household is given by:

$$c_t + q_t b_{t+1} = y_t(1 - \tau) + b_t + T_t,$$

where  $q_t$  denotes the price of the bond with face value  $b_{t+1}$ . The government taxes individual

income at an exogenous proportional tax rate  $\tau$ .  $T_t$  denote lump-sum transfers provided by the government. The idiosyncratic income shocks and saving decisions generate an endogenous distribution of income and wealth denoted by  $\Lambda_t(b_t, y_t)$ .

In case of a sovereign default, the government renegotiates its debt. Renegotiations take one period during which the budget constraint of an individual household is given as:

$$c_t = y_t(1 - \tau) + T_t - \phi(G_t).$$

$\phi(G_t)$  denotes exogenous default costs with  $\phi'(G_t) < 0$ .

The government issues non-state-contingent one-period bonds  $B_{t+1}$ . We assume the government to be a debtor such that  $B_{t+1} \geq 0$ . If debt is fully repaid, the government's budget constraint is given by:

$$T_t = \tau Y + q_t B_{t+1} - B_t - G_t.$$

The government uses revenues from income taxation  $\tau Y$  and resources from borrowing  $q_t B_{t+1}$  net of debt repayment  $B_t$  and government spending  $G_t$  to finance lump-sum transfers  $T_t$ .

We follow [Andreasen et al. \(2019\)](#) and assume that the government faces a political constraint when choosing its fiscal policy. To get accepted, a fiscal plan needs the majority of votes of the households. We define the individual approval  $p_t \in \{0, 1\}$  of a fiscal plan to be an indicator function which equals one if the associated household's discounted expected lifetime utility is greater than the one associated with a default and zero otherwise. Using the endogenous income and wealth distribution  $\Lambda_t(b_t, y_t)$ , the individual approvals can be aggregated to derive the population's vote share  $P_t$  supporting the fiscal plan. The fiscal plan is accepted if the aggregate approval  $P_t$  exceeds an exogenous vote threshold:  $P_t \geq P^s$ . If all fiscal plans are rejected, the government is forced to default.

In case of a sovereign default, in the period of debt renegotiation, the government's budget constraint reads as:

$$T_t = \tau Y - G_t.$$

We follow [Yue \(2010\)](#) and assume that in default debt is rescheduled. The debt renegotiation process is modeled as a one-period Nash-bargaining over the joint surplus, in which the government and the creditors agree on the debt recovery rate  $a_t$ .

In addition to domestic creditors, there are many identical foreign creditors who are risk-neutral, act in perfect competition, and borrow at the risk-free rate  $r$ . They have full information about the state of the economy.



## 2.2 Recursive Equilibrium

The timing is as follows. At the beginning of each period  $t$ , idiosyncratic and aggregate shocks are realized. Individual states  $(b, y)$ , aggregate states  $(B, G)$  and the distribution  $\Lambda(b, y)$  are observed. The government proposes its fiscal plan and individual voting on the fiscal plan takes place. Either the fiscal plan is implemented or a sovereign default takes place. Taking as given the government's policies, households make their savings and consumption choices.

### 2.2.1 Private Sector

Taking as given the government's fiscal policy, an individual household maximizes her expected discounted lifetime utility subject to her budget constraint.  $B'$  denotes the government's borrowing policy and  $d$  is an indicator function that takes the value of one if the government defaults and zero otherwise. The individual household's value function is given as:

$$V(b, y, B, G; B') = (1 - d)V^{d=0}(b, y, B, G; B') + dV^{d=1}(b, y, B, G) \quad (1)$$

$V^{d=0}(b, y, B, G; B')$  refers to the individual household's value function if the government does not default and issues new debt  $B'$ , given the individual states  $(b, y)$  and the aggregate states  $(B, G)$ .  $V^{d=1}(b, y, B, G)$  is the household's value function if the government defaults and enters debt renegotiations.

If the government repays its debt, the individual's value function is given by:

$$V^{d=0}(b, y, B, G; B') = \max_{\{c, b'\}} u(c) + \beta \mathbb{E}[V(b', y', B', G'; B''|y, G)] \quad (2)$$

s.t.

$$c + q(B', G)b' = y(1 - \tau) + b + T,$$

$$b' \geq 0.$$

The solution to this maximization problem yields the individual policy functions  $c(b, y, B, G; B')$  and  $b'(b, y, B, G; B')$ .

If the government defaults and negotiates over debt reduction, the individual's value function is given as:

$$V^{d=1}(b, y, B, G) = u(c) + \beta \mathbb{E}[V(ab, y', aB, G'; B''|y, G)] \quad (3)$$

s.t.

$$c = y(1 - \tau) + T - \phi(G),$$

where  $a$  denotes the recovery rate being the outcome of a static Nash bargaining described below.

### 2.2.2 Political Process

An individual household supports the government's fiscal plan  $(B', T)$  if her associated expected discounted lifetime utility is larger than her expected discounted lifetime utility of a sovereign default:

$$p(b, y, B, G; B') = \begin{cases} 1 & \text{if } V^{d=0}(b, y, B, G; B') \geq V^{d=1}(b, y, B, G) \\ 0 & \text{else.} \end{cases}$$

Using the distribution  $\Lambda(b, y)$ , the aggregate population's vote share supporting the fiscal plan can be derived as:

$$P(B, G; B') = \int_{\mathbb{Y} \times \mathbb{B}} p(b, y, B, G; B') d\Lambda(b, y). \quad (4)$$

### 2.2.3 Public Sector

The government chooses its optimal policy as to maximize the weighted expected discounted lifetime utility of households. The weights  $\omega(b, y)$  characterize the political preferences of the government. The government's maximization problem is given by:

$$\max_{d \in \{0,1\}} \{W^{d=0}(B, G; B'), W^{d=1}(B, G)\}, \quad (5)$$

where  $W^{d=0}(B, G; B')$  refers to the government's value function conditional on debt repayment.  $W^{d=1}(B, G)$  is the government's value function of default.

If the government repays its debt, it chooses its optimal fiscal plan taking into account the political constraint and the private sector policy functions  $c(b, y, B, G; B')$  and

$b'(b, y, B, G; B')$ :

$$W^{d=0}(B, G; B') = \max_{B'} \int_{\mathbb{Y} \times \mathbb{B}} V^{d=0}(b, y, B, G; B') d\omega(b, y)$$

s.t.

$$T = \tau Y + q(B', G)B' - B - G,$$

$$B' \geq 0,$$

$$P(B, G; B') \geq P^s$$

$$c(b, y, B, G; B') \text{ and } b'(y, B, G; B').$$

Given the aggregate states and the distribution of wealth and income, the government takes into account that its fiscal plan needs to receive a majority of votes in the population. A sovereign default takes place when the government cannot propose any fiscal plan such that  $P(B, G; B') \geq P^s$ , where  $P(B, G; B')$  is determined in equation (4).

In default, the government negotiates over debt reduction. The renegotiations are described by a static Nash bargaining game between the government and the creditors over the joint surplus. The government's value function of agreeing on a debt recovery rate  $a$  with the creditors is given by:

$$W^{d=1}(B, G) = \int_{\mathbb{Y} \times \mathbb{B}} V^{d=1}(b, y, B, G) d\omega(b, y),$$

where  $V^{d=1}(b, y, B, G)$  fulfills equation (3).

In case the government cannot reach an agreement with the creditors, the outside option is assumed to be:

$$\begin{aligned} W^{aut}(G) &= \int_{\mathbb{Y} \times \mathbb{B}} V^{aut}(y, G) d\omega(b, y) \text{ with} \\ V^{aut}(y, G) &= u(c) + \beta \mathbb{E}[V^{aut}(y', G') | y, G] \\ \text{s.t. } c &= y(1 - \tau) + T - \phi(G). \end{aligned}$$

The government's surplus of a recovery rate  $a$  is given as:

$$\Delta^{gov}(a, B, G) = W^{d=1}(B, G) - W^{aut}(G).$$

We follow [Chatterjee and Eyigungor \(2015\)](#) and assume that every creditor, regardless of her bond holdings, seeks to maximize the aggregate value of bonds. The creditor's surplus

is given by

$$\Delta^{cred}(a, B, G) = q(aB, G)aB.$$

Given debt  $B$  and government spending  $G$ , the equilibrium recovery rate  $\alpha(B, G)$  solves the following Nash bargaining problem:

$$\alpha(B, G) = \arg \max_a \left[ (\Delta^{gov}(a, B, G))^\theta (\Delta^{cred}(a, B, G))^{1-\theta} \right],$$

where  $\theta$  denotes the government's bargaining power.

Let  $D(B)$  be the set of government spending realizations  $G \in \mathbb{G}$  such that a default occurs:

$$D(B) = \{G \in \mathbb{G} : d(B, G) = 1\}.$$

$\delta(B', G)$  denotes the associated default probability.

#### 2.2.4 Creditors

In addition to domestic creditors, there is a large number of identical risk-neutral foreign creditors who have full information on the state of the economy and act in perfect competition. They can borrow or lend at risk free rate  $r$ . The zero expected profit condition implies:

$$q(B', G) = \frac{1}{1+r} \mathbb{E}[1 - d(B', G')|G] + \frac{1}{1+r} \mathbb{E}[d(B', G')\alpha(B', G')q(\alpha(B', G')B', G')|G].$$

### 3 Solution Method and Calibration

#### 3.1 Solution Method

Solving the model is challenging because the aggregate approval  $P$  depends on the wealth distribution  $\Lambda(b, y)$ , which itself is affected by the fiscal plan chosen by the government. Inspired by the solution method proposed in [Krusell and Smith \(1998\)](#), we assume that the government uses a forecasting rule  $F(\mathbf{x}\gamma)$  to predict the aggregate approval  $P$ . The forecasting rule depends on two variables  $\mathbf{x} = (T, q)$  that are the main determinants of the individual approval: transfers  $T$  and the bond price  $q$ . On the one hand, individuals assess the government's fiscal plan by evaluating the size of the transfers in comparison with the size of transfers in case of a sovereign default. On the other hand,  $q$  shapes the individual approval since it captures the rate of return a household receives when saving in bonds.

While poor households do not hold government bonds, for wealthier households the bond price becomes an important determinant of their individual approval of a fiscal plan.

We use a fractional response model to specify the forecasting rule  $F(\mathbf{x}\gamma)$  as an approximation of the aggregate approval rate  $P \in (0, 1)$ . Following [Papke and Wooldridge \(1996\)](#), the fractional response model with  $j = 1, \dots, n$  observations is given by:

$$P_j = F(x'_j\gamma) + \epsilon_j, \quad j = 1, \dots, n$$

where the dependent variable  $P_j$  is the aggregate approval rate.  $0 \leq F(x'_j\gamma) \leq 1$  is a cumulative distribution function,  $x_j$  contains the independent variables  $T_j$  and  $q_j$ ,  $\gamma$  is the vector of regression coefficients, and  $\epsilon_j$  is the error term. Following [Papke and Wooldridge \(1996\)](#), we choose the logistic function  $F(z) = \frac{\exp(z)}{1+\exp(z)}$  and determine  $\gamma$  by maximizing the log-likelihood function:

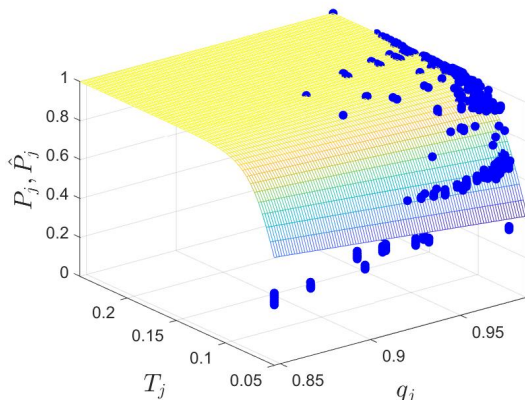
$$\mathbb{L}(\gamma) = \sum_j^n y_j \log(F(x'_j\gamma)) + (1 - y_j) \log(1 - F(x'_j\gamma)).$$

To solve the model we apply the following algorithm:

1. Start with an initial guess for the forecasting coefficients  $\gamma$ .
2. Given the forecasting rule  $F(x'_j\gamma)$ , apply standard value function iteration techniques to solve for the optimal policy functions of the public and private sector.
3. Given the policy functions, simulate the model economy to derive the wealth distribution, individual voting, and the aggregate approval.
4. Use the simulated time series to estimate the coefficients  $\gamma$  of the fractional response model.
5. Update the coefficients  $\gamma$  and go back to step 1.
6. Iterate until the coefficients  $\gamma$  converge.

Figure 2 shows the aggregate approval  $\hat{P}$  predicted by the estimated forecasting rule. The dots show the simulated observations  $(T_j, q_j, P_j)$  entering the estimation. A comparison of the estimated and the simulated aggregate approval suggests that the parsimonious specification of the forecast rule delivers a suitable approximation.

Figure 2. Predicted Aggregate Approval



Notes: The figure shows the aggregate approval  $\hat{P}_j$  predicted by the estimated forecasting rule. The dots show the simulated observations  $(T_j, q_j, P_j)$  entering the estimation.

### 3.2 Calibration

In the quantitative analysis, we calibrate the model to the Italian economy. Italy was particularly hit by the Eurozone debt crisis and exhibits a substantial amount of domestic public debt. In the following, we specify the functional forms and calibrate the parameter values on an annual basis. A subset of parameters is calibrated externally whereas the remaining parameters are calibrated internally to match specific empirical targets. Table 1 summarizes the set of parameters and its targets.

Table 1. Benchmark calibration

Parameter	Target		
<i>External</i>			
Risk-free rate	$r$	0.013	German bond yields
Risk aversion	$\sigma$	2	Standard value
Idiosyncratic income	$\rho_y$	0.7	Autocorrelation income
	$\mu_y$	1.0	Average income
	$\sigma_v$	0.319	Standard deviation income
Government spending	$\rho_G$	0.82	Autocorrelation government spending
	$\mu_G$	0.189	Average government spending
	$\sigma_\epsilon$	0.024	Standard deviation government spending
Voting threshold	$P^s$	0.5	Simple majority
Political preference	$\bar{\omega}$	0.05	–
<i>Internal</i>			
Time preference	$\beta$	0.77	Average domestic debt ratio
Income tax	$\tau$	0.28	Tax revenues as share of GDP
Default cost	$\phi_1$	0.7	Average bond spreads vs. Germany
Bargaining power	$\theta$	0.95	Average recovery rate

The utility function is assumed to have a constant relative risk aversion (CRRA):

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

where  $\sigma > 0$  denotes the parameter of relative risk aversion. We set  $\sigma = 2$  which is a standard value in the literature on sovereign debt. We calibrate the time preference  $\beta$  to match the domestic debt ratio of 67.92%. The risk-free rate  $r$  is set to 1.3% based on the average long-term bond yields of Germany. We assume default costs of the following form:

$$\phi(G) = \phi_1 \sqrt{(\bar{G} - G)},$$

where  $\phi_1 > 0$  determines the level of the cost.  $\bar{G}$  is the maximum value that  $G$  can take. Since  $\phi'(G) < 0$ , default becomes more costly for lower realizations of government spending. We set  $\phi_1$  to match the average spread of Italy vs. Germany of 1.21%.

The bargaining power  $\theta$  is set to match an average recovery rate of 27% based on [Sunder-Plassmann \(2018\)](#) and [Yue \(2010\)](#).

Income and government spending shocks are assumed to follow AR(1) processes:

$$\begin{aligned} \log(y') &= (1 - \rho_y) \log(\mu_y) + \rho_y \log(y) + v, \\ \log(G') &= (1 - \rho_G) \log(\mu_G) + \rho_G \log(G) + \epsilon, \end{aligned}$$

where  $v$  and  $\epsilon$  are i.i.d  $N(0, \sigma_v^2)$  and  $N(0, \sigma_\epsilon^2)$ , respectively. We estimate the AR(1) process for  $G$  using data for government final consumption expenditures. For  $y$ , we rely on parameters used in the macroeconomic literature and choose  $\rho_y = 0.7$  and  $\sigma_v = 0.319$ . We normalize  $\mu_y = 1$  such that aggregate income  $Y = 1$ . Given the normalization, all variables are measured as GDP ratios. We discretize both Markov processes using Tauchen's method ([Tauchen and Hussey \(1991\)](#)).

The proportional tax  $\tau$  is set such that tax revenues  $\tau Y$  match the average tax revenue collected from individual labor and consumption taxes as share of GDP (27.95%).

We assume that the government needs a simple majority to get approval of its fiscal plan,  $P^s = 0.5$ . The government's political preferences are given by:

$$\omega(b, y) = \sum_{y \in \mathbb{Y}} \pi^*(y_i) (1 - e^{-\frac{b}{\bar{\omega}}}).$$

This specification is taken from [D'Erasmus and Mendoza \(2021\)](#).  $\pi^*(y)$  is the long-run distribution of income. The parameter  $\bar{\omega} > 0$  determines the creditor bias: With increasing  $\bar{\omega}$ ,

the government gives more weight to the utility of households with larger bond savings. In the benchmark economy, we set  $\bar{\omega} = 0.05$ . We highlight the role of the political constraint by studying the impact of the political preferences on the likelihood of a political default.

## 4 Results

### 4.1 Understanding Political Defaults

In a first step, we study the properties of the policy functions to understand the economic mechanisms behind the dynamic interaction between sovereign default risk, political constraints, and the distribution of income and wealth. We facilitate a comparison of our benchmark political economy with a counterfactual economy in which the government does not require approval of a fiscal plan. In this counterfactual economy, the government is politically unconstrained such that its debt policy is determined by its political preferences  $\omega(b, y)$ . The counterfactual economy is similar to the one proposed by [D’Erasmus and Mendoza \(2021\)](#) in which the government optimally decides whether to repay outstanding debt obligations or to default. However, we assume that in default, the recovery rate is an endogenous outcome of a bargaining process while in [D’Erasmus and Mendoza \(2021\)](#) it is exogenously set to zero.

Figure 3 shows the government’s policy functions for the counterfactual economy (solid line) and the benchmark political economy (dotted line). Specifically, the figure depicts the bond price  $q(B', G)$  as a function of  $B'$ , the borrowing policy  $B'(B, G)$  as a function of  $B$ , and the debt Laffer curve  $q(B', G)B'$  as a function of  $B'$  for different realizations of government spending  $G$ . Furthermore, it displays the sovereign default set  $d(B, G)$ , the recovery rate  $\alpha(B, G)$ , and the aggregate approval  $P(B, G)$  together with the tax policy  $T(B, G)$ .

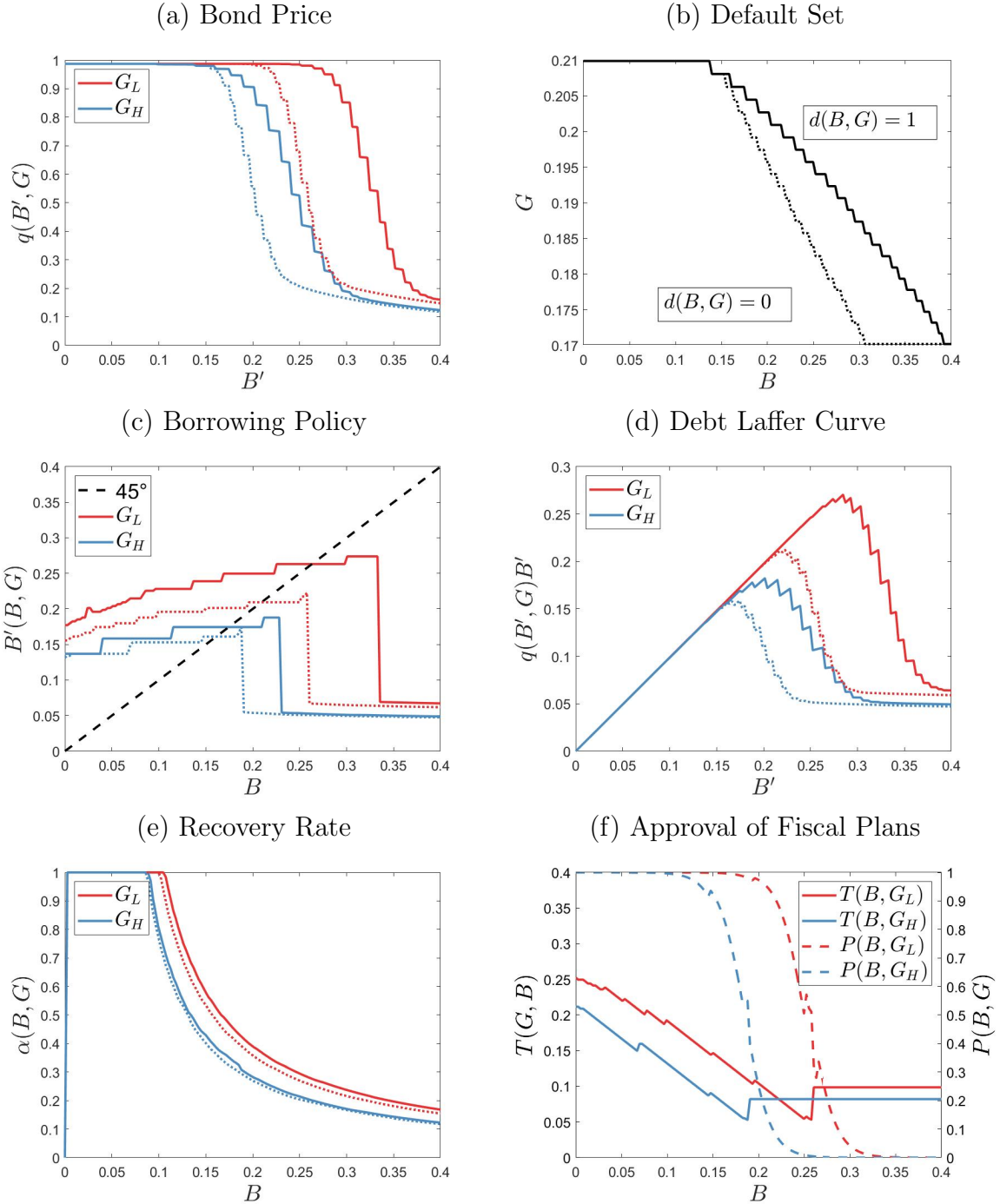
Let us first consider the counterfactual economy in which the government does not face any political constraints. The bond price function is decreasing in  $B'$  reflecting the government’s default risk. The default set highlights that default incentives are larger for higher levels of sovereign debt and for larger shocks to government spending. For a small amount of borrowing  $B'$ , the government has no incentive to default and repayment is certain. Consequently, the bond price is equal to the inverse of the risk free rate. For higher amounts of borrowing, the bond price is determined by the probability of a sovereign default. When borrowing is so large that a sovereign default occurs for any realization of the aggregate spending shock, the bond price collapses to zero. The pattern of the bond price function is reflected in the government’s optimal borrowing policy function  $B'(B, G)$ . The borrowing policy is increasing in the level of existing debt  $B$  and intersects with the 45-line. On the left of the 45-line the government accumulates debt whereas on the right of the 45-line it reduces debt. Clearly, the bond price restricts the government in the issuance of new debt.



For lower realizations of government spending, the bond price function is smooth such that borrowing gradually increases up to the point where the government decides to default. For high spending realizations, default incentives are large and the bond price function is very steep. In this case, the government is severely borrowing constrained. The debt Laffer curve  $q(B', G)B'$  is hump-shaped in  $B'$ . First, borrowing is risk free and revenues from borrowing increase at a linear rate  $\frac{1}{1+r}$ . When debt becomes risky, revenues from borrowing are still increasing but at a lower rate as the interest rate on government bonds rises. In default, the government re-schedules its debt and the recovery rate is decreasing in the degree of sovereign indebtedness.

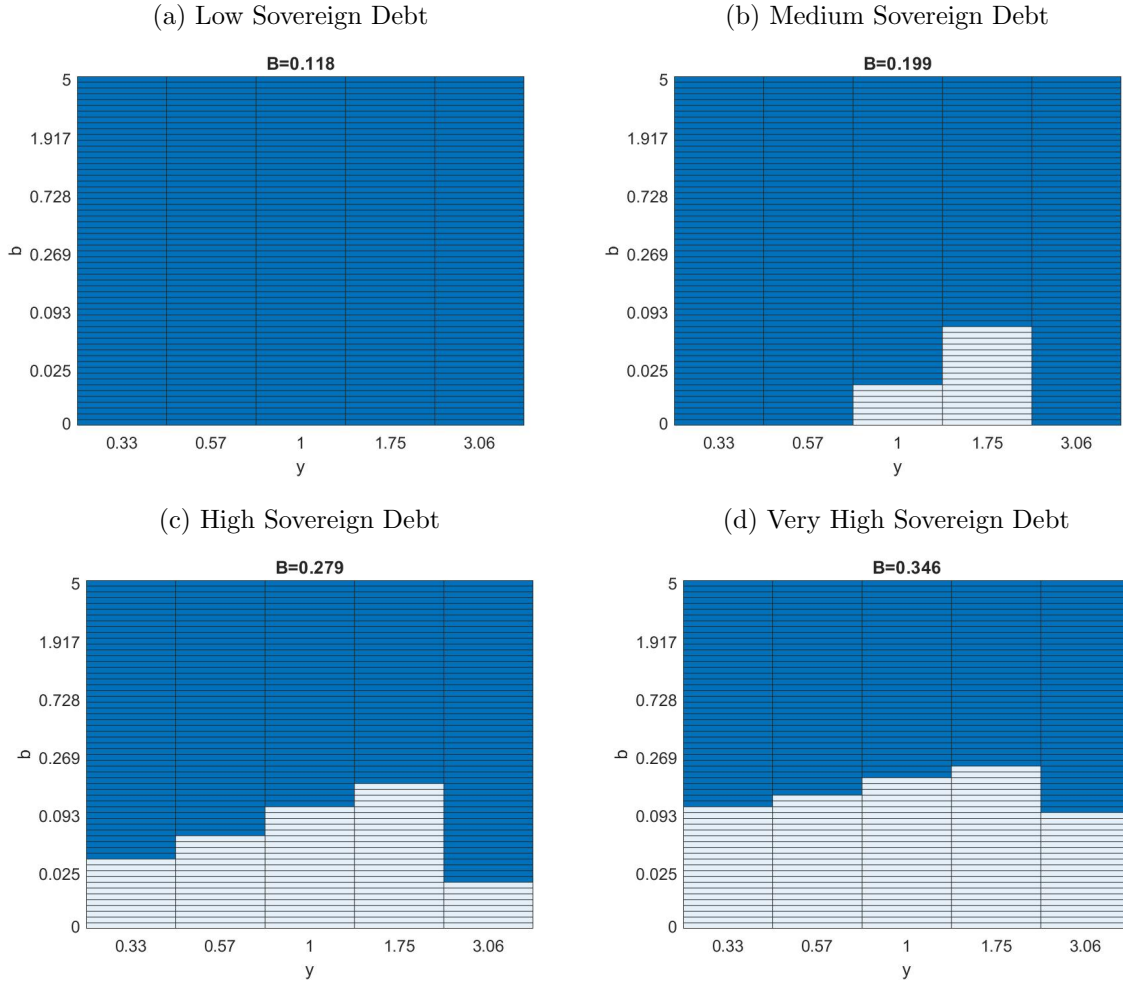
To evaluate the impact of the political constraint on the government's decisions, we now compare the counterfactual economy with the benchmark political economy (dotted lines in Figure 3). To implement a fiscal plan, the government needs the support of the majority of the households. Panel (f) highlights that the aggregate approval decreases if indebtedness increases. To shed light on this finding, Figure 4 displays the individual approval decisions  $p(b, y)$  as functions of individual bond holdings and idiosyncratic income for different levels of sovereign debt  $B$ . If sovereign indebtedness is low, all individuals in the economy approve the fiscal plan. With increasing level of public debt, however, the bond price falls such that the government has to cut down transfers. Consequently, households at the bottom of the wealth distribution do not support the fiscal plan and prefer the government to renegotiate its debt. In contrast, wealthier households benefit from the higher interest rate on their savings. In the aggregate, it turns out that the political constraint makes fiscal plans infeasible already for intermediate levels of debt and enlarges the default set. Thus, the political constraint produces a *political default set* characterized by the difference between the defaults sets of the benchmark economy and the counterfactual economy. The higher sovereign default risk is reflected in the pattern of the bond price function, which becomes much steeper. Consequently, the government becomes more credit-constrained and the revenues collected from borrowing decrease. Moreover, the Laffer curve peaks at a lower level of debt.

Figure 3. Policy Functions, Debt Laffer Curve and Default Set



Notes: The upper left panel shows the bond price  $q(B', G)$  as a function of  $B'$ . The middle left panel displays the borrowing policy  $B'(B, G)$  as a function of  $B$  whereas the upper right panel visualizes the debt Laffer curve  $q(B', G)B'$  as a function of  $B'$ . The middle right panel shows the default set for combinations of  $B$  and  $G$  whereas the lower left panel display the recovery rate  $\alpha(B, G)$  as a function of  $B$ . The solid lines refer the counterfactual economy in which the government is politically unconstrained. The dotted lines refer to the benchmark political economy. The lower right panel shows the transfer policy  $T(B, G)$  and approval  $P(B, G)$  for the benchmark political economy as a function of  $B$ .  $G_H$  and  $G_L$  are government spending shock realizations one standard deviation above and below the mean, respectively.

Figure 4. Individual Approval of Fiscal Plans



Notes: The figure shows the individual approval  $p(b, y, B, G)$  for different combinations of individual bond holdings  $b$  and idiosyncratic income  $y$  for given level of sovereign debt  $B$  and mean government spending  $G = \mu_G$ . The blue area denote approval,  $p(b, y, B, G) = 1$ , and the white areas denote rejection of a fiscal plan,  $p(b, y, B, G) = 0$ .

## 4.2 The Impact of Political Constraints on Sovereign Debt and Default in the Long Run

To study the impact of the political constraint on sovereign debt and default, we simulate the benchmark economy and the counterfactual economy for 10.000 periods and exclude all default events when computing the long-run statistics. Table 2 summarizes the results. First of all, the model economy provides a reasonable match of the Italian data. In particular, it matches the empirical overall level of debt as share of GDP, the domestic debt ratio, the spread, and the average recovery rate.

It turns out that in the long run, political constraints reduce the total amount of sovereign

debt and default risk. This finding is driven by a general equilibrium effect. The policy functions have shown that the government finds it difficult to design a fiscal plan that gains the support of the majority of households. Consequently, for a given level of debt, the political constraint raises sovereign default risk. Since higher interest rates make debt more expensive, the government is more restricted in its borrowing decisions. In the long run, the government accumulates less debt compared to counterfactual economy, which, in turn, dampens sovereign default risk in general equilibrium.

Table 2. Long-Run Statistics

Description	Variable	Counterfactual	Benchmark	Data
Total debt	$B$	21.68	18.00	17.92
Domestic debt	$\check{B}$	12.22	12.10	12.17
External debt	$\hat{B}$	9.45	5.90	5.75
Domestic debt ratio	$\check{B}/B$	56.38	67.22	67.91
Government spending	$G$	18.90	18.90	18.72
Transfers	$T$	8.80	8.82	4.96
Interest spread	$\frac{q(B',G)^{-1}}{1+r} - 1$	1.50	1.06	1.21
Recovery rate	$\alpha$	25.18	28.97	27.00

Notes: The statistics are based on average values of 10.000 simulated periods and excluding all default events. All variables are denoted in percent. Debt (total, domestic, external), government spending, and transfers are reported as GDP ratios. Recovered debt and recovery rate are based on all default events.

### 4.3 Political Conflict and Default Events

Figure 5 considers the benchmark political economy model and presents the macroeconomic dynamics around the default event at  $t = 0$ . It shows average debt, the composition of debt (domestic, external), the interest spread, government spending, transfers, aggregated approval, and the variance of domestic bond holdings as a measure for wealth inequality.

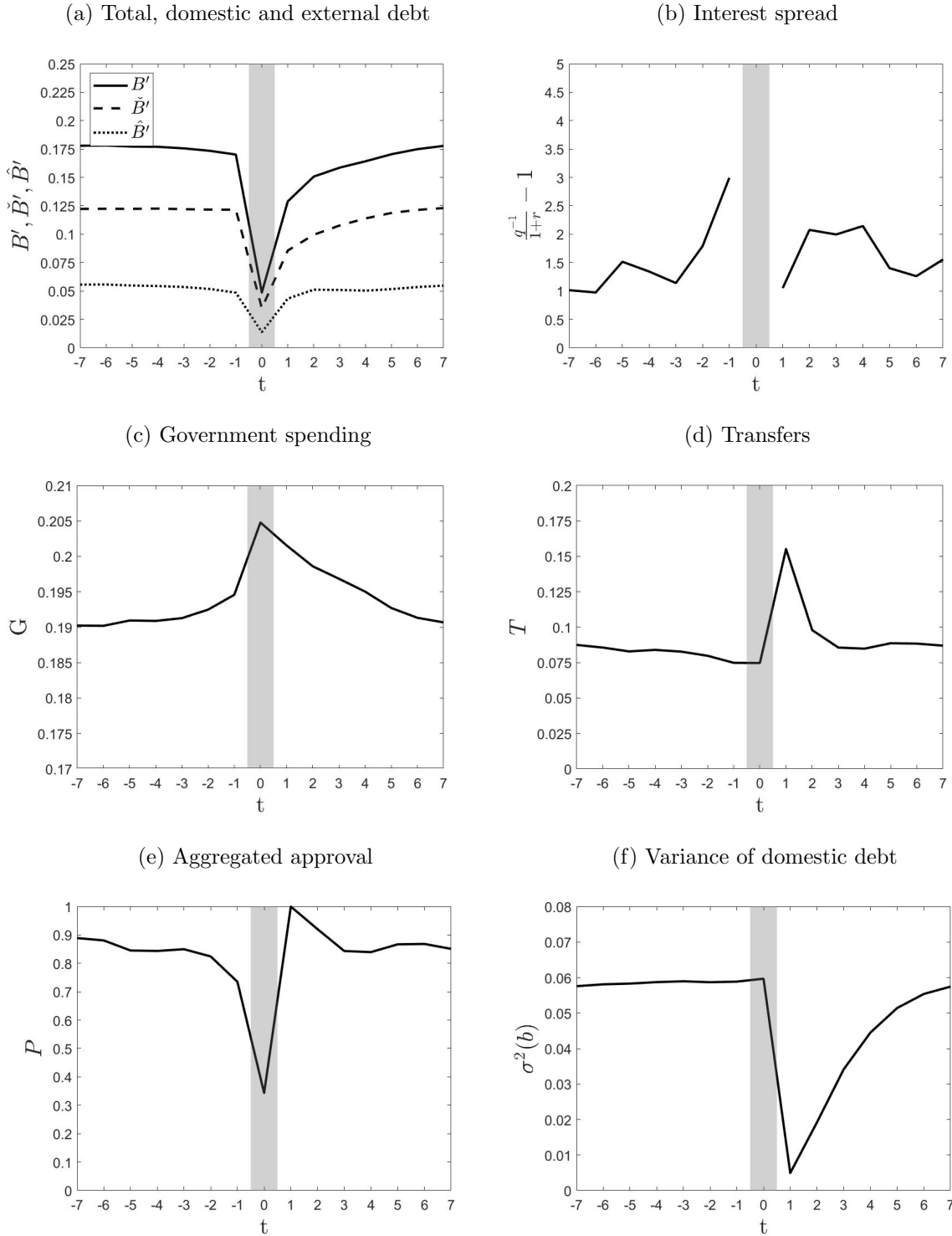
Prior to a typical default, the economy is characterized by a series of favorable government spending shocks. In response, the government borrows and accumulates debt such that the interest spread starts to increase. Households raise their savings in government bonds because of higher returns and larger transfers. Since the domestic demand for government bonds does not fully absorb the larger government bond supply, external debt increases. The aggregate approval rate increases prior to the default because of higher interest spreads and larger transfers.

Wealth inequality gradually increases in the run-up to the debt crises. Two forces have opposing effects on wealth inequality. On the one hand, the government borrows more and raises transfers. Given the proportional income tax and the lump-sum transfers, the system

redistributes progressively. On the other hand, higher borrowing increases the interest rate on government bonds and raises the return on household savings. Thus, households with a large bond position become richer. The simulation shows that the second effect mildly dominates resulting in slightly increasing wealth inequality prior to the default.

Then, in  $t = 0$ , the default is triggered by a large government spending shock. Since the government has accumulated a substantial amount of debt, the interest spread increases strongly. Debt repayment becomes very costly implying low transfers, such that there occurs a political conflict. While wealthy households prefer the government to fulfill the debt contract, poorer households are in favor of a default. Consequently, the approval rate of the fiscal plan decreases substantially forcing the government to default. In  $t = 1$ , after the default, the government re-schedules its debt, regains access to financial markets, and starts borrowing again. Transfers increase sharply and the associated fiscal plans receives the full support of the population.

Figure 5. Default Event

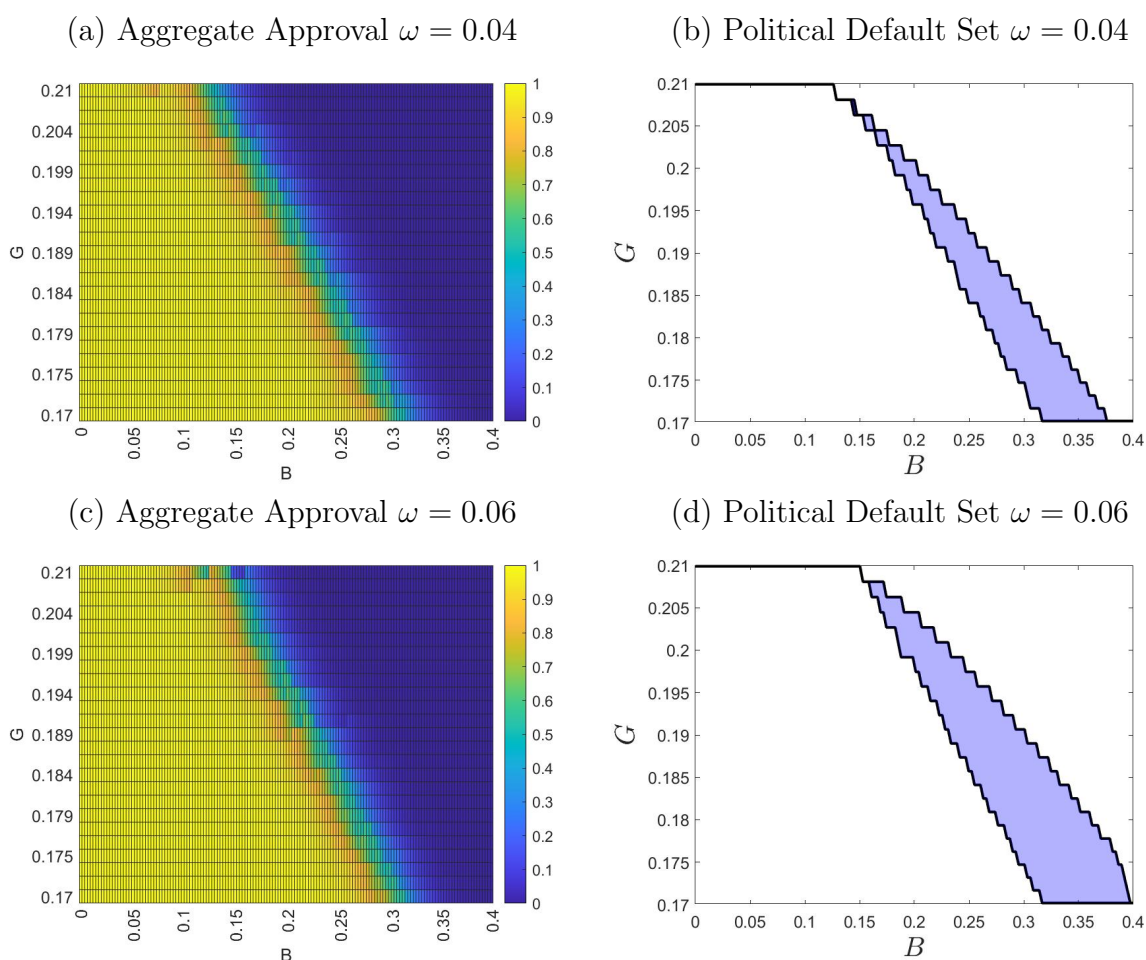


Notes: The figure shows the dynamics around an average default event taking place in period  $t = 0$ . We simulate the model for 10.000 periods, collect all default episodes and take the average over all default events. The panels show debt (total, domestic, external), government spending and transfers as shares of GDP. The interest spread and aggregated approval are depicted in percent.

#### 4.4 The Impact of Political Preferences on Political Defaults

To explore the role of political preferences, in Figure 6 we compare aggregate approval rates and political default sets for two government types. The first government type (panels (a) and (c)) is the one with political preferences as specified in our baseline calibration. The second government (panels (b) and (d)) has a larger bias towards households who hold government bonds. Our findings highlight that the government with the larger creditor bias is politically more constrained. As the political constraint is binding for lower levels of debt and smaller shock realizations, the set of political defaults increases.

Figure 6. Aggregate Approval and Political Default Set



Notes: The left panels show the aggregate approval rate  $P(B, G)$  as a heatmap depending on debt  $B$  and spending shocks  $G$ . The right panels display the political default sets for combinations of  $B$  and  $G$ .

## 5 Conclusions

This paper has explored the political and distributional consequences of sovereign debt and default. Specifically, we have analyzed how optimal fiscal policy choices are affected by redistributive concerns, the composition of sovereign debt, and political constraints.

We have studied the research question within a quantitative macroeconomic model of sovereign debt and default in which heterogeneous households face idiosyncratic income risk and save in non-state-contingent government bonds. Debt contracts are not enforceable and the government is politically constrained in its policy choices: A fiscal plan is required to receive the support of the majority of households. If neither fiscal plan is approved, the government is forced to default.

We highlight that debt crises are characterized by a political conflict. In the run-up to a sovereign default, the government has to reduce redistributive transfers to pay for increasing debt service costs. While wealthy households prefer the government to fulfill the debt contract as they benefit from high interest rates, poorer households are in favor of a default. Consequently, the approval of the fiscal plan decreases and raises the likelihood of a sovereign default.



## References

- Aghion, P. and P. Bolton**, “Government domestic debt and the risk of default: a political-economic model of the strategic role of debt,” in R. Dornbusch and M. Draghi, eds., *Government Domestic Debt and the Risk of Default: A Political- Economic Model of the Strategic Role of Debt*, Cambridge, MA: MIT Press, 1990.
- Aguiar, Mark and Gita Gopinath**, “Defaultable debt, interest rates and the current account,” *Journal of International Economics*, 2006, *69* (1), 64–83.
- **and Manuel Amador**, “Growth in the Shadow of Expropriation,” *Quarterly Journal of Economics*, 2011, *126* (2), 651–697.
- Aiyagari, S.Rao and Ellen R. McGrattan**, “The optimum quantity of debt,” *Journal of Monetary Economics*, 1998, *42* (3), 447–469.
- Andreasen, Eugenia, Guido Sandleris, and Alejandro van der Ghote**, “The political economy of sovereign defaults,” *Journal of Monetary Economics*, 2019, *104*, 23–36.
- Arellano, Cristina**, “Default risk and income fluctuations in emerging economies,” *American Economic Review*, 2008, *98* (3), 690–712.
- Azzimonti, Marina and Nirvana Mitra**, “Political Constraints and Sovereign Default,” *Manuscript, Stony Brook University*, 2012.
- **, Eva de Francisco, and Vincenzo Quadrini**, “Financial globalization, inequality, and the rising public debt,” *American Economic Review*, 2014, *104* (8), 2267–2302.
- Chatterjee, Satyajit and Burcu Eyigungor**, “Endogenous Political Turnover and Fluctuations in Sovereign Default Risk,” *Journal of International Economics*, 2019, *17-01*, 37–50.
- **and Burcu Eyigungor**, “A Seniority for Sovereign Debt,” *American Economic Review*, 2015, *105* (12), 3740–3765.
- Cuadra, Gabriel and Horacio Sapriza**, “Sovereign default, interest rates and political uncertainty in emerging markets,” *Journal of International Economics*, 2008, *76* (1), 78–88.
- Deng, Minjie**, “Inequality, Taxation, and Sovereign Default Risk,” *Discussion Papers, Simon Fraser University*, 2021, (dp21-15).

- D’Erasmus, Pablo and Enrique G. Mendoza**, “Distributional incentives in an equilibrium model of domestic sovereign default,” *Journal of the European Economic Association*, 2016, *14* (1), 7–44.
- **and** –, “History remembered: optimal sovereign default on domestic and external debt,” *Journal of Monetary Economics*, 2021, *117*, 969–989.
- Dixit, Avinash and John Londregan**, “Political power and the credibility of government debt,” *Journal of Economic Theory*, 2000, *94* (1), 80–105.
- Dovis, Alessandro, Mikhail Golosov, and Ali Shourideh**, “Political economy of sovereign debt: a theory of cycles of populism and austerity,” *NBER Working Papers*, 2016, *21948*.
- Ferriere, Axelle**, “Sovereign default, inequality, and progressive taxation,” *Working Paper, European University Institute*, 2015, *29*.
- Flodén, Martin**, “The effectiveness of government debt and transfers as insurance,” *Journal of Monetary Economics*, 2001, *48* (1), 81–108.
- Guembel, Alexander and Oren Sussman**, “Sovereign debt without default penalties,” *The Review of Economic Studies*, 2009, *76* (4), 1297–1320.
- Hatchondo, Juan Carlos, Leonardo Martinez, and Horacio Saprizza**, “Heterogeneous borrowers in quantitative models of sovereign default,” *International Economic Review*, 2009, *50* (4), 1129–1151.
- Heathcote, Jonathan**, “Fiscal policy with heterogeneous agents and incomplete markets,” *The Review of Economic Studies*, 2005, *72* (1), 161–188.
- Jeon, Kiyong and Zeynep Kabukcuoglu**, “Income inequality and sovereign default,” *Journal of Economic Dynamics and Control*, 2018, *95*, 211–232.
- Krusell, Per and Anthony A. Smith**, “Income and Wealth Heterogeneity in the Macroeconomy,” *Journal of Political Economy*, 1998, *106* (5), 867–896.
- Novelli, Antonio Cusato**, “Sovereign Default, Political Instability and Political Fragmentation,” *Review of International Economics*, 2021, *29* (4), 732–755.
- Papke, Leslie E. and Jeffrey M. Wooldridge**, “Econometric methods for fractional response variables with an application to 401(k) plan participation rates,” *Journal of Applied Econometrics*, 1996, *11* (6), 619–632.

- Prein, Timm M. and Almuth Scholl**, “The impact of bailouts on political turnover and sovereign default risk,” *Journal of Economic Dynamics and Control*, 2021, *124*, 104065.
- Röhrs, Sigrid and Christoph Winter**, “Reducing government debt in the presence of inequality,” *Journal of Economic Dynamics and Control*, 2017, *82*, 1–20.
- Scholl, Almuth**, “The dynamics of sovereign default risk and political turnover,” *Journal of International Economics*, 2017, *108*, 37–53.
- , “The Politics of Redistribution and Sovereign Default,” *working paper*, *University of Konstanz*, 2022.
- Sunder-Plassmann, Laura**, “Writing off sovereign debt: Default and recovery rate over the cycle,” *Journal of International Money and Finance*, 2018, *81*, 221–241.
- Tabellini, Guido**, “The politics of intergenerational redistribution,” *Journal of Political Economy*, 1991, *99* (2), 335–357.
- Tauchen, George and Robert Hussey**, “Quadrature-Based Methods for Obtaining Approximate Solutions to Nonlinear Asset Pricing Models,” *Econometrica*, 1991, *59* (2), 371–396.
- Tran-Xuan, Monica**, “Sovereign Debt Sustainability and Redistribution,” *mimeo*, 2022.
- Yue, Vivian Z.**, “Sovereign default and debt renegotiation,” *Journal of International Economics*, 2010, *80* (2), 176–187.

## A Data Sources, Calibration Targets, Time Period

Table 3. Data Sources and Time Period

Description	Period	Source
Gov. debt (consolidated) (% of GDP)	1995 - 2015	<a href="#">ECB GFS</a>
Gov. debt held by residents (% of GDP)	1995 - 2015	<a href="#">ECB GFS</a>
Average residual maturity of gov. debt	1995 - 2015	<a href="#">Bank of Italy</a>
Gov. final consumption expenditure (% of GDP)	1995 - 2015	<a href="#">WDI</a>
Gov. transfers (% of GDP)	1995 - 2015	<a href="#">D’Erasmus and Mendoza (2021)</a>
Gov. tax revenue (% of GDP)	1995 - 2015	<a href="#">D’Erasmus and Mendoza (2021)</a>
EMU convergence criterion bond yields	2002 - 2015	<a href="#">Eurostat</a>
Recovery rate of gov. debt		<a href="#">Sunder-Plassmann (2018)</a> , <a href="#">Yue (2010)</a>

- **Average debt to GDP (maturity adjusted):** We use government debt (consolidated) (% of GDP) from ECB GFS (1995-2015) with an average ratio of 115.5%. Then, we use average residual maturity of government debt from Bank of Italy (1995-2015) with an average value of 6.45 yielding an average debt to GDP ratio (maturity adjusted) of 17.92%.
- **Average domestic debt ratio:** We use government debt held by residents (% of GDP) from ECB GFS (1995-2015). The average domestic debt ratio is 67.92%.
- **Government spending process:** We use general government final consumption expenditure (% of GDP) from WDI (1995-2015) and estimate  $\rho_G = 0.92$ ,  $\sigma_e = 0.021$  and  $\mu_G = 18.54$ .
- **Income process:** We normalize  $\mu_y = 1$  such that aggregate income  $Y = 1$ . We set  $\rho_y = 0.7$  as a standard value and set  $Var(\log(y)) = 0.2$  to match the residual cross-sectional variance of log-earnings for Italy.
- **Average bond spreads vs. Germany:** We use EMU convergence criterion bond yields from Eurostat (2002-2015) to find an average bond spread vs. Germany of 1.21%.
- While for government transfers (% of GDP) and government tax revenues (% of GDP) we rely on [D’Erasmus and Mendoza \(2021\)](#), we refer to [Sunder-Plassmann \(2018\)](#) and [Yue \(2010\)](#) for recovery rates of government debt.