Monetary Conservatism, Default Risk, and Political Frictions*

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Abstract

This paper studies the consequences of delegating monetary policy to an inflation conservative central banker as in Rogoff (1985) for an emerging economy that faces three frictions which might undermine the success of such a policy reform: (i) incomplete financial markets, (ii) risk of default and (iii) political distortions. To do so, a quantitative sovereign default model is developed in which monetary and fiscal policies are set by two different authorities that both cannot commit to future policies. Inflation conservatism tends to result in lower and more stable inflation as well as a higher average debt burden, more frequent default events and more volatile fiscal policy. Whether the economy benefits from the appointment of a conservative central banker depends on the degree of inflation conservatism, the amount of political distortions and the volatility of fiscal shocks.

Keywords: Monetary Conservatism, Public Debt, Lack of Commitment, Sovereign Default, Political Economy

JEL Classification: E58, H63, P16

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1 Introduction

At least since the seminal work of Kydland and Prescott (1977) and Barro and Gordon (1983a), it is well known that the conduct of monetary policy often faces a time-inconsistency problem. More specifically, when monetary policy is set under discretion, it tends to result in an inflation bias, i.e. an inflation rate that is persistently higher than the optimal one under commitment.[1] To avoid (or at least reduce) this inflation bias, Rogoff (1985) has suggested the delegation of monetary policy to a monetary conservative central banker who views inflation as more costly than society. Under discretion, the appointment of such an individual makes monetary policy less tempted to resort to inflationary policies and might therefore increase welfare relative to a scenario with a benevolent policy maker.

In practice, most developed economies have indeed delegated monetary policy to independent central banks that emphasize low and stable inflation. These reforms have shielded monetary policy from the sequential nature of policy making in democratic societies and have usually been accompanied by lower inflation rates. Recently, many emerging economies have also introduced central bank independence in an attempt to bring down their persistently high inflation rates (see e.g. Carstens and Jácome, 2005). However, a lot of these countries are subject to frictions that might undermine the success of such reforms.

The aim of this paper is to assess the effectiveness and desirability of monetary conservatism by using a model that accounts for three frictions which matter for many emerging economies: (i) incomplete financial markets, (ii) risk of default, and (iii) political distortions. More specifically, monetary-fiscal policy interactions are introduced into a sovereign default model in the tradition of Eaton and Gersovitz (1981). In the model, the government consists of two independent policy authorities, a fiscal authority and a central bank, which both cannot commit to future actions. Without commitment, the presence of nominal non-state contingent government debt introduces the incentive to reduce the real debt burden ex post by using surprise inflation or default and relax the government budget. Fiscal policy, which involves the provision of a public good, borrowing and debt repayment, is controlled by a fiscal authority that exhibits a deficit bias due to political economy frictions, whereas monetary policy is set by an independent central bank. Reflecting its independence, the central bank's objective might differ from that of the fiscal authority and society. In particular, the central bank is not subject to political economy constraints and might place a higher value on price stability (see Rogoff, 1985; Adam and Billi, 2008). The interaction between the fiscal authority and the central bank is modeled as a Markov-perfect game (see e.g. Niemann, 2011).

The frictions (i)-(iii) matter for the implications of monetary conservatism for the following reasons. When the central bank places a higher weight on price stability than the fiscal authority and society, it is less tempted to use inflation to reduce the real debt burden. However, when financial

[1] This result holds for model environments where monetary policy is tempted to use surprise inflation to stimulate the economy (see e.g. Barro and Gordon, 1983a; Clarida, Gali, and Gertler, 1999) or relax the government budget by reducing the real value of outstanding nominal public debt payments (see e.g. Lucas and Stokey, 1983). See Nicolini (1998) for a discussion about how monetary policy might also be tempted to use surprise deflation, resulting in a deflation bias under discretionary policy. This case does however not seem to be particularly relevant for most countries in practice.

markets are incomplete and only non-state contingent bonds can be issued, this also implies that the central bank is less willing to use inflation in response to fiscal shocks to make real debt payments state contingent. As a result, even if monetary conservatism can bring down inflation, it is not clear that this is indeed welfare enhancing. The central bank's willingness to use inflation might also affect the economy's vulnerability to sovereign debt crises (see e.g. Kocherlakota, 2014). The more conservative the central bank is, the more attractive the default option might become for the fiscal authority to relax the government budget, potentially increasing the likelihood of a debt crisis. Lastly, political frictions might render a higher credibility for low inflation costly as well. When a fiscal authority exhibits a deficit bias, for instance - as in this paper - due to the interaction of political disagreement and turnover risk (see Cuadra and Sapriza, 2008; Aguiar and Amador, 2011), it has a long-run borrowing motive that does not reflect the preferences of society. A central bank that is less tempted to use inflation will tend to lower inflation risk for a given debt burden and - ceteris paribus-reduce nominal interest rates. This in turn could encourage the fiscal authority to borrow more and reduce household welfare even further (see also Niemann, 2011).[2]

This paper shows that an economy with a conservative central bank tends to end up with more debt, more frequent default events and lower inflation relative to a scenario without monetary policy delegation. Monetary conservatism can thus successfully reduce the inflation bias. This success comes however at a cost. By lowering expected inflation and hence nominal interest rates, it makes debt accumulation more attractive for the fiscal authority and thereby exposes the economy more often to sovereign debt crises since the incentive to default increases with the size of the debt burden. By reducing the time-inconsistency problem related to inflation, monetary conservatism therefore aggravates the time-inconsistency problem related to sovereign default. The reluctance of a conservative central banker to use surprise inflation in response to bad shocks furthermore results in more volatile fiscal policy. By increasing the risk of default, monetary conservatism also leads to borrowing conditions that are more sensitive to fiscal shocks, which additionally makes it more costly to smooth government spending across states.

Whether the benefits of lower and more stable inflation outweigh the welfare costs of experiencing higher average debt, more frequent debt crises and more volatile fiscal policy crucially depends on the degree of monetary conservatism, the amount of political distortions and the volatility of fiscal shocks faced by the government. While there are net welfare gains of monetary conservatism for the baseline model, varying the degree of the political distortions can reverse this finding and result in net welfare costs. More specifically, net welfare costs of monetary policy delegation occur when political economy frictions are entirely absent. Interestingly, across all model versions, the relation between welfare and monetary conservatism is inverse humped-shaped, reflecting how the relative incentives to use inflation or default shift with the monetary policy stance. Regardless of the type and magnitude of political frictions, welfare can be lower relative to a scenario without delegated monetary policy if the degree of monetary conservatism is not high enough. When the model economy faces less volatile

[2] Although developed economies could be subject to these three frictions as well, they are more relevant for emerging economies. While the role of inflation as a shock absorber is more important for emerging economies because of their higher degree of macroeconomic volatility, risk of default and political frictions tend to be more pronounced in emerging economies compared to developed ones.

fiscal shocks, the net benefits of monetary conservatism can be positive even when political economy distortions are absent, which is due to the reduced importance of inflation as a shock absorber.

Related Literature This paper is related to three strands of literature. First, it is related to the recent literature on sovereign default and incomplete markets (see e.g. Aguiar and Amador, 2014 for details). Within this growing literature, the studies that are closest to this paper are Cuadra and Sapriza (2008), Du and Schreger (2017) and Nuño and Thomas (2018).[3] The former paper introduces political polarization and turnover risk into the sovereign default model of Arellano (2008), showing that such political frictions make policy makers act in a more impatient manner. In this paper, the economy faces similar political distortions.[4] Du and Schreger (2017) develop a quantitative sovereign default model in which a government can reduce the real debt burden by raising inflation (and thereby depreciating the domestic currency) at the cost of hurting the balance sheet of domestic firms which issue debt denominated in foreign currency and earn revenues in local currency.[5] Nuño and Thomas (2018) study a model in which a policy maker borrows from abroad and monetary policy is either chosen under discretion or always following a zero-inflation policy that is not responsive to the state of the economy. In contrast to this paper, the authors only consider a benevolent policy maker and focus on the Euro area. They find that economies are better off when the respective governments are not tempted to reduce the real debt burden via inflation, except when fiscal shocks are implausibly volatile. Very briefly, they also consider the case of delegated monetary policy but do not allow for political distortions and do not discuss how disagreement between the fiscal and the monetary authority can affect outcomes. Further model differences relative to Nuño and Thomas (2018) are that I allow for more general preferences and an endogenous debt recovery rate. Methodologically, our papers differ because their model is formulated in continuous time, whereas I use a discrete-time model which is more common in the quantitative sovereign default literature (see Aguiar and Amador, 2014) and hence makes it easier to relate the model's properties to the previous literature.

Second, the paper is related to recent papers that study central bank independence in the presence of nominal government debt and lack of commitment. In particular, it relates to Niemann (2011) who studies a Markov-perfect policy game between a monetary conservative central bank and a myopic fiscal authority, using the cash-in-advance model of Nicolini (1998). In his model, the fiscal authority has a lower discount factor than society and does not internalize the effect of its borrowing decision on future policy. When nominal debt is the only source of the time-inconsistency problem, the author shows that monetary conservatism backfires. While it lowers average inflation when the degree of monetary conservatism is sufficiently high, it encourages the fiscal authority to borrow more in the long run, decreasing welfare. Other related papers are Niemann, Pichler, and Sorger (2013) and Martin (2015) who also investigate central bank independence in models with nominal

[3] Roettger (2018) provides a joint analysis of monetary policy and sovereign default in the absence of commitment but studies a closed production economy with a cash-in-advance constraint and a single benevolent policy maker.

[4] See Hatchondo, Martinez, and Sapriza (2009) for an alternative setting where policy makers with different discount factors randomly alternate in power.

[5] Na, Schmitt-Grohé, Uribe, and Yue (2018) also study a model where the government can default as well as devalue the local currency. However, they exclusively look at externally held foreign currency debt.

debt and lack of commitment but abstract from monetary conservatism.[6] All of these papers do not consider sovereign default, micro-founded political distortions, uncertainty and long-term debt. Moreover, their focus is on the United States, whereas I look at the role of central bank independence for emerging economies.

Third, this paper is related to Aguiar, Amador, Farhi, and Gopinath (2013, 2015). Aguiar, Amador, Farhi, and Gopinath (2013) study a model of discretionary monetary and fiscal policy where default events are self-fulfilling in the spirit of Cole and Kehoe (2000). Building on this paper, Aguiar, Amador, Farhi, and Gopinath (2015) consider a model of a monetary union with a continuum of countries which independently choose fiscal policy and a common central bank that is in charge of monetary policy. The authors show the existence of a fiscal externality that encourages countries to overborrow. In contrast to this paper, the authors focus on benevolent policy makers and thus do not allow for political frictions and varying degrees of central bank independence. In addition, they abstract from fundamental uncertainty and only consider sunspot-driven default events.[7]

Layout The rest of this paper is organized as follows. Section 2 describes the model. Section 3 discusses the main policy trade-offs. Section 4 presents the quantitative model analysis. Section 5 concludes.

2 Model

Time is discrete, indexed with $t = 0, 1, 2, ...$ and goes on forever. The model features a small open economy and a continuum of risk-neutral foreign investors. The small open economy is inhabited by a unit-mass continuum of households and a government. The government consists of two independent authorities: a central bank and a fiscal authority. In the economy, there are two political parties that might be in charge of the fiscal authority. These parties randomly enter and leave office, i.e. only one party chooses fiscal policy in a given period.

2.1 Households

Households have preferences over a public good g_t and inflation $\pi_t = P_t/P_{t-1}$. The public good g_t is in terms of a tradable good that will be the numeraire in the model. Its domestic price in local currency is denoted as P_t and its initial value $P_{-1} \in (0, \infty)$ is taken as given. Assuming that the law of one price holds and that the foreign price of the numeraire is constant over time, the model implies a one-to-one relationship between inflation and currency risk.

[6] Adam and Billi (2008) study the role of monetary conservatism in a sticky price model with endogenous fiscal policy but without public debt.

[7] Other recent papers that study the interaction between monetary policy and self-fulfilling sovereign debt crises are Araujo, Leon, and Santos (2013), Da-Rocha, Gimenez, and Lores (2013), Bachetta, Perazzi, and van Wincoop (2015) and Corsetti and Dedola (2016).

The household objective is given as

$$\mathcal{U} = \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t U(c_t, g_t) \right], \; 0 < \beta < 1,$$

where the period utility function is given by

$$U(g_t, \pi_t) = u(g_t) - \psi(\pi_t),$$

with $u_g(\cdot), -u_{gg}(\cdot) > 0$ and $\psi_\pi(\cdot), \psi_{\pi\pi}(\cdot) > 0$.

The household objective reflects the preferences of society and will be used to evaluate the welfare properties of public policy. As is common in the sovereign default literature, households are completely passive and only the policy authorities make decisions.

2.2 Government

In the economy, a government is in charge of setting monetary and fiscal policy. This government consists of two separate entities: a fiscal authority and a monetary authority (from now on referred to as central bank). Both authorities re-optimize in each period and cannot commit to future policies.

Fiscal Authority Similar to Cuadra and Sapriza (2008), the fiscal authority is controlled by either one of two political parties. These parties have symmetric objectives and randomly enter and leave office. More specifically, the incumbent party remains in office in the subsequent period with constant probability μ and is replaced by the opposite party with probability $1 - \mu$.[8]

The objective of political party $i \in \mathbb{I} \equiv \{1, 2\}$ is given by

$$\mathcal{F}_i = \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t U_i^{\mathcal{F}}(g_t, \pi_t) \right],$$

where

$$U_i^{\mathcal{F}}(g_t, \pi_t) = \tilde{\theta}_{it} u(g_t) - \psi(\pi_t),$$

with $\tilde{\theta}_{it} = \theta > 1$ if party i is in office and $\tilde{\theta}_{it} = 1$ if it is not.

In each period, the fiscal authority chooses the supply of the public good, trades bonds with foreign investors and decides on whether to repay outstanding debt or not as in Eaton and Gersovitz (1981). As in Aguiar and Amador (2011), both political parties place a higher weight θ on the utility derived from the public good when they are in office.[9] While the political parties disagree about the value of the public good, there is no disagreement about the cost of inflation $\psi(\pi_t)$. However, $\tilde{\theta}_{it}$ leads to disagreement about the optimal inflation rate between the two parties since the incumbent

[8] See Chatterjee and Eyigungor (2017) and Scholl (2017) for quantitative sovereign default models with endogenous political turnover.

[9] Cuadra and Sapriza (2008) consider a model with two population groups where each group is favored by one of two potentially ruling parties.

party places a lower relative weight on the cost of inflation $\psi(\pi_t)$.[10] [11]

The weight $\tilde{\theta}_{it}$ can be interpreted in several ways (see Aguiar and Amador, 2011, p. 661). For instance, it can represent disagreement between the two political parties about the implementation of public policy, leading to a higher marginal utility of public consumption for the incumbent political party since it can carry out its desired policy. Another interpretation for the assumption $\theta > 1$ could be that it is a shortcut for the incumbent's ability to divert public funds into its own pocket (see Battaglini and Coate, 2008; Caballero and Yared, 2010).

For simplicity, I assume that the political parties have completely symmetric objectives. In addition, once in office, the probability of being in office in the next period μ is the same for both parties.[12] These assumptions imply that - for the recursive model formulation below - there is no need to keep track of which particular party is in office since they will choose the same policies in a symmetric equilibrium. To smooth public spending across states, the fiscal authority can trade nominal bonds with risk-neutral foreign investors. These bonds are non-state contingent and defaultable, i.e. the fiscal authority can refuse to repay bondholders. Following the recent sovereign default literature, a default is costly because of direct resource costs and a temporary loss of access to international financial markets (see e.g. Aguiar and Gopinath, 2006; Arellano, 2008).

The presence of political disagreement and turnover risk leads the fiscal authority to exhibit a present bias that makes it behave similarly to a decision maker who discounts in a quasi-geometric fashion (see Laibson, 1997; Krusell, Kuruscu, and Smith, 2002).[13] As a result, it is more biased towards the present compared to a policy maker who does not face the risk of leaving office. In the context of the model, the present bias implies that the fiscal authority has an incentive to front-load public spending by either borrowing more or defaulting on debt payments. In any period, the costs associated with these policies are (partly) borne in the future, either through increases in the primary surplus or temporary financial autarky. When less patient, these costs are discounted more by the fiscal authority, making borrowing and default more attractive policy options. It is important to note that the strength of the present bias varies with the state of the economy. The present bias of the fiscal authority in this paper thus is different from that of a policy maker who has a low discount factor β relative to the lenders (see Niemann, 2011).

The government receives random tax revenues τ_t that follow a first-order Markov process with continuous support $\mathbb{T} \subseteq \mathbb{R}_+$ and transition function $f(\tau_{t+1}|\tau_t)$.[14] I consider exogenous tax revenues for three reasons.[15] First, for many countries it is difficult, if not virtually impossible, to quickly change the tax code in the short run. By contrast, sudden adjustments of public spending tend to

[10] Aisen and Veiga (2005) document a positive relationship between political instability and average inflation. The fiscal authority's lower relative emphasis on price stability compared to society is consistent with this pattern.

[11] Martin (2015) considers a model of discretionary monetary-fiscal interactions without political turnover and sovereign default in which the fiscal authority has a spending bias which also implies that it places a lower relative weight on price stability than society.

[12] On average, a newly appointed incumbent thus spends $1/(1-\mu)$ subsequent periods in office.

[13] Persson and Svensson (1989) and Alesina and Tabellini (1990) were the first to recognize that the combination of turnover risk and political disagreement about the size or composition of public spending lead to a present bias. The connection between such a bias and quasi-geometric discounting is discussed in Aguiar and Amador (2011) and Chatterjee and Eyigungor (2016). A related treatment in a continuous-time setting can be found in Cao and Werning (2016).

[14] I will occasionally refer to shocks to tax revenues as fiscal shocks.

[15] Bocola and Dovis (2016) consider random tax revenues in a quantitative sovereign default model without monetary policy.

be easier to carry out in practice. Second, since the sovereign default literature mostly considers endowment economies (see e.g. Aguiar and Gopinath, 2006; Arellano, 2008), a setting that models public resources also as an endowment makes it easier to relate the model to this literature. Third, the numerical solution of the model is quite difficult as it involves solving the decision problems of two distinct authorities. Abstracting from the tax rate as a decision variable for the fiscal authority substantially reduces the computational burden.

If the fiscal authority repays its debt, the period government budget constraint is given by

$$P_t \tau_t + q_t I_t \geq P_t g_t + \kappa B_t,$$

where q_t denotes the unit price of newly issued nominal bonds I_t and B_t the beginning-of-period stock of nominal debt. The parameter $\kappa > 0$ governs the size of the coupon payments made by the government.

As in Du and Schreger (2017), I follow Hatchondo and Martinez (2009) and model bonds as perpetuities that promise to pay an infinite stream of geometrically declining coupon payments with decay parameter $\delta \in [0, 1)$. More specifically, conditional on repayment, a bond issued in period t promises the nominal cash flow $P_t \kappa \delta^{i-1}$ in periods $t+i$, for $i \geq 1$. A convenient property of these perpetuities is that they allow the law of motion for the stock of nominal government debt to be recursively written as

$$B_{t+1} = \delta B_t + I_t.$$

Using this law of motion to eliminate debt issuance I_t in the government budget constraint and expressing it in real terms yields

$$\tau_t + q_t \left(b_{t+1} - \pi_t^{-1} \delta b_t \right) \geq g_t + \pi_t^{-1} \kappa b_t,$$

with normalized nominal debt $b_t \equiv B_t / P_{t-1}$.

In this paper, I follow Du and Schreger (2017) and only consider issuance of external local currency debt. While many emerging economies issue bonds that are denominated in foreign currency, the portfolio share of local currency debt has strongly increased over the last decades (see Du and Schreger, 2017). As interesting as it would be to endogenize the currency composition of external debt, offering a theory that can successfully achieve this is beyond the scope of this paper.[16] Furthermore, although the mentioned shift in external debt portfolios might have, at least partly, been driven by central bank reforms undertaken in the respective economies, total foreign currency debt (in percent of real GDP) has been quite stable during this period of time. Movements in the total debt position are hence largely driven by changes in local currency debt, which can be captured by the model used in this paper.

[16] In a previous version of this paper I have allowed the government to issue both foreign and local currency bonds, assuming that the local currency share is constant over time, which did not qualitatively change the results of this paper and hardly mattered quantitatively.

In the default case, the budget constraint is given by

$$\tau_t - \phi(\tau_t) \geq g_t,$$

where $\phi(\tau_t) \geq 0$ are (public) resource costs of default. In the sovereign default literature, such resource costs are standard but modeled in terms of aggregate output and not in terms of public funds (see e.g. Arellano, 2008). One interpretation for public resource costs is that they result from the abandonment of public projects which leads to net losses for the government. Another possible interpretation is that in the default case, the country experiences a decline in tax morale which makes it more difficult for the government to collect tax payments. As a result, it has to spend additional resources on tax enforcement to raise a given amount of revenues τ_t.

Central Bank Monetary policy is controlled by the central bank. As in Aguiar, Amador, Farhi, and Gopinath (2013, 2015), I assume that the central bank can directly choose the inflation rate by setting its policy instruments in an appropriate way.[17] Reflecting its independence, the central bank's objective may differ from that of the fiscal authority:

$$\mathcal{M} = \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t U^{\mathcal{M}}(g_t, \pi_t) \right],$$

where

$$U^{\mathcal{M}}(g_t, \pi_t) = u(g_t) - \alpha \psi(\pi_t),$$

with $\alpha \geq 0$.

Following the literature (see Rogoff, 1985; Adam and Billi, 2008; Niemann, 2011), monetary policy is delegated to a monetary conservative central banker who has the same preferences as the average citizen, except that he has an inherent distaste for inflation: $U^{\mathcal{M}}(g_t, \pi_t) = U(g_t, \pi_t) - (\alpha - 1)\psi(\pi_t)$. The parameter α is the central banker's degree of monetary conservatism. For $\alpha > 1$ ($\alpha < 1$), the central banker values price stability more (less) than society. Since the economy borrows in its own currency, the central bank can reduce the real debt burden and relax the government budget by raising inflation. The temptation to do so strongly depends on α. In contrast to the fiscal policy maker, the central banker is not subject to political risk and remains in power forever. Importantly, the central banker also does not derive additional utility from the public good like the incumbent political party. In the economy, the degree of central bank independence thus is characterized by the central bank's monetary conservatism and its independence from political economy considerations. For $\alpha = \alpha_\theta \equiv 1/\theta$, the central bank puts the same relative weights on $u(g)$ and $\psi(\pi)$ as the fiscal

[17] Niemann, Pichler, and Sorger (2013) consider a Markov-perfect policy game between a central bank and a fiscal authority which may exhibit different discount factors. The authors argue that it can matter whether the central bank sets the nominal interest rate or the money growth rate. More specifically, in their setting, the central bank can neutralize the fiscal authority's intertemporal bias by appropriately setting the interest rate. In contrast to their model, my setting features intra-temporal disagreement between policy authorities, which can endogenously give rise to intertemporal disagreement as well. In this case, their neutrality argument does not apply. Furthermore, I will not consider a simultaneous-move game like they do, which is also crucial for their neutrality result, and allow for sovereign default.

authority. This case will be a useful benchmark since it implies that the only source of disagreement between the fiscal and the monetary authority is the fiscal authority's present bias.

While most central banks are officially given the task to ensure low and stable inflation, it often is only one of many objectives, which might involve additional targets like the stabilization of output or unemployment (see Carstens and Jácome, 2005). The degree of monetary conservatism α can be seen as a measure of how strong the central bank is dedicated to the goal of price stability. In emerging economies, central bankers also often face direct political pressure to neglect or even abandon the goal of price stability. It will then be useful to imagine that the model economy faces an exogenous upper bound on α which can be interpreted as the maximum degree of monetary conservatism that is politically feasible and sustainable.[18] This way, the model is able to capture political limits to price stability, leaving an endogenous modeling of such an upper bound for future research.

Policy Interaction The interaction between the political parties, which determines the actions of the fiscal authority, as well as the interaction between the fiscal authority and the central bank is modeled as a Markov-perfect game (see e.g. Niemann, Pichler, and Sorger, 2013). As is common in the literature, I restrict attention to stationary equilibria. In a stationary Markov-perfect equilibrium, the policy functions that characterize the optimal decisions of the two authorities only depend on the minimal payoff-relevant state, which includes the beginning-of-period debt position b_t.[19] As in Cuadra and Sapriza (2008), I only study symmetric equilibria in which the two political parties choose the same policies when in power, given the aggregate state. This way, fiscal policy does not depend on which party is in office. Because the two authorities optimize under discretion, they do not internalize the effect of their actions on previous periods and have no incentive to honor promises made by policy makers in the past. As a result, they cannot credibly commit to carry out specific actions in the future and take the policies set in the subsequent period as given. However, since these policies will depend on the future aggregate state, the authorities can influence the way public policy is conducted in the future via the debt position b_{t+1}.

Conditional on entering a period with debt b_t, the within-period timing is as follows. First, the revenue shock τ_t is realized and the office-holder is determined. Then, the fiscal authority chooses whether to repay its debt. After this, the central bank sets the inflation rate, followed by the fiscal authority's spending and borrowing decisions. Conditional on the default decision, the two authorities thus play a Stackelberg game with the central bank acting as the Stackelberg leader. This particular timing is chosen for two reasons. First, it implies that the central bank is not powerless and can influence the decisions of the fiscal authority via the inflation rate. If the fiscal authority were the Stackelberg leader and made all its decisions before the central bank acts, it could effectively also control the inflation rate since the central bank would have no other choice than to set the inflation rate that satisfies the budget constraint.[20] Second, the value and policy functions are not generally

[18]The appointed central banker would then not face the risk of being replaced as long as his degree of conservatism α is below this upper bound.

[19]Since the optimal strategies are only conditioned on the current payoff-relevant (fundamental) state of the economy, the Markov-perfect equilibrium concept rules out reputational considerations as discussed by Barro and Gordon (1983b) that rely on trigger strategies which require strategies to exhibit complex history dependence.

[20]Alternatively, one could follow Niemann, Pichler, and Sorger (2013) and assume that the fiscal authority chooses public

differentiable due to the discrete default option and the presence of political frictions (see Chatterjee and Eyigungor, 2016), suggesting that a numerical algorithm which computes the optimal policies based on first-order conditions as in Niemann, Pichler, and Sorger (2013) or Martin (2015) is not feasible here. The Stackelberg leadership timing allows to solve the model numerically by sequentially solving the decision problems of the two authorities in any period, given the respective aggregate state at the beginning of the period (see Appendix A.2 for details).[21]

2.3 International Investors

The government can sell non-state contingent nominal bonds to homogeneous risk-neutral foreign investors who can borrow and save on international financial markets at the real risk-free rate r_f. As is common in the sovereign default literature, investors act after all public policies have been determined. The central bank and the fiscal authority therefore anticipate how their decisions affect the bond price in the current period. Risk neutrality and expected profit maximization imply the bond pricing condition

$$q\left(b',\tau\right)=\frac{1}{1+r_f}\mathbb{E}_{\tau'|\tau}\left[\frac{1-\mathcal{D}(b',\tau')}{\Pi^r\left(b',\tau'\right)}\left(\kappa+\delta\mathcal{Q}^r(b',\tau')\right)+\frac{\mathcal{D}(b',\tau')}{\Pi^d\left(b',\tau'\right)}\mathcal{Q}^d(b',\tau')\right]. \tag{1}$$

The bond price schedule $q\left(b',\tau\right)$ reflects rational expectations of default risk, inflation risk and bond price risk. Given the focus on Markov-perfect public policy, next period's default and inflation policies $\mathcal{D}(\cdot)$, $\Pi^r(\cdot)$ and $\Pi^d(\cdot)$ depend on end-of-period debt b' as well as future tax revenues τ'. The same holds true for the equilibrium bond prices in the repayment case, $\mathcal{Q}^r(\cdot)$, and the default case, $\mathcal{Q}^d(\cdot)$. The relation between the former bond price and the bond price schedule $q\left(b',\tau\right)$ is given by condition

$$\mathcal{Q}^r(b,\tau)=q\left(\mathcal{B}^r(b,\tau),\tau\right), \tag{2}$$

with $\mathcal{B}^r(\cdot)$ denoting the policy function for public debt issuance in the next period.

As in Hatchondo, Martinez, and Sosa-Padilla (2016), I allow for a positive debt recovery rate. After a default, the government enters financial autarky and is not able to borrow or save. When in financial autarky, with constant probability ξ, the government receives an offer to repay the fraction ω of its outstanding debt and immediately regain access to financial markets in return. In contrast to Hatchondo, Martinez, and Sosa-Padilla (2016), I model the offer $\omega\in\Omega\subseteq[0,1]$ as an i.i.d. random variable, similar to Pouzo and Presno (2016).[22] If an offer is declined, i.e. $\mathcal{D}(\omega b,\tau)=1$, the government remains in autarky and may receive a new offer in the next period. However, in this case, the debt burden carried into the subsequent period is nevertheless reduced by $1-\omega$ percent.[23] In

spending but not borrowing. The end-of-period debt position then is determined residually to satisfy the budget constraint, given the spending and inflation decisions of the fiscal authority and the central bank.

[21] While it would certainly be interesting to let the central bank set the inflation rate after the exogenous state is realized but before the repayment decision is made, such a timing would introduce severe non-linearities into the model that render a numerical solution of the model infeasible and even an analytical treatment of the policy trade-offs would become quite difficult.

[22] A randomly fluctuating offer rate effectively allows the fiscal authority to choose the size of the recovery rate since it has the option to decline an offer, remain in (costly) autarky and wait for a better offer (and higher tax revenues).

[23] Employing the alternative assumption of having no debt reduction after an offer is declined does not matter for the results

periods of financial exclusion, beginning-of-period debt is simply carried into the next period in case that no repayment offer has been received.

In the default case, the equilibrium bond price then satisfies the functional equation

$$\mathcal{Q}^d(b,\tau) = \frac{1}{1+r_f}\mathbb{E}_{\tau',\omega'|\tau}\left[\begin{array}{c} \xi\,\omega'\left\{\begin{array}{c} \frac{1-\mathcal{D}(\omega' b,\tau')}{\Pi^r(\omega' b,\tau')}\left(\kappa+\delta\,\mathcal{Q}^r(\omega' b,\tau')\right) \\ +\frac{\mathcal{D}(\omega' b,\tau')}{\Pi^d(\omega' b,\tau')}\mathcal{Q}^d(\omega' b,\tau') \end{array}\right\} \\ +(1-\xi)\frac{1}{\Pi^d(b',\tau')}\mathcal{Q}^d(b,\tau') \end{array}\right]. \tag{3}$$

2.4 Public Policy Problems

Conditional on having access to financial markets, the beginning-of-period value of the central bank is denoted as $\mathcal{M}(s)$, that of an incumbent as $\mathcal{F}(s)$ and that of a party not in office as $\mathcal{F}^*(s)$, where $s \equiv (b,\tau)$.[24]

The default decision of the fiscal authority solves

$$\mathcal{F}(b,\tau) = \max_{d\in\{0,1\}}\left\{(1-d)\,\mathcal{F}^r(b,\tau)+d\mathcal{F}^d(b,\tau)\right\}, \tag{4}$$

where $\mathcal{F}^r(\cdot)$ is the value of repayment and $\mathcal{F}^d(\cdot)$ the value of default.

The beginning-of-period values of the central bank and the political party currently not in office satisfy

$$\mathcal{M}(b,\tau) = (1-\mathcal{D}(b,\tau))\,\mathcal{M}^r(b,\tau)+\mathcal{D}(b,\tau)\mathcal{M}^d(b,\tau), \tag{5}$$

$$\mathcal{F}^*(b,\tau) = (1-\mathcal{D}(b,\tau))\,\mathcal{F}^{*r}(b,\tau)+\mathcal{D}(b,\tau)\mathcal{F}^{*d}(b,\tau), \tag{6}$$

where $\mathcal{D}(b,\tau)$ characterizes the optimal default decision of the fiscal authority.

After the default decision has been made, the central bank acts, solving

$$\mathcal{M}^r(b,\tau) = \max_{\pi}\left\{\hat{\mathcal{M}}^r(\pi,b,\tau)\right\}, \tag{7}$$

if the fiscal authority repays and

$$\mathcal{M}^d(\tau) = \max_{\pi}\left\{\hat{\mathcal{M}}^d(\pi,b,\tau)\right\}, \tag{8}$$

if it defaults or starts the period in financial autarky.

The value functions $\hat{\mathcal{M}}^r(\cdot)$ and $\hat{\mathcal{M}}^d(\cdot)$ are the intra-period continuation values for the central bank. They are determined below and depend on how the fiscal authority sets its policies, given the inflation rate π.

but requires additional notation since the repayment decision and the acceptance decision do not necessarily coincide.

[24] In addition to $s = (b,\tau)$, whether the economy is in financial autarky or not also counts as a state variable in the model. The model formulation below accounts for this by formulating the public policy problem conditional on the economy's default/autarky status.

For the political parties, the repayment and default values satisfy

$$\mathcal{F}^r(b,\tau) = \hat{\mathcal{F}}^r(\Pi^r(b,\tau),b,\tau), \tag{9}$$

$$\mathcal{F}^d(b,\tau) = \hat{\mathcal{F}}^d(\Pi^d(b,\tau),b,\tau), \tag{10}$$

$$\mathcal{F}^{*r}(b,\tau) = \hat{\mathcal{F}}^{*r}(\Pi^r(b,\tau),b,\tau), \tag{11}$$

$$\mathcal{F}^{*d}(b,\tau) = \hat{\mathcal{F}}^{*d}(\Pi^d(b,\tau),b,\tau), \tag{12}$$

where $\Pi^r(\cdot)$ and $\Pi^d(\cdot)$ denote the policy functions for inflation that solve the central bank's decision problem, $\hat{\mathcal{F}}^r(\cdot)$ and $\hat{\mathcal{F}}^d(\cdot)$ the intra-period continuation values for the incumbent party, and $\hat{\mathcal{F}}^{*r}(\cdot)$ and $\hat{\mathcal{F}}^{*d}(\cdot)$ the intra-period continuation values for the party not in office. When choosing whether to default or repay, the fiscal authority thus internalizes how its default decision affects the inflation rate.

After the central bank has set the inflation rate, the fiscal authority makes its spending and borrowing decisions. Its decision problem is given by

$$\hat{\mathcal{F}}^r(\pi,b,\tau) = \max_{g,b'} \left\{ \begin{array}{c} \theta u(g) - \psi(\pi) \\ +\beta \mathbb{E}_{\tau'|\tau} \left[\begin{array}{c} \mu \mathcal{F}(b',\tau') \\ +(1-\mu)\mathcal{F}^*(b',\tau') \end{array} \right] \end{array} \right\} \tag{13}$$

$$\text{subject to } 0 \leq \tau - g + q\left(b',\tau\right)\left(b' - \pi^{-1}\delta b\right) - \pi^{-1}\kappa b,$$

in the repayment case and by

$$\hat{\mathcal{F}}^d(\pi,b,\tau) = \max_{g} \left\{ \begin{array}{c} \theta u(g) - \psi(\pi) \\ +\xi\beta \mathbb{E}_{\tau',\omega'|\tau} \left[\begin{array}{c} \mu \mathcal{F}(\omega' b,\tau') \\ +(1-\mu)\mathcal{F}^*(\omega' b,\tau') \end{array} \right] \\ +(1-\xi)\beta \mathbb{E}_{\tau'|\tau} \left[\begin{array}{c} \mu \mathcal{F}^d(b,\tau') \\ +(1-\mu)\mathcal{F}^{*d}(b,\tau') \end{array} \right] \end{array} \right\} \tag{14}$$

$$\text{subject to } 0 \leq \tau - g - \phi(\tau),$$

in the default case.

If the fiscal authority reneges on debt payments, it is excluded from international financial markets for the current period. Conditional on being in autarky, the economy receives an offer to regain access to financial markets with probability ξ in the following period. Regardless of whether the party currently in charge of fiscal policy defaults or repays, it remains in office in the subsequent period with probability μ and is replaced by the opposite party with the counter-probability $1-\mu$.

For the central bank, the intra-period continuation values $\hat{\mathcal{M}}^r(\cdot)$ and $\hat{\mathcal{M}}^d(\cdot)$ satisfy

$$\hat{\mathcal{M}}^r(\pi,b,\tau) = \left\{ \begin{array}{c} u(\hat{\mathcal{G}}^r(\pi,b,\tau)) - \alpha\psi(\pi) \\ +\beta \mathbb{E}_{\tau'|\tau}\left[\mathcal{M}(\hat{\mathcal{B}}^r(\pi,b,\tau),\tau')\right] \end{array} \right\}, \tag{15}$$

and

$$\hat{\mathcal{M}}^d(\pi,b,\tau) = \left\{ \begin{array}{c} u(\hat{\mathcal{G}}^d(\pi,b,\tau)) - \alpha\psi(\pi) \\ +\beta\mathbb{E}_{\tau',\omega'|\tau} \left[\begin{array}{c} \xi\mathcal{M}(\omega' b,\tau') \\ +(1-\xi)\,\mathcal{M}^d(b,\tau') \end{array} \right] \end{array} \right\}, \tag{16}$$

and for the party not in office, the continuation values $\hat{\mathcal{F}}^{*r}(\cdot)$ and $\hat{\mathcal{F}}^{*d}(\cdot)$ satsify

$$\hat{\mathcal{F}}^{*r}(\pi,b,\tau) = \left\{ \begin{array}{c} u(\hat{\mathcal{G}}^r(\pi,b,\tau)) - \psi(\pi) \\ +\beta\mathbb{E}_{\tau'|\tau} \left[\begin{array}{c} \mu\mathcal{F}^*(\hat{\mathcal{B}}^r(\pi,b,\tau),\tau') \\ +(1-\mu)\,\mathcal{F}(\hat{\mathcal{B}}^r(\pi,b,\tau),\tau') \end{array} \right] \end{array} \right\}, \tag{17}$$

and

$$\hat{\mathcal{F}}^{*d}(\pi,b,\tau) = \left\{ \begin{array}{c} u(\hat{\mathcal{G}}^d(\pi,b,\tau)) - \psi(\pi) \\ +\xi\beta\mathbb{E}_{\tau',\omega'|\tau} \left[\begin{array}{c} \mu\mathcal{F}^*(\omega' b,\tau') \\ (1-\mu)\,\mathcal{F}(\omega' b,\tau') \end{array} \right] \\ +(1-\xi)\,\beta\mathbb{E}_{\tau'|\tau} \left[\begin{array}{c} \mu\mathcal{F}^{*d}(b,\tau') \\ (1-\mu)\,\mathcal{F}^d(b,\tau') \end{array} \right] \end{array} \right\}, \tag{18}$$

where $\hat{\mathcal{B}}^r(\cdot)$, $\hat{\mathcal{G}}^r(\cdot)$ and $\hat{\mathcal{G}}^d(\cdot)$ denote the policy functions for borrowing and government spending that solve the fiscal authority's decision problems (13) and (14). These functions characterize the fiscal authority's optimal response to the inflation rate π set by the central bank. The probabilities μ and $1-\mu$ do not enter the continuation values of the central bank $\hat{\mathcal{M}}^r(\cdot)$ and $\hat{\mathcal{M}}^d(\cdot)$ since future fiscal policy does not depend on which of the political parties will be in office. The objective of the central bank does not vary with the office-holder of the fiscal authority either.

Equations (15) and (16) illustrate that inflation affects the objective of the central bank in two ways. First, there is a direct effect of π on the cost of inflation $\alpha\psi(\pi)$. Second, there is an indirect effect that operates through the optimal response functions of the fiscal authority. When solving the decision problems (7) and (8), the central bank internalizes both of these effects.

The policy functions for inflation $\Pi^r(\cdot)$ and $\Pi^d(\cdot)$ then determine

$$\mathcal{B}^r(b,\tau) = \hat{\mathcal{B}}^r(\Pi^r(b,\tau),b,\tau), \tag{19}$$

$$\mathcal{G}^r(b,\tau) = \hat{\mathcal{G}}^r(\Pi^r(b,\tau),b,\tau), \tag{20}$$

$$\mathcal{G}^d(b,\tau) = \hat{\mathcal{G}}^d(\Pi^d(b,\tau),b,\tau), \tag{21}$$

such that the equilibrium policies will only depend on (b,τ), since the inflation choices are conditioned on these states as well.

Conditional on having access to financial markets, the equilibrium policies are ultimately pinned down by the fiscal authority's default decision, such that

$$\Pi(b,\tau) = (1-\mathcal{D}(b,\tau))\,\Pi^r(b,\tau) + \mathcal{D}(b,\tau)\Pi^d(b,\tau), \tag{22}$$

$$\mathcal{B}(b,\tau) = (1-\mathcal{D}(b,\tau))\,\mathcal{B}^r(b,\tau) + \mathcal{D}(b,\tau)b, \tag{23}$$

$$\mathcal{G}(b,\tau) = (1-\mathcal{D}(b,\tau))\,\mathcal{G}^r(b,\tau) + \mathcal{D}(b,\tau)\mathcal{G}^d(b,\tau). \tag{24}$$

2.5 Equilibrium

The Markov-perfect equilibrium for the model is then defined as follows:

Definition 1 *A stationary Markov-perfect equilibrium is given by bond price functions* $\{q, \mathcal{Q}^r, \mathcal{Q}^d\}$ *that satisfy conditions (1)-(3), value functions* $\{\mathcal{F}, \mathcal{F}^r, \mathcal{F}^d, \hat{\mathcal{F}}^r, \hat{\mathcal{F}}^d, \mathcal{F}^*, \mathcal{F}^{*r}, \mathcal{F}^{*d}, \hat{\mathcal{F}}^{*r}, \hat{\mathcal{F}}^{*d}, \mathcal{M}, \mathcal{M}^r, \mathcal{M}^d, \hat{\mathcal{M}}^r, \hat{\mathcal{M}}^d\}$ *that satisfy the equations (4)-(18) and policy functions* $\{\Pi, \Pi^r, \Pi^d, \mathcal{B}, \mathcal{B}^r, \hat{\mathcal{B}}^r, \mathcal{D}, \mathcal{G}, \mathcal{G}^r, \mathcal{G}^d, \hat{\mathcal{G}}^r, \hat{\mathcal{G}}^d\}$ *that satisfy the conditions (1)-(3), (5)-(6), (9)-(12), (15)-(24). The functions* $\{\Pi^r, \Pi^d\}$ *furthermore solve the policy problems of the central bank (7)-(8) and the functions* $\{\hat{\mathcal{B}}^r, \mathcal{D}, \hat{\mathcal{G}}^r, \hat{\mathcal{G}}^d\}$ *solve the policy problems of the fiscal authority (4), (13)-(14).*

3 Policy Trade-Offs

Before moving to the quantitative analysis, it is helpful to first look at the first-order conditions for the optimal debt and inflation choices to understand the motives that drive policy-making in the model.[25] To do this in a transparent and intuitive way, I will proceed in three steps. First, I will present and discuss the policy trade-offs for a model version in which a benevolent government is in charge of setting monetary and fiscal policy without commitment, which provides a good benchmark. Second, I will look at the case with delegated monetary policy and show how disagreement between the fiscal and monetary policy authorities changes policy trade-offs. Third, I will add political economy distortions and discuss their implications for public policy.

Benevolent Government For a benevolent government, interior solutions to its decision problem satisfy the two conditions

$$
\begin{aligned}
u_g(g)\Delta_q &= \beta \mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[u_g(g')\Delta_b'\right] \\
&\quad -\beta \mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\frac{\partial \mathcal{F}^d(b',\tau')}{\partial b'}\right], \qquad (25)\\
u_g(g)\pi^{-2}\left(\kappa+\delta q\left(b',\tau\right)\right)b &= \psi_\pi(\pi), \qquad (26)
\end{aligned}
$$

with

$$
\begin{aligned}
\Delta_b &\equiv \pi^{-1}\left(\kappa+\delta \mathcal{Q}^r(b,\tau)\right),\\
\Delta_q &\equiv q\left(b',\tau\right)+\frac{\partial q(b',\tau)}{\partial b'}\left(b'-\pi^{-1}\delta b\right).
\end{aligned}
$$

Note that conditional expectations are taken with respect to repayment or default states, where the function $\hat{\tau}(b)$ denotes the default threshold, i.e. the lowest revenue value τ that is consistent with

[25] The derivation of these conditions can be found in Appendix A.1. It requires that the policy, bond price and value functions in the model are differentiable with respect to the debt position. Note that, as in Cuadra and Sapriza (2008) or Hatchondo, Martinez, and Sosa-Padilla (2016), the first-order conditions are only derived and presented here to illustrate the policy trade-offs in a transparent way. The numerical algorithm used for the quantitative analysis does not build on the first-order conditions (see Appendix A.2 for details).

repayment for given debt b: $\mathcal{F}^r(b, \hat{\tau}(b)) = \mathcal{F}^d(b, \hat{\tau}(b))$.[26]

The government can trade non-state contingent bonds to smooth the impact of fiscal shocks on public consumption (see condition (25)). The marginal revenues obtained by borrowing more today are given by Δ_q. Due to lack of commitment, they do not equal average revenues $q(b', \tau)$. The reason for this is that the bond price responds to the amount of borrowing b' as it governs expected inflation, the probability of default and next period's bond price. This effect is captured by the derivative $\partial q(b', \tau) / \partial b'$ and is internalized by the fiscal authority when choosing end-of-period debt b'.

Condition (26) depicts the static trade-off involved when setting the optimal inflation rate without commitment. When the government inherits positive nominal debt b, it wants to reduce real debt payments to free resources for public spending (LHS). The optimal inflation rate equates these marginal benefits of inflation to its marginal costs $\psi_\pi(\pi)$. Since the government optimizes sequentially, it does not internalize that an increase in π additionally affects the nominal bond price in previous periods in an adverse way. The failure to internalize this effect is the source of the time-inconsistency problem of monetary policy in the model. Reflecting that the temptation to raise inflation increases with the nominal debt position b, expected inflation is an increasing function of end-of-period debt b'. This implies that, even in the absence of sovereign risk, the elasticity of the bond price schedule with respect to b' is negative, which discourages public debt accumulation by impeding the government's ability to smooth public spending via bond issuance.

Since the government issues long-term bonds, its borrowing decision does not only affect the price of newly issued bonds but also the price of bonds issued in previous periods. By optimizing from period to period, the government does however not internalize that expectations about its current borrowing behavior have an impact on outcomes in previous periods. Since, as highlighted by the RHS of (1), investors anticipate that the value of debt might change in the future and want to be compensated for this risk, the government's lack of commitment results in adverse borrowing conditions. In the literature, this time-inconsistency problem related to long-term debt is known as "debt dilution problem" (see Chatterjee and Eyigungor, 2015; Hatchondo, Martinez, and Sosa-Padilla, 2016). Relative to a scenario without debt dilution, the government not only faces adverse borrowing conditions but also borrows excessively due to its failure to internalize how the adverse impact of debt issuance on today's borrowing conditions deteriorates bond prices in previous periods.

Although nominal debt introduces a time-inconsistency problem that increases the cost of borrowing, it also has potential benefits. When only non-state contingent bonds can be issued, the debt contract does not specify future debt payments conditional on future fiscal shocks. While the fiscal authority has the discrete option to adjust debt payments ex post via outright default, inflation offers a much more flexible way of adjusting payments in response to fluctuating tax revenues, making nominal debt a potentially useful hedge against bad fiscal shocks.[27] This hedging property of nominal government debt is captured by the RHS of the Euler equation (25). First, suppose that the government can only issue short-term debt, i.e. $\delta = 0$. When public debt is denominated in local

[26] The second term on the RHS of (25) captures the marginal effect of debt issuance on next period's outcome in the case of default ($\tau' < \hat{\tau}(b')$).

[27] The hedging benefit of nominal government debt is discussed in detail by Bohn (1988). Schmitt-Grohé and Uribe (2004) study the role of inflation as a shock absorber in the context of a New Keynesian model.

currency, real debt payments Δ_b' (negatively) depend on future inflation π'. Since the government will tend to increase inflation in response to adverse fiscal shocks, i.e. when τ' is low and $u_g(g')$ is high, the effective debt payment will decline exactly when public resources are scarce. Of course, this state-contingency of real debt payments will be anticipated by rational investors, who demand to be compensated for it, and therefore comes at a cost. Now consider the case with long-term bonds, i.e. $\delta > 0$. As discussed in detail by Arellano and Ramanarayanan (2012) for a setting with defaultable real debt, long-term bonds carry a hedging benefit relative to short-term bonds even in the absence of inflation risk via the bond price of outstanding debt $\mathcal{Q}^r(b', \tau')$, which introduces an additional state-contingency into Δ_b' that can mitigate the costs associated with the incentive problems caused by long-term debt.

Monetary-Fiscal Policy Interactions Now consider the case with delegated monetary policy. When political frictions are ($\theta = \mu = 1$) but there is disagreement between the fiscal authority and the central bank ($\alpha \neq 1/\theta$), the first-order condition for the fiscal authority is given by

$$\begin{aligned} u_g(g)\Delta_q &= \beta \mathbb{E}_{\tau'|\tau,\tau' \geq \hat{\tau}(b')} \left[u_g(g')\Delta_b' - \Delta_\theta' \frac{\partial \Pi^r(b',\tau')}{\partial b'} \right] \\ &\quad - \beta \mathbb{E}_{\tau'|\tau,\tau' < \hat{\tau}(b')} \left[\frac{\partial \mathcal{F}^d(b',\tau')}{\partial b'} \right], \end{aligned} \tag{27}$$

whereas the optimality condition for the central bank is given by

$$\begin{aligned} 0 &= \Delta_\alpha + u_g(g)\Delta_q \frac{\partial \hat{\mathcal{B}}^r(\pi,b,\tau)}{\partial \pi} \\ &\quad + \beta \left(\mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')} \left[\frac{\partial \mathcal{M}^d(b',\tau')}{\partial b'} \right] + \Delta_{\mathcal{M}}' \frac{\partial \hat{\tau}(b')}{\partial b'} f(\hat{\tau}(b')|\tau) \right) \frac{\partial \hat{\mathcal{B}}^r(\pi,b,\tau)}{\partial \pi} \\ &\quad - \beta \mathbb{E}_{\tau'|\tau,\tau' \geq \hat{\tau}(b')} \left[u_g(g')\Delta_b' - \Delta_\alpha' \left(\frac{\partial \Pi^r(b',\tau')}{\partial b'} - \frac{\frac{\partial \mathcal{B}^r(b',\tau')}{\partial b'}}{\frac{\partial \hat{\mathcal{B}}^r(\pi',b',\tau')}{\partial \pi'}} \right) \right] \frac{\partial \hat{\mathcal{B}}^r(\pi,b,\tau)}{\partial \pi}, \end{aligned} \tag{28}$$

with

$$\begin{aligned} \Delta_\theta &\equiv \theta u_g(g)\pi^{-2}\left(\kappa + \delta q(b',\tau)\right)b - \psi_\pi(\pi), \\ \Delta_\alpha &\equiv u_g(g)\pi^{-2}\left(\kappa + \delta q(b',\tau)\right)b - \alpha\psi_\pi(\pi), \\ \Delta_{\mathcal{M}} &\equiv \mathcal{M}^d(b,\hat{\tau}(b)) - \mathcal{M}^r(b,\hat{\tau}(b)). \end{aligned}$$

The expressions Δ_α and Δ_θ measure the net marginal gains of inflation from the perspective of the central bank and the fiscal authority, respectively. If the fiscal authority and the central bank agree on the optimal inflation rate ($\alpha = 1/\theta = 1$), $\Delta_\alpha = \Delta_\theta = 0$ as well as (26) hold. If there is however disagreement about the optimal inflation rate ($\alpha \neq 1/\theta$), $\Delta_\alpha \neq \Delta_\theta$ holds and the two authorities use their policy instruments to strategically manipulate the policies chosen by the other authority. By comparing (27) to (25), one can see that disagreement about future inflation - as measured by Δ_θ' - introduces a wedge into the first-order condition (25), thereby distorting public consumption smoothing.[28] The size of this wedge depends on $\partial \Pi^r(b',\tau')/\partial b'$, i.e. on the response of future inflation to an increase in borrowing. As argued above, this derivative tends to be positive which implies that if, from the perspective of the fiscal authority, the expected marginal benefits of inflation exceed the respective marginal costs ($\Delta'_\theta > 0$), the fiscal authority has an incentive to increase borrowing to reduce the gap Δ'_θ. Similarly, the central bank has an incentive to use inflation to distort the borrowing decision of the fiscal authority (see condition (28)). In contrast to (26), the inflation choice now involves intertemporal considerations because the central bank has an incentive to influence the borrowing decision of the fiscal authority in the current period via the inflation rate.

When the two policy authorities have different objectives, one motivation for the central bank to distort the borrowing decision is to affect the default decision in the subsequent period. This motive is captured by the third term on the RHS of equation (28). The wedge $\Delta'_{\mathcal{M}}$ measures the magnitude and direction of the central bank's disagreement with the fiscal authority's default decision, whereas the derivative $\partial \hat{\tau}(b')/\partial b'$ measures how the default decision responds to changes in debt issuance. As will become clear in the next section, consistent with Arellano (2008), this derivative is positive, i.e. default is more attractive for higher debt levels.

Political Economy Distortions So far, the government's incentive to persistently accumulate positive amounts of debt was primarily driven by the economy's impatience relative to foreign investors, i.e. by the relation between β and $1/(1+r_f)$. As mentioned in the previous section, the combination of political disagreement ($\theta > 1$) and turnover risk ($\mu < 1$) gives rise to another long-run borrowing motive, which will be discussed in the remainder of this section.

When, in addition to disagreement between the fiscal authority and the central bank ($\alpha \neq 1/\theta$), there are also political frictions ($\theta > 1$, $\mu < 1$), the first-order condition for the fiscal authority changes from (27) to

$$\begin{aligned}
0 \;=\;& \theta u_g(g)\Delta_q \qquad (29)\\
& -\mu\beta\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\theta u_g(g')\Delta'_b - \Delta'_\theta \frac{\partial \Pi^r(b',\tau')}{\partial b'}\right]\\
& +(1-\mu)\beta\left(\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[u_g(g')\frac{\partial \mathcal{G}^r(b',\tau')}{\partial b'} - \psi_\pi(\pi')\frac{\partial \Pi^r(b',\tau')}{\partial b'}\right] + \Delta'_{\mathcal{F}*}\frac{\partial \hat{\tau}(b')}{\partial b'} f(\hat{\tau}(b')|\tau)\right)\\
& -\mu\beta\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\theta u_g(g')\Delta'_q \frac{\partial \mathcal{B}^r(b',\tau')}{\partial b'}\right]\\
& +(2\mu-1)\beta\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\left(\begin{array}{c}\beta\mathbb{E}_{\tau''|\tau',\tau''\geq\hat{\tau}(b'')}\left[\theta u_g(g'')\Delta''_b - \Delta''_\theta \frac{\partial \Pi^r(b'',\tau'')}{\partial b''}\right]\\ +\beta\mathbb{E}_{\tau''|\tau',\tau''<\hat{\tau}(b'')}\left[\frac{\partial \mathcal{F}^d(b'',\tau'')}{\partial b''}\right]\end{array}\right)\frac{\partial \mathcal{B}^r(b',\tau')}{\partial b'}\right]\\
& +\beta\mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\mu\frac{\partial \mathcal{F}^d(b',\tau')}{\partial b'} + (1-\mu)\frac{\partial \mathcal{F}^{*d}(b',\tau')}{\partial b'}\right],
\end{aligned}$$

[28] Similar wedges can be found in Niemann (2011) and Martin (2015).

with

$$\Delta_{\mathcal{F}^*} \equiv \mathcal{F}^{*d}(b, \hat{\tau}(b)) - \mathcal{F}^{*r}(b, \hat{\tau}(b)).$$

It can be thought of as a version of the Euler equation derived in Cuadra and Sapriza (2008), extended to incorporate monetary-fiscal policy interactions (see Niemann, 2011; Martin, 2015), long-term bonds and positive debt recovery. As in Cuadra and Sapriza (2008), the existence of political disagreement and turnover risk affects the borrowing decision of the fiscal authority via three effects (see Cuadra and Sapriza, 2008, p.84). The first effect is captured by the second term on the RHS of (29) and is referred to as "impatience effect" by Cuadra and Sapriza (2008). Because the incumbent party only stays in office with probability μ, it discounts the expected marginal costs of debt repayment more than without turnover risk. As a result, it is encouraged to front-load public consumption by borrowing more in the current period.

The third term on the RHS of (29) displays what Cuadra and Sapriza (2008) call the "disagreement effect". With probability $1-\mu$, the opposite party takes over office in the subsequent period. In this case, the implemented fiscal policy will be different from what the party currently in office would prefer since it will have a lower marginal valuation of the public good when it is not in power anymore. In the current period, the incumbent party then uses borrowing as a strategic device to manipulate future fiscal policy set by the opposite political party in case there is a change in power. More specifically, the incumbent party increases borrowing (or reduces savings) to leave less financial resources for the other party to spend on public spending in the next period. With political frictions, the party not in office also tends to disagree with the incumbent party's default decision as measured by the wedge $\Delta'_{\mathcal{F}^*}$.

The last two terms on the RHS of (29) capture the third effect by which political frictions affect the fiscal authority's borrowing decision. It shows that there is not only disagreement about future public spending - as captured by the "disagreement effect" above - but also about future borrowing. While the role of this effect for the borrowing decision of today's incumbent party is not clear ex ante, the two other effects tend to lead the fiscal authority to borrow more relative to a scenario without political frictions.

4 Quantitative Analysis

After having discussed the key forces of the model in the previous section, this section presents a quantitative analysis of the model's properties. Section 4.1 is concerned with model specification. Section 4.2 presents simulation results. Section 4.3 evaluates the welfare properties of different monetary policy regimes and alternative model versions. Appendix A.2 provides details about the numerical solution algorithm used to compute the model, which extends existing methods to solve a model with two policy authorities.

4.1 Model Specification

This section discusses how the model is specified.

Functional Forms For the objective function, an iso-elastic utility function

$$u(g) = \begin{cases} \frac{g^{1-\gamma}-1}{1-\gamma} & \text{if } \gamma \neq 1 \\ \ln g & \text{if } \gamma = 1 \end{cases}$$

and quadratic inflation costs

$$\psi(\pi) = \frac{\chi}{2}(\pi-1)^2, \; \chi > 0,$$

are used.

Following Arellano (2008), I adopt an asymmetric specification for the resource costs of default:

$$\phi(\tau) = \max\{0, \tau - \tilde{\tau}\}.$$

This default cost specification implies that the resource costs of default increase overproportionally with tax revenues. As a result, default is particularly attractive in bad states, i.e. when tax revenues are low, which is a feature that is both intuitive and empirically plausible (see Tomz and Wright, 2007).

Finally, tax revenues follow a log-normal AR(1)-process,

$$\tau_t = \tau_{t-1}^{\rho} \exp(\sigma \varepsilon_t), \; \varepsilon_t \overset{i.i.d.}{\sim} \mathcal{N}(0,1),$$

and the repayment offer ω is drawn from a probability distribution with discrete support Ω.

Parameters The baseline model is calibrated under the assumption that there is no central bank independence and monetary policy is directly set by the party currently in office, which is not benevolent due to $\theta > 1$.[29] Section 4.2 will then look at how different monetary policy regimes affect public policy relative to this scenario. In particular, I will consider α-values relative to $\alpha_\theta \equiv 1/\theta$. If $\alpha = \alpha_\theta$, the central bank and the fiscal authority put the same relative weights on $u(g)$ and $\psi(\pi)$, such that the main source of disagreement between the two authorities is the present bias of the fiscal authority.

One model period corresponds to one year. The model parameters are either taken from the literature or calibrated to match certain long-run characteristics of a sample of 14 emerging economies.[30] The values are as follows. For γ, a standard value of 2 is used. The value for the real risk-free rate $r_f = 0.032$ is taken from Arellano and Ramanarayanan (2012). The probability of reentry ξ is set to $1/3$ which is consistent with empirical estimates (see e.g. Dias and Richmond, 2009). For the decay

[29] In a two-authority setting, this assumption means that the central bank now solves $\mathcal{M}^j(b,\tau) = \max_\pi \{\hat{\mathcal{F}}^j(\pi,b,\tau)\}$, $j \in \{r,d\}$, instead of the problems (7) and (8).

[30] More specifically, I focus on the same set of countries analyzed in Du and Schreger (2017), which consists of Brazil, Colombia, Hungary, Indonesia, Israel, Malaysia, Mexico, Peru, Poland, Russia, South Africa, South Korea, Thailand and Turkey.

Parameter	Description	Value
β	Discount factor	0.9224
γ	Coefficient of relative risk aversion	2.0000
δ	Coupon decay parameter	0.8256
θ	Political friction parameter	2.1800
κ	Coupon size parameter	0.2064
μ	Probability of reelection	0.8700
ξ	Probability of receiving repayment offer	0.3333
ρ	Persistence revenue process	0.9000
σ	Std. dev. revenue process	0.0170
$\bar{\tau}$	Default cost parameter	0.8760
χ	Inflation cost parameter	3.7500
ω_1	Minimum offer rate	0.3500
ω_N	Maximum offer rate	1.0000
r_f	Risk-free rate	0.0320

Table 1: Baseline model parameters

parameter δ, I use a value of 0.8256 to obtain an average (risk-free) bond duration of 5 years as in Du and Schreger (2017). Following Du and Schreger (2017), I set the coupon parameter κ to $1 + r_f - \delta$, which normalizes the price of a bond, absent inflation and default risk, to one. The probability of remaining in power μ is set to 0.87, capturing the average number of years that the party of chief executive spent in office without interruption for the country sample.[31]

For the inflation cost parameter χ, the default cost parameter $\tilde{\tau}$ and the disagreement parameter θ, I use values of 3.75, 0.876 and 2.18 to match an average debt-to-tax revenue ratio of roughly 53%, an annual default probability of 1% and an average annual inflation rate of around 15%. In contrast to most papers in the sovereign default literature, the appropriate measure of indebtedness for the model is not the debt-to-GDP ratio but the debt-to-tax-revenue ratio. I target an external debt-to-GDP ratio of 9% as observed for the considered country sample (see Du and Schreger, 2017). For the time period from 1990 to 2014, tax revenues account for roughly 17% of GDP for the country sample, which translates into an average debt-to-tax-revenue ratio of around 53%.[32] An average annual default probability of 1% means that the economy defaults on average once in 100 years. This value implies that the government is not a notorious serial defaulter but that it defaults frequently enough for sovereign risk to clearly matter for public borrowing conditions and hence for monetary and fiscal policy.[33] Most central bank reforms in emerging economies have been undertaken during the 1990s. Looking at the considered country sample, the average inflation rate for this decade is around 15%.[34]

For the tax revenue process, I take the values $\rho = 0.9$ and $\sigma = 0.017$ used by Arellano and

[31] The calculations are based on data provided by Beck, Groff, Keefer, and Walsh (2001).

[32] Data from the Worldbank's World Development Indicators is used for these calculations.

[33] Some countries in the sample face sovereign risk but have not experienced default events in the recent past. Targeting a higher default probability does not qualitatively change the results of this paper.

[34] To reduce the impact of outliers due to hyperinflationary episodes, the average value is calculated by computing the median inflation rate across countries for each year and then taking the mean across time. Using the median instead of the mean for the last step leads to virtually the same value. Data source is the Worldbank's World Development Indicators data set.

	Baseline	$\alpha = \alpha_\theta$	$\alpha = 2\alpha_\theta$	$\alpha = 3\alpha_\theta$	$\alpha = 5\alpha_\theta$	$\alpha = 8\alpha_\theta$	$\alpha \to \infty$
Mean							
Default probability	0.0101	0.0062	0.0496	0.0580	0.0635	0.0659	0.0612
Debt-to-tax-revenues	0.5345	0.4398	0.9195	0.9193	0.8775	0.8275	0.7022
Inflation rate	0.1502	0.1427	0.1176	0.0838	0.0537	0.0350	0
Standard deviation							
Government spending	0.0134	0.0120	0.0301	0.0333	0.0347	0.0349	0.0336
Inflation rate	0.0128	0.0096	0.0250	0.0201	0.0139	0.0094	0
Correlation with taxes							
Government spending	0.8680	0.9154	0.7358	0.6979	0.6625	0.6496	0.6325
Inflation rate	-0.0142	-0.0872	0.2564	0.2968	0.3112	0.3041	-

Table 2: Selected model statistics

Ramanarayanan (2012) for the case of Brazil's real GDP, thus assuming that tax revenues inherit the cyclical properties from real GDP as in Bocola and Dovis (2016). For the offer distribution, I follow Pouzo and Presno (2016) and specify its support as an equidistant set $\Omega = \{\omega_1, ..., \omega_N\}$ whose elements are realized with equal probability $1/N$, where $N = 7$. The maximum offer rate ω_N is normalized to one, whereas the minimum value is set to $\omega_1 = 0.35$ to match an empirically plausible average haircut of 37% (see Cruces and Trebesch, 2013).

The household discount factor β is set to 0.9224, implying a quarterly discount factor of 0.98, which is a value that is substantially higher than the ones typically used for quantitative sovereign default models.[35] In these types of models, a high degree of impatience is usually needed to make the government accumulate debt levels that are sufficiently high to render default an attractive policy option. Often, such low discount factors are motivated by referring to political economy distortions as modeled by Cuadra and Sapriza (2008). While it might not be of first-order importance to explicitly model the source of the government's impatience for a strictly positive analysis, a welfare analysis as performed in this paper should however consider the possibility that a government borrows due to political frictions and not simply because its citizens are more impatient than foreign investors. In Section 4.3, I will consider an alternative model version without political frictions ($\theta = 1$) and an accordingly lower household discount factor to clarify the role of political economy distortions for the results.

4.2 Simulation Results

The simulation results are shown in Table 2. It presents average statistics calculated for a panel of 1000 simulated economies with 2000 periods each, where the first 500 observations of each sample were discarded to eliminate the impact of initial conditions. The baseline scenario corresponds to the model version without central bank independence. The key findings, which are visualized by Figure 1, can be summarized as follows. A higher degree of monetary conservatism α tends to result in

[35] For instance, Aguiar and Gopinath (2006) consider an annualized discount factor of 0.4096 for a model with one-period bonds, whereas Chatterjee and Eyigungor (2015) use an annualized value of 0.7741 for a setting with long-term debt and positive debt recovery.

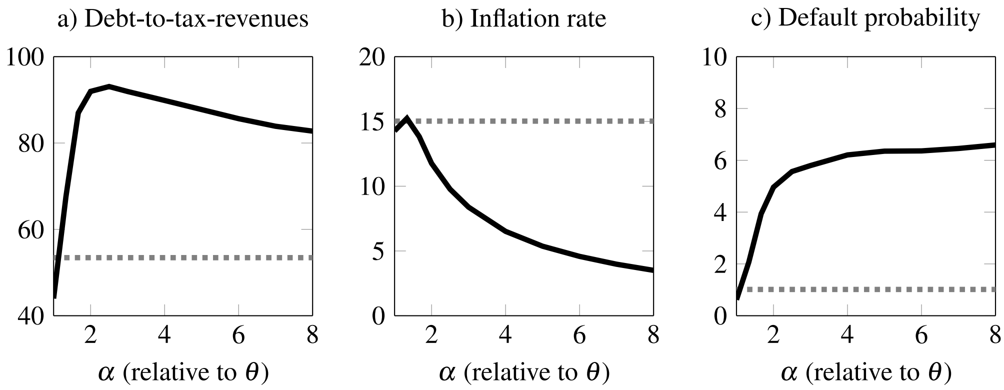

Figure 1: Selected first moments (in %) for different degrees of monetary conservatism α (in terms of $\alpha_\theta \equiv 1/\theta$). The respective value for the baseline model is given by the dotted line.

more frequent default events and a decline in inflation, whereas the relationship between the average debt-to-tax-revenue ratio and α clearly is a hump-shaped one. In terms of short-run implications, appointing a more conservative central banker tends to result in more stable inflation but more volatile fiscal policy. In the remainder of this section, potential channels that are responsible for these results are discussed in detail.

Bond Price Elasticity Channel As discussed in the previous section, the borrowing decision of the fiscal authority depends on how elastic the bond price schedule $q(b', \tau)$ responds to changes in the level of debt b' (see Figure 2), which reflects how the government's future incentives to use inflation or default vary with the debt burden. To understand how the degree of conservatism α affects monetary and fiscal policy, it is hence important to understand how it affects the bond price schedule by changing these relative incentives.

As in Arellano (2008), a default is more attractive in adverse states, i.e. when tax revenues are low and/or debt is high. As a result, for such combinations the bond price schedule is lower and more responsive to debt issuance, reflecting a higher probability of default (see Figure 2). When tax revenues are high, sovereign risk is low and the bond price schedule mostly reflects inflation and bond price risk. As debt increases, the gains from inflation increase as well and monetary policy implements a higher inflation rate to reduce the real debt burden (see Figure 3). Ceteris paribus, a higher degree of monetary conservatism discourages the central bank from using an inflationary policy by raising its internalized cost, translating into a bond price schedule that is less responsive to the level of borrowing. This is visualized in panel a) of Figure 4 which depicts the bond price schedule for different degrees of conservatism, assuming that tax revenues are equal to their unconditional mean. A less debt-elastic bond price in turn encourages the fiscal authority to borrow more, especially in good times, i.e. when sovereign risk is low.[36] The relation between the degree of monetary

[36]Aguiar, Amador, Farhi, and Gopinath (2014) make a related argument in a model of a small open (endowment) economy without policy interaction between a fiscal and a monetary authority and (equilibrium) default. They also highlight the link between the incentive to use inflation, the elasticity of the nominal interest rate and the evolution of debt. Niemann (2011) finds

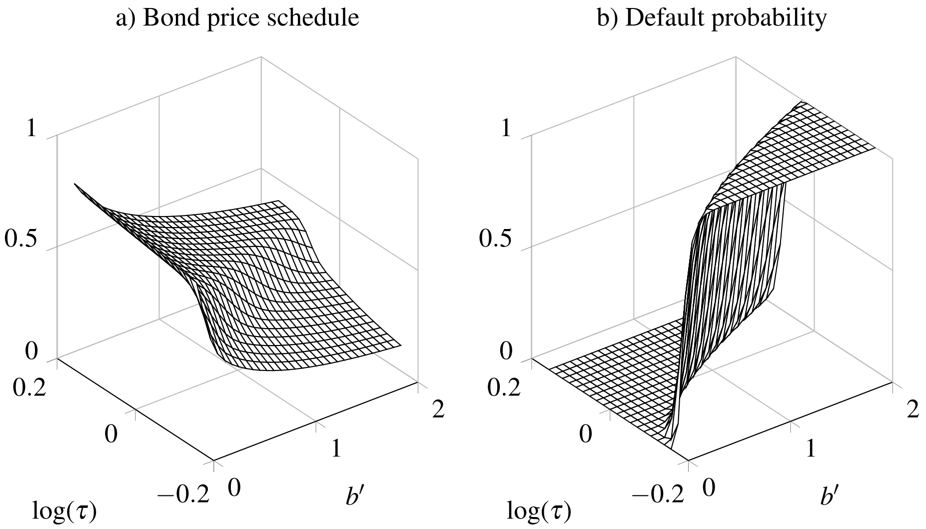

Figure 2: Bond price schedule $q(b', \tau)$ and default probability $\mathbb{E}_{\tau'|\tau}[\mathcal{D}(b', \tau')]$ for the baseline model

conservatism and the average debt burden is however not monotonic since α also impacts on the bond price schedule by changing the fiscal authority's incentive to default and hence the economy's vulnerability to a sovereign debt crisis.

When the central banker is more conservative, one might probably expect that, for a given state (b, τ), it becomes more attractive for the fiscal authority to default since the central bank is less willing to reduce the real debt burden via inflation. However, this reasoning ignores that the fiscal authority might, ceteris paribus, also face lower nominal interest rates for a given amount of debt issuance since the central bank's tougher monetary policy stance tends to reduce expected inflation. These improved borrowing conditions might then encourage the fiscal authority not to default, reducing the likelihood of such an event for a given amount of debt. In addition, when the central bank is less willing to raise inflation, the relative gains of default decline since the drop in inflation after a default would be smaller, reducing the fiscal authority's incentive to default (see Aguiar, Amador, Farhi, and Gopinath, 2014). The effect of α on the probability of default can be seen in panel b) of Figure 4 which depicts the default probability for different degrees of conservatism. The figure shows that when the degree of monetary conservatism is low, raising α decreases default risk for a given debt position, whereas for higher α-values, the attractiveness of default increases with the central banker's conservatism.

For low degrees of monetary conservatism, an increase in α then strongly raises debt accumulation by reducing the incentives to use inflation and default for a given debt position, improving public borrowing conditions at the margin (see Figure 4). The economy still experiences more frequent default events because the higher debt burden makes default more attractive for the fiscal authority on average. Although a higher degree of conservatism increases the central bank's cost of implementing a given inflation rate, the increase in average debt implies that it is not clear that a higher α-value

that increased monetary conservatism leads to increased debt accumulation in a model where the fiscal authority is myopic, cannot default and does not internalize its effect on future policies.

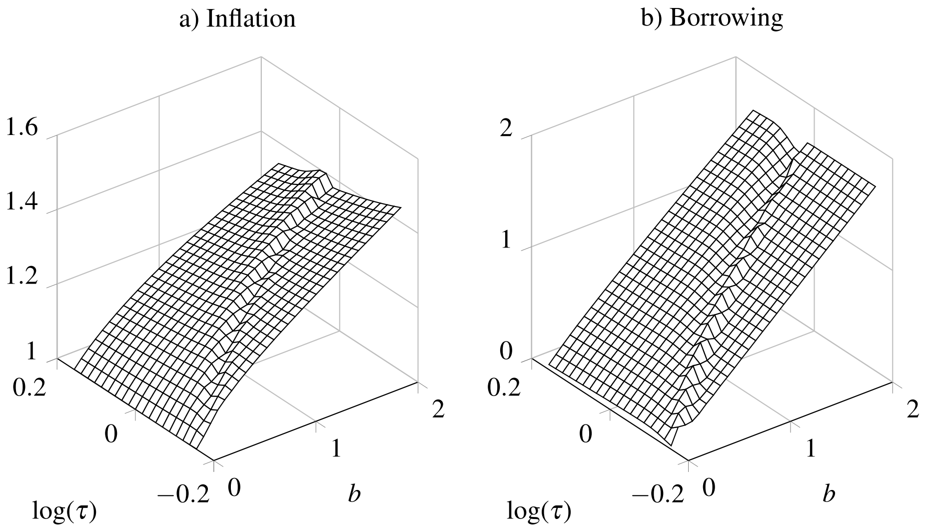

Figure 3: Inflation policy $\Pi^r(b,\tau)$ and borrowing policy $\mathcal{B}^r(b,\tau)$ for the baseline model

brings down average inflation since the higher debt burden also raises the gains of inflation on average. It turns however out that inflation only increases for very small α-values relative to the baseline scenario and then decreases with α. For higher degrees of conservatism, the impact of α on the incentive to use inflation is rather small, whereas its effect on default incentives gains importance, causing the bond price schedule to become steeper for high and intermediate levels of debt. This change prompts the fiscal authority to reduce its debt position, which eventually also brings down the default probability (see $\alpha \to \infty$).

Disagreement Channel In Section 3, I have argued that disagreement between the fiscal and the monetary authority might also affect public policy. This disagreement channel can be studied in a transparent way by comparing the baseline model without central bank independence with a setting in which the central bank places the same relative weights on $u(g)$ and $\psi(\pi)$ as the fiscal authority ($\alpha = \alpha_\theta$). In the latter case, the central bank's only incentive to deviate from the policy chosen in the baseline scenario without central bank independence is to correct the fiscal authority's present bias. To do so, the central bank deliberately chooses a higher inflation rate for a given debt and tax revenue combination relative to the baseline scenario. This policy disciplines the fiscal authority's present bias in two ways. First, by reducing the real value of debt payments, the central bank reduces the fiscal authority's incentive to borrow today by relaxing the government budget constraint. Second, since this policy implies a tighter link between the debt position and the inflation rate, the bond price becomes more responsive to the debt position which additionally discourages the fiscal authority from issuing debt.[37] Note that only the first effect is internalized by the central bank, whereas the second effect is unintended. As shown by Table 2, when $\alpha = \alpha_\theta$, although monetary policy becomes

[37]The central bank's more inflationary policy also increases the relative gains from default. This effect is however negligible relative to the bond price effect since is it only has a very small impact on the probability of default.

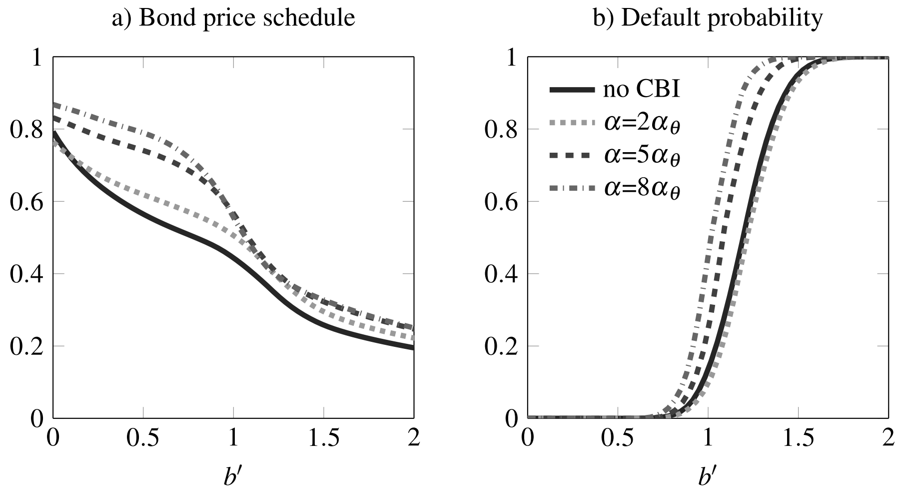

Figure 4: Bond price schedule $q(b',\tau)$ and default probability $\mathbb{E}_{\tau'|\tau}[\mathcal{D}(b',\tau')]$ for the baseline scenario (no CBI) and different degrees of monetary conservatism ($\tau = \mathbb{E}[\tau]$))

more inflationary, the inflation rate in the model version with central bank independence slightly declines due to the lower average debt burden, which also leads to a small drop in the average default probability. As α goes up, the central bank's tolerance for inflationary policies declines, reducing the scope for monetary policy to actively correct the fiscal authority's behavior by adjusting real debt payments.

As outlined in Section 3, disagreement about the costs and benefits of inflation could also affect fiscal policy via an expectation channel through the term Δ'_θ, which measures the future net marginal gains of inflation from the perspective of the fiscal authority. With central bank independence, this term is positive and increasing in the degree of monetary conservatism α. As shown by condition (29), a positive value for Δ_θ will tend to encourage the fiscal policy maker to borrow more since inflation positively responds to debt, i.e. $\partial\Pi^r(b,\tau)/\partial b > 0$. This way, the fiscal authority tries to force the central bank to implement an inflation rate that is higher and thus closer to its preferred one. While Δ_θ increases with the degree of monetary conservatism, the response of the inflation rate to the level of debt declines as α goes up. As a consequence, the combined expression $\Delta_\theta(\partial\Pi^r(b,\tau)/\partial b)$ does not respond to changes in the degree of monetary conservatism very much. While the disagreement channel is present and affecting the borrowing decision also via expectations, this particular mechanism it is not as important as the manipulation mechanism outlined in the previous paragraph or the bond price elasticity channel.

Hedging Effect of Inflation Due to the hedging role of inflation, the degree of monetary conservatism also has important direct consequences for the fiscal authority's ability to smooth government spending across states. By decreasing the central bank's willingness to use inflation to adjust real debt payments in response to fiscal shocks, the appointment of a monetary conservative central banker tends to result in more volatile fiscal policy since a more stable inflation rate implies a reduced role for inflation as a shock absorber. In addition, the increase in average debt additionally raises the volatility of fiscal policy by making borrowing conditions react more sensitively to adverse shocks. For low α-values, this increased sensitivity not only increases the volatility of government spending but also the volatility of inflation relative to the baseline scenario without delegated monetary policy.

4.3 Welfare Analysis

Given the results of the previous section, the welfare effects of delegated monetary policy are not obvious. While monetary conservatism tends to lower the mean and variance of inflation if it is strong enough, it also leads to more frequent default events that are associated with temporary periods of costly autarky. In addition, it tends to be associated with more volatile public spending which has an adverse impact on household welfare as well.

To quantify the welfare implications of monetary policy delegation, I calculate the measure λ. It is the percentage increase in public consumption that households in an economy without central bank independence need to be given in each period to achieve the same welfare as in the respective economy with monetary conservatism of degree α, where household welfare is given by

$$\mathcal{U} = \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t U(g_t, \pi_t) \right],$$

with

$$U(g_t, \pi_t) = u(g_t) - \psi(\pi_t).$$

Figure 5 shows that the relationship between α and λ is an inverse hump-shaped one.[38] When monetary policy is delegated to a central banker who is not more inflation averse than the fiscal authority ($\alpha = 1/\theta$), welfare goes up relative to the baseline scenario. However, as the degree of conservatism is increased, the welfare gain declines and even becomes negative until it recovers and eventually exceeds the λ-value at $\alpha = 1/\theta$. The relationship between α and λ reflects the one between the degree of monetary conservatism and the average debt burden, which in turn governs the impact of α on the mean and variance of inflation, as well as its effect on the volatility of public spending.[39] For low α-values, the economy experiences much more volatile public spending and even the standard deviation of inflation increases. Since the inflation rate declines only slightly in this case, if at all, there is a net welfare loss of monetary policy delegation. As α is further increased, the mean and variance of inflation are brought down, whereas the volatility of g does not respond much, explaining the increase in λ.

For the model, the optimal degree of monetary conservatism involves a central banker who completely stabilizes inflation to zero ($\alpha \to \infty$), resulting in a welfare gain of $\lambda = 1.45\%$. As discussed earlier in the paper, one can imagine that the economy faces an upper bound on α which

[38] The unconditional expectation of discounted life-time utility $\mathcal{U}$ is calculated by computing the sum of discounted simulated utilities for 2000 periods, based on unfiltered simulated time series, and taking the average value over 1000 samples, where the first 500 observations were again discarded for each sample to reduce the role of initial conditions.

[39] The impact of α on average public spending is negative but of negligible size.

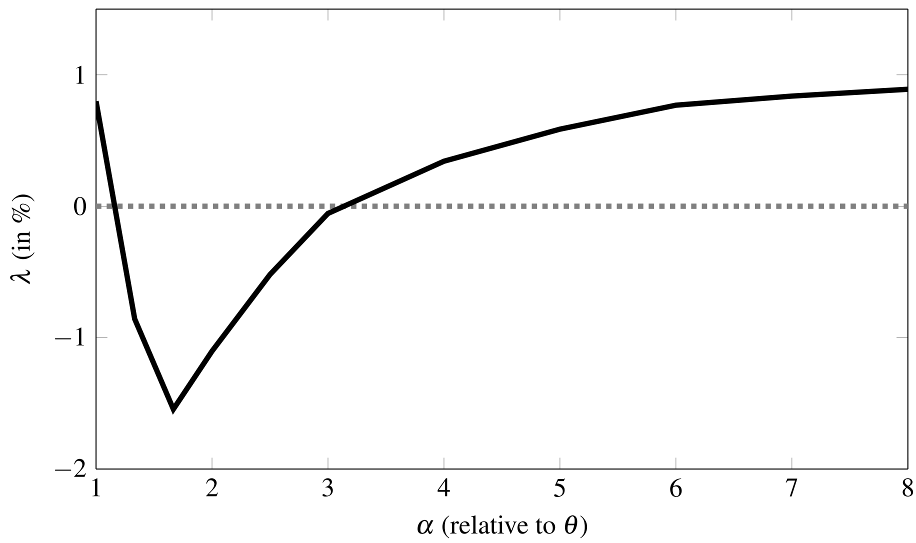

Figure 5: Welfare measure λ (in %) for the baseline model

represents the most inflation averse monetary policy regime that is politically feasible and sustainable. Given the inverse hump-shaped welfare profile, it might then be the case that countries which face strong political limits to central bank independence, i.e. a low or intermediate upper bound on α, are in fact better off not delegating monetary policy at all or to a central banker who is not more inflation averse than the fiscal authority. When a central bank reform is implemented, its success thus crucially depends on whether the central bank is allowed to be sufficiently tough on inflation.

The welfare results discussed so far are consistent with Nuño and Thomas (2018)'s finding that the gains from eliminating the time-inconsistency problem related to inflation dominate the costs of having a less flexible monetary policy. In this paper however, the superiority of such an unresponsive monetary policy regime holds in a setting where the fiscal authority is not benevolent due to political economy distortions. Whether it also holds in the absence of political economy frictions will be covered in the following subsection.

The Role of Political Frictions To understand the importance of the political economy distortions for the welfare results, I will now consider two alternative model versions where political frictions are either completely absent ($\theta = \mu = 1$) or partially absent ($\theta > 1$, $\mu = 1$).[40] Since the model requires political disagreement ($\theta > 1$) and turnover risk ($\mu < 1$) to generate a strong deficit bias, adjustments are needed to ensure the government still issues realistic amounts of debt for these model versions. To achieve this, I make the standard assumption that the small open economy is much more impatient than foreign investors. For comparability, the parameters β, τ^d and χ are chosen to roughly match the same long-run values for average debt, inflation and the frequency of default as in the baseline

[40]The latter case is similar to that studied by Martin (2015) whose model assumes that fiscal policy makers do not face turnover risk and derive additional utility from a public good due to rent-seeking activities, whereas the central bank might not.

	$\alpha = \alpha_\theta$	$\alpha = 2\alpha_\theta$	$\alpha = 3\alpha_\theta$	$\alpha = 5\alpha_\theta$	$\alpha = 8\alpha_\theta$	$\alpha \to \infty$
$\theta > 1$, $\mu < 1$	0.7990	-1.1029	-0.0548	0.5865	0.8901	1.4504
$\theta > 1$, $\mu = 1$	0	-0.2035	0.8067	1.5276	1.8874	2.3569
$\theta = 1$	0	-1.1256	-0.8797	-0.6581	-0.5170	-0.1313
$\theta = 1$ ($\sigma = 0.01$)	0	0.3320	0.4666	0.5317	0.6414	0.9986

Table 3: Welfare measure λ (in %) for the baseline model ($\theta > 1$, $\mu < 1$), the model version without turnover risk ($\theta > 1$, $\mu = 1$) and model versions without political economy distortions ($\theta = 1$)

scenario without delegated monetary policy.[41] The remaining model parameters from Section 4 are kept unchanged.

The welfare results are presented in Table 3. All model versions exhibit an inverse hump-shaped λ-α-profile, which reflects that the positive model implications of monetary conservatism are very similar across model version.[42] If there is disagreement between the political parties but no turnover risk (second row), the welfare profile is qualitatively similar to that in the model with political turnover (first row). An exception is $\alpha = \alpha_\theta$ since the policy authorities have the same objectives in this case, even when monetary policy is delegated. The size of the welfare gains in the model without turnover risk is however higher since the increase in average debt issuance now reflects the households' time preference and not the fiscal authority's present bias. This illustrates that the borrowing motive matters when assessing the costs and benefits of monetary conservatism. A comparison between the model versions with and without political disagreement shows that it is also important to know the origin of the inflation bias to properly assess the welfare effects of monetary conservatism. The key observation is that the welfare measure is always negative for the model version without political frictions (third row). From the perspective of the households, it is hence welfare reducing to appoint a monetary conservative central banker when the fiscal authority is benevolent. If the initial ("pre-reform") inflation rate thus is high but due to society's preferences and not because of the non-benevolent preferences of the incumbent party, the economy is better off without central bank independence. The findings hence illustrate that the motive to borrow and the motive to use inflation are both important when evaluating the desirability of monetary conservatism.[43]

The Role of Revenue Volatility A key difference between emerging and developed economies is that the former tend to experience more macroeconomic volatility than the latter. The question of whether the results presented in the previous subsection extend to economies with less volatile shocks then naturally arises. The intuition for why this might not necessarily be the case is as follows (see also Nuño and Thomas, 2018). When economies face less volatile fiscal shocks, the importance of inflation as a shock absorber diminishes, which can increase the value of monetary

[41] The new parameter values are $\beta = 0.894$ and $\tau^d = 0.883$ for both model versions as well as $\chi = 1.643$ for the model version without political frictions.

[42] The positive results for the alternative model versions are relegated to Appendix A.3 for brevity (see Table 4 and 5).

[43] Another model version with $\theta = \mu = 1$ where households and the central bank have a higher discount factor than the fiscal authority (0.9224 vs. 0.893), similar to Niemann (2011), delivers positive results close to the model without political frictions. Unsurprisingly, the welfare costs of delegation are however higher in this case, underscoring the importance of the borrowing motive.

conservatism when the economy faces no or little political distortions. The last row of Table 3 shows that this intuition indeed applies. It presents λ for a model version without political frictions where the standard deviation of revenue shocks is lower ($\sigma = 0.01$).[44] This result is consistent with the findings of Nuño and Thomas (2018) who show for a related model without political frictions that the gains of completely eliminating the inflation bias dominate the costs of having a less flexible monetary policy. As in this paper, Nuño and Thomas (2018) also find that the net-welfare effects can be negative if the degree of macroeconomic volatility faced by the economy is high. In their case, unrealistically volatile shocks are however needed to obtain such negative welfare effects. Since their continuous-time modeling approach relies on logarithmic preferences for household consumption, it might however underestimate the households' degree of risk aversion.

5 Conclusion

This paper has studied the effectiveness and desirability of monetary conservatism by using a model that accounts for three frictions that matter for many emerging economies: (i) incomplete financial markets, (ii) default risk, and (iii) political economy distortions. In the model, fiscal policy is set by a fiscal authority that exhibits a deficit bias and is unable to commit to future policies. Monetary policy is chosen by a central bank that also lacks commitment and might care more about inflation than the fiscal authority and society. The paper has shown that the delegation of monetary policy to an inflation conservative central banker can successfully reduce the mean and variance of inflation but tends to be associated with a higher average debt burden, more frequent default episodes and more volatile fiscal policy. A welfare analysis has shown that the benefits of lower and more stable inflation can outweigh the costs of having a more volatile fiscal policy, depending on the degree of inflation conservatism, the amount of political distortions and the volatility of fiscal shocks.

[44] For comparability, the model is re-calibrated to match the same average values for the debt position, the default frequency and inflation as in the respective model version with more volatile shocks. The welfare results however also hold when all parameters except for σ are kept unchanged.

A Appendix

A.1 First-Order Conditions for the Policy Problems

I will first cover the decision problem of the central bank and then derive the first-order condition associated with the fiscal policy problem.[45] Before doing so, I introduce the notation $s \equiv (b, \tau)$and $\hat{s} \equiv (\pi, s)$.

Central Bank The first-order condition for the central bank's problem is

$$\frac{\partial \hat{\mathcal{M}}^r(\hat{s})}{\partial \pi} = 0,$$

or

$$u_g(g)\frac{\partial \hat{\mathcal{G}}^r(\hat{s})}{\partial \pi} - \alpha \psi_\pi(\pi) + \beta \begin{pmatrix} \mathbb{E}_{\tau'|\tau,\tau' \geq \hat{\tau}(b')}\left[\frac{\partial \mathcal{M}^r(s')}{\partial b'}\right] \\ +\mathbb{E}_{\tau'|\tau,\tau' < \hat{\tau}(b')}\left[\frac{\partial \mathcal{M}^d(s')}{\partial b'}\right] \\ +\Delta'_{\mathcal{M}}\frac{\partial \hat{\tau}(b')}{\partial b'} f(\hat{\tau}(b')|\tau) \end{pmatrix} \frac{\partial \hat{\mathcal{B}}^r(\hat{s})}{\partial \pi} = 0, \tag{30}$$

with

$$\Delta_{\mathcal{M}} = \mathcal{M}^d(b, \hat{\tau}(b)) - \mathcal{M}^r(b, \hat{\tau}(b)).$$

For the central bank, the value $\mathcal{M}^r(s)$ satisfies

$$\mathcal{M}^r(s) = u(\mathcal{G}^r(s)) - \alpha \psi(\Pi^r(s)) + \beta \mathbb{E}_{\tau'|\tau}\left[\mathcal{M}(\mathcal{B}^r(s), \tau')\right].$$

Differentiating $\mathcal{M}^r(s)$ with respect to b yields

$$\begin{aligned} \frac{\partial \mathcal{M}^r(s)}{\partial b} \quad &= \quad u_g(g)\frac{\partial \mathcal{G}^r(s)}{\partial b} - \alpha \psi_\pi(\pi)\frac{\partial \Pi^r(s)}{\partial b} \\ &\quad + \beta \begin{pmatrix} \mathbb{E}_{\tau'|\tau,\tau' \geq \hat{\tau}(b')}\left[\frac{\partial \mathcal{M}^r(s')}{\partial b'}\right] \\ +\mathbb{E}_{\tau'|\tau,\tau' < \hat{\tau}(b')}\left[\frac{\partial \mathcal{M}^d(s')}{\partial b'}\right] \\ +\Delta'_{\mathcal{M}}\frac{\partial \hat{\tau}(b')}{\partial b'} f(\hat{\tau}(b')|\tau) \end{pmatrix} \frac{\partial \mathcal{B}^r(s)}{\partial b}. \end{aligned} \tag{31}$$

By using the first-order condition (30) to replace last term on the RHS of condition (31), one obtains

$$\frac{\partial \mathcal{M}^r(s)}{\partial b} = u_g(g)\frac{\partial \mathcal{G}^r(s)}{\partial b} - \alpha \psi_\pi(\pi)\frac{\partial \Pi^r(s)}{\partial b} - \left(u_g(g)\frac{\partial \hat{\mathcal{G}}^r(\hat{s})}{\partial \pi} - \alpha \psi_\pi(\pi)\right)\frac{\frac{\partial \mathcal{B}^r(s)}{\partial b}}{\frac{\partial \hat{\mathcal{B}}^r(\hat{s})}{\partial \pi}}.$$

[45] The derivations share similarities with those in Cuadra and Sapriza (2008) and Niemann, Pichler, and Sorger (2013) who derive Euler equations for models with political frictions or monetary-fiscal policy interactions, respectively (see Section 1 for details).

By using the conditions

$$
\begin{aligned}
\frac{\partial \hat{\mathcal{G}}^r(\hat{s})}{\partial \pi} &= \pi^{-2}(\kappa+\delta q\left(b',\tau\right))b+\Delta_q \frac{\partial \hat{\mathcal{B}}^r(\hat{s})}{\partial \pi}, &(32)\\
\frac{\partial \mathcal{G}^r(s)}{\partial b} &= \pi^{-2}(\kappa+\delta q\left(b',\tau\right))b\frac{\partial \Pi^r(s)}{\partial b}-\Delta_b+\Delta_q \frac{\partial \mathcal{B}^r(s)}{\partial b}, &(33)
\end{aligned}
$$

which are derived by differentiating the government budget constraint with respect to π and b, this condition can further be rewritten as

$$
\begin{aligned}
\frac{\partial \mathcal{M}^r(s)}{\partial b} &= u_g(g)\left(\pi^{-2}(\kappa+\delta q\left(b',\tau\right))b\frac{\partial \Pi^r(s)}{\partial b}-\Delta_b+\Delta_q \frac{\partial \mathcal{B}^r(s)}{\partial b}\right)-\alpha\psi_\pi(\pi)\frac{\partial \Pi^r(s)}{\partial b}\\
&\quad -\left(u_g(g)\left(\pi^{-2}(\kappa+\delta q\left(b',\tau\right))b+\Delta_q \frac{\partial \hat{\mathcal{B}}^r(\hat{s})}{\partial \pi}\right)-\alpha\psi_\pi(\pi)\right)\frac{\frac{\partial \mathcal{B}^r(s)}{\partial b}}{\frac{\partial \hat{\mathcal{B}}^r(\hat{s})}{\partial \pi}},
\end{aligned}
$$

or

$$
\frac{\partial \mathcal{M}^r(s)}{\partial b} = -u_g(g)\Delta_b+\Delta_\alpha\left(\frac{\partial \Pi^r(s)}{\partial b}-\frac{\frac{\partial \mathcal{B}^r(s)}{\partial b}}{\frac{\partial \hat{\mathcal{B}}^r(\hat{s})}{\partial \pi}}\right). \tag{34}
$$

As in Section 3, I use the definitions

$$
\begin{aligned}
\Delta_\alpha &\equiv u_g(g)\pi^{-2}(\kappa+\delta q\left(b',\tau\right))b-\alpha\psi_\pi(\pi),\\
\Delta_b &\equiv \pi^{-1}\left(\kappa+\delta \mathcal{Q}^r(b,\tau)\right),\\
\Delta_q &\equiv q\left(b',\tau\right)+\frac{\partial q\left(b',\tau\right)}{\partial b'}\left(b'-\pi^{-1}\delta b\right).
\end{aligned}
$$

By eliminating $\partial \hat{\mathcal{G}}(\hat{s})/\partial \pi$ in (30) via (32), one obtains

$$
\Delta_\alpha+u_g(g)\Delta_q\frac{\partial \hat{\mathcal{B}}^r(\hat{s})}{\partial \pi}+\beta\left(\begin{array}{c}\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\frac{\partial \mathcal{M}^r(s')}{\partial b'}\right]\\ +\mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\frac{\partial \mathcal{M}^d(s')}{\partial b'}\right]\\ +\Delta'_{\mathcal{M}}\frac{\partial \hat{\tau}(b')}{\partial b'}f(\hat{\tau}(b')|\tau)\end{array}\right)\frac{\partial \hat{\mathcal{B}}^r(\hat{s})}{\partial \pi}=0. \tag{35}
$$

After updating (34) one period ahead and using it to eliminate $\partial \mathcal{M}^r(s')/\partial b'$ in (35), one arrives at

$$
\begin{aligned}
0 &= \Delta_\alpha+u_g(g)\Delta_q\frac{\partial \hat{\mathcal{B}}^r(\hat{s})}{\partial \pi}\\
&\quad +\beta\left(\mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\frac{\partial \mathcal{M}^d(s')}{\partial b'}\right]+\Delta'_{\mathcal{M}}\frac{\partial \hat{\tau}(b')}{\partial b'}f(\hat{\tau}(b')|\tau)\right)\frac{\partial \hat{\mathcal{B}}^r(\hat{s})}{\partial \pi}\\
&\quad -\beta\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[u_g\left(g'\right)\Delta'_b-\Delta'_\alpha\left(\frac{\partial \Pi^r(s')}{\partial b'}-\frac{\frac{\partial \mathcal{B}^r(s')}{\partial b'}}{\frac{\partial \hat{\mathcal{B}}^r(\hat{s}')}{\partial \pi'}}\right)\right]\frac{\partial \hat{\mathcal{B}}^r(\hat{s})}{\partial \pi},
\end{aligned}
$$

which is the Euler equation for the central bank presented in Section 3.

Fiscal Authority The first-order condition for the fiscal policy problem is given by

$$0=\theta u_g(g)\Delta_q+\beta\left(\begin{array}{c}\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\begin{array}{c}\mu\frac{\partial\mathcal{F}^r(s')}{\partial b'}\\+(1-\mu)\frac{\partial\mathcal{F}^{*r}(s')}{\partial b'}\end{array}\right]\\+\mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\begin{array}{c}\mu\frac{\partial\mathcal{F}^d(s')}{\partial b'}\\+(1-\mu)\frac{\partial\mathcal{F}^{*d}(s')}{\partial b'}\end{array}\right]\\+(1-\mu)\Delta'_{\mathcal{F}^*}\frac{\partial\hat{\tau}(b')}{\partial b'}f(\hat{\tau}(b')|\tau)\end{array}\right),\tag{36}$$

with

$$\Delta_{\mathcal{F}^*}=\mathcal{F}^{*d}(b,\hat{\tau}(b))-\mathcal{F}^{*r}(b,\hat{\tau}(b)).$$

The value $\mathcal{F}^r(s)$ satisfies

$$\mathcal{F}^r(s)=\theta u(\mathcal{G}^r(s))-\psi(\Pi(s))+\beta\mathbb{E}_{\tau'|\tau'}\left[\begin{array}{c}\mu\mathcal{F}(\mathcal{B}^r(s),\tau')\\+(1-\mu)\mathcal{F}^*(\mathcal{B}^r(s),\tau')\end{array}\right].$$

Differentiating $\mathcal{F}^r(s)$ with respect to b yields

$$\begin{aligned}\frac{\partial\mathcal{F}^r(s)}{\partial b} &= \theta u_g(g)\frac{\partial\mathcal{G}^r(s)}{\partial b}-\psi_\pi(\pi)\frac{\partial\Pi^r(s)}{\partial b}\\ &\quad+\beta\left(\begin{array}{c}\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\begin{array}{c}\mu\frac{\partial\mathcal{F}^r(s')}{\partial b'}\\+(1-\mu)\frac{\partial\mathcal{F}^{*r}(s')}{\partial b'}\end{array}\right]\\+\mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\begin{array}{c}\mu\frac{\partial\mathcal{F}^d(s')}{\partial b'}\\+(1-\mu)\frac{\partial\mathcal{F}^{*d}(s')}{\partial b'}\end{array}\right]\\+(1-\mu)\Delta'_{\mathcal{F}^*}\frac{\partial\hat{\tau}(b')}{\partial b'}f(\hat{\tau}(b')|\tau)\end{array}\right)\frac{\partial\mathcal{B}^r(s)}{\partial b}.\end{aligned}\tag{37}$$

Using the first-order condition (36), (37) can be written as

$$\frac{\partial\mathcal{F}^r(s)}{\partial b}=\theta u_g(g)\frac{\partial\mathcal{G}^r(s)}{\partial b}-\psi_\pi(\pi)\frac{\partial\Pi^r(s)}{\partial b}-\theta u_g(g)\Delta_q\frac{\partial\mathcal{B}^r(s)}{\partial b}.$$

When combined with (33), this expression can be written as

$$\begin{aligned}\frac{\partial\mathcal{F}^r(s)}{\partial b} &= \theta u_g(g)\left(\pi^{-2}(\kappa+\delta q(b',\tau))b\frac{\partial\Pi^r(s)}{\partial b}-\Delta_b+\Delta_q\frac{\partial\mathcal{B}^r(s)}{\partial b}\right)\\ &\quad-\psi_\pi(\pi)\frac{\partial\Pi^r(s)}{\partial b}-\theta u_g(g)\Delta_q\frac{\partial\mathcal{B}^r(s)}{\partial b},\end{aligned}$$

which reduces to

$$\frac{\partial\mathcal{F}^r(s)}{\partial b}=\Delta_\theta\frac{\partial\Pi^r(s)}{\partial b}-\theta u_g(g)\Delta_b,\tag{38}$$

when using the definition $\Delta_\theta \equiv \theta u_g(g)\pi^{-2}(\kappa+\delta q(b',\tau))b - \psi_\pi(\pi)$ from Section 3. For the party currently not in office, the value $\mathcal{F}^{*r}(s)$ satisfies

$$\mathcal{F}^{*r}(s) = u(\mathcal{G}^r(s)) - \psi(\Pi^r(s)) + \beta \mathbb{E}_{\tau'|\tau}\left[\begin{array}{c}\mu \mathcal{F}^*(\mathcal{B}^r(s),\tau') \\ +(1-\mu)\mathcal{F}(\mathcal{B}^r(s),\tau')\end{array}\right].$$

Differentiating $\mathcal{F}^{*r}(s)$ with respect to b yields

$$\begin{aligned}\frac{\partial \mathcal{F}^{*r}(s)}{\partial b} &= u_g(g)\frac{\partial \mathcal{G}^r(s)}{\partial b} - \psi_\pi(\pi)\frac{\partial \Pi^r(s)}{\partial b} \\ &\quad +\beta\left(\begin{array}{c}\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\begin{array}{c}\mu\frac{\partial \mathcal{F}^{*r}(s')}{\partial b'} \\ +(1-\mu)\frac{\partial \mathcal{F}^r(s')}{\partial b'}\end{array}\right] \\ +\mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\begin{array}{c}\mu\frac{\partial \mathcal{F}^{*d}(s')}{\partial b'} \\ +(1-\mu)\frac{\partial \mathcal{F}^d(s')}{\partial b'}\end{array}\right] \\ +\mu\Delta'_{\mathcal{F}^*}\frac{\partial\hat{\tau}(b')}{\partial b'}f(\hat{\tau}(b')|\tau)\end{array}\right)\frac{\partial \mathcal{B}^r(s)}{\partial b}.\end{aligned} \tag{39}$$

By rewriting the first-order condition (36), one obtains the expression

$$\begin{aligned}&\beta\left(\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\frac{\partial \mathcal{F}^{*r}(s')}{\partial b'}\right] + \mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\frac{\partial \mathcal{F}^{*d}(s')}{\partial b'}\right] + \Delta'_{\mathcal{F}^*}\frac{\partial\hat{\tau}(b')}{\partial b'}f(\hat{\tau}(b')|\tau)\right) \\ &= \frac{1}{1-\mu}\left[-\theta u_g(g)\Delta_q - \beta\mu\left(\begin{array}{c}\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\frac{\partial \mathcal{F}^r(s')}{\partial b'}\right] \\ +\mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\frac{\partial \mathcal{F}^d(s')}{\partial b'}\right]\end{array}\right)\right].\end{aligned} \tag{40}$$

Inserting (40) into (39) yields

$$\begin{aligned}\frac{\partial \mathcal{F}^{*r}(s)}{\partial b} &= u_g(g)\frac{\partial \mathcal{G}^r(s)}{\partial b} - \psi_\pi(\pi)\frac{\partial \Pi^r(s)}{\partial b} \\ &\quad + \left[\begin{array}{c}\frac{\mu}{1-\mu}\left[-\theta u_g(g)\Delta_q - \beta\mu\left(\begin{array}{c}\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\frac{\partial \mathcal{F}^r(s')}{\partial b'}\right] \\ +\mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\frac{\partial \mathcal{F}^d(s')}{\partial b'}\right]\end{array}\right)\right] \\ +(1-\mu)\beta\left(\begin{array}{c}\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\frac{\partial \mathcal{F}^r(s')}{\partial b'}\right] \\ +\mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\frac{\partial \mathcal{F}^d(s')}{\partial b'}\right]\end{array}\right)\end{array}\right]\frac{\partial \mathcal{B}^r(s)}{\partial b}\end{aligned}$$

which reduces to

$$\begin{aligned}\frac{\partial \mathcal{F}^{*r}(s)}{\partial b} &= u_g(g)\frac{\partial \mathcal{G}^r(s)}{\partial b} - \psi_\pi(\pi)\frac{\partial \Pi^r(s)}{\partial b} - \mu\frac{\theta u_g(g)}{1-\mu}\Delta_q\frac{\partial \mathcal{B}^r(s)}{\partial b} \\ &\quad +\beta\frac{1-2\mu}{1-\mu}\left(\begin{array}{c}\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\frac{\partial \mathcal{F}^r(s')}{\partial b'}\right] \\ +\mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\frac{\partial \mathcal{F}^d(s')}{\partial b'}\right]\end{array}\right)\frac{\partial \mathcal{B}^r(s)}{\partial b}.\end{aligned}$$

With (38), this expression can further be written as

$$
\begin{aligned}
\frac{\partial \mathcal{F}^{*r}(s)}{\partial b} &= u_g(g)\frac{\partial \mathcal{G}^r(s)}{\partial b} - \psi_\pi(\pi)\frac{\partial \Pi^r(s)}{\partial b} - \mu\frac{\theta u_g(g)}{1-\mu}\Delta_q\frac{\partial \mathcal{B}^r(s)}{\partial b} \\
&\quad + \beta\frac{1-2\mu}{1-\mu}\left(\begin{array}{c} \mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\Delta'_\theta\frac{\partial \Pi^r(s')}{\partial b'} - \theta u_g(g')\Delta'_b\right] \\ + \mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\frac{\partial \mathcal{F}^d(s')}{\partial b'}\right] \end{array}\right)\frac{\partial \mathcal{B}^r(s)}{\partial b}.
\end{aligned} \tag{41}
$$

Updating (38) and (41) one period ahead and inserting the resulting expressions into the first-order condition (36) leads to

$$
\begin{aligned}
0 &= \theta u_g(g)\Delta_q + \beta\mu\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\Delta'_\theta\frac{\partial \Pi^r(s')}{\partial b'} - \theta u_g(g')\Delta'_b\right] \\
&\quad + \beta\mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\mu\frac{\partial \mathcal{F}^d(s')}{\partial b'} + (1-\mu)\frac{\partial \mathcal{F}^{*d}(s')}{\partial b'}\right] + \beta(1-\mu)\Delta_{\mathcal{F}^*}\frac{\partial \hat{\tau}(b')}{\partial b'}f(\hat{\tau}(b')|\tau) \\
&\quad + \beta(1-\mu)\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\begin{array}{c} u_g(g')\frac{\partial \mathcal{G}^r(s')}{\partial b'} - \psi_\pi(\pi')\frac{\partial \Pi^r(s')}{\partial b'} - \mu\frac{\theta u_g(g')}{1-\mu}\Delta'_q\frac{\partial \mathcal{B}^r(s')}{\partial b'} \\ + \beta\frac{1-2\mu}{1-\mu}\left(\begin{array}{c} \mathbb{E}_{\tau''|\tau',\tau''\geq\hat{\tau}(b'')}\left[\Delta''_\theta\frac{\partial \Pi^r(s'')}{\partial b''} - \theta u_g(g'')\Delta''_b\right] \\ + \mathbb{E}_{\tau''|\tau',\tau''<\hat{\tau}(b'')}\left[\frac{\partial \mathcal{F}^d(s'')}{\partial b''}\right] \end{array}\right)\frac{\partial \mathcal{B}^r(s')}{\partial b'} \end{array}\right].
\end{aligned}
$$

After rearranging this condition a little bit, one finally arrives at the Euler equation for the fiscal authority:

$$
\begin{aligned}
0 &= \theta u_g(g)\Delta_q \\
&\quad - \mu\beta\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\theta u_g(g')\Delta'_b - \Delta'_\theta\frac{\partial \Pi^r(s')}{\partial b'}\right] \\
&\quad + (1-\mu)\beta\left(\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[u_g(g')\frac{\partial \mathcal{G}^r(s')}{\partial b'} - \psi_\pi(\pi')\frac{\partial \Pi^r(s')}{\partial b'}\right] + \Delta'_{\mathcal{F}^*}\frac{\partial \hat{\tau}(b')}{\partial b'}f(\hat{\tau}(b')|\tau)\right) \\
&\quad - \mu\beta\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\theta u_g(g')\Delta'_q\frac{\partial \mathcal{B}^r(s')}{\partial b'}\right] \\
&\quad + (2\mu-1)\beta\mathbb{E}_{\tau'|\tau,\tau'\geq\hat{\tau}(b')}\left[\left(\begin{array}{c} \beta\mathbb{E}_{\tau''|\tau',\tau''\geq\hat{\tau}(b'')}\left[\theta u_g(g'')\Delta''_b - \Delta''_\theta\frac{\partial \Pi^r(s'')}{\partial b''}\right] \\ + \beta\mathbb{E}_{\tau''|\tau',\tau''<\hat{\tau}(b'')}\left[\frac{\partial \mathcal{F}^d(s'')}{\partial b''}\right] \end{array}\right)\frac{\partial \mathcal{B}^r(s')}{\partial b'}\right] \\
&\quad + \beta\mathbb{E}_{\tau'|\tau,\tau'<\hat{\tau}(b')}\left[\mu\frac{\partial \mathcal{F}^d(s')}{\partial b'} + (1-\mu)\frac{\partial \mathcal{F}^{*d}(s')}{\partial b'}\right].
\end{aligned}
$$

A.2 Numerical Solution

The numerical solution algorithm builds on Hatchondo, Martinez, and Sapriza (2010) who use value function iteration with interpolation and global optimization methods to solve a standard sovereign default model as in Arellano (2008). More specifically, I extend their approach to a setting with two optimizing authorities. The task of the algorithm is to compute the functions $\mathcal{X}^r(b,\tau)$, $\mathcal{X} \in \{\mathcal{F},\mathcal{F}^*,\mathcal{M},\mathcal{B},\mathcal{G},\Pi,\mathcal{Q}\}$, and $\mathcal{X}^d(b,\tau), \mathcal{X} \in \{\mathcal{F},\mathcal{F}^*,\mathcal{M},\mathcal{G},\Pi,\mathcal{Q}\}$. I approximate these functions on discrete grids for debt and tax revenues, using Chebyshev interpolation for function evaluations at off-grid values for b and linear interpolation for τ-values that are off-grid.

Solution Algorithm The numerical solution algorithm consists of the following steps:

1. Construct discrete grids for debt $[\underline{b}, \overline{b}]$, tax revenues $[\underline{\tau}, \overline{\tau}]$ and inflation $[\underline{\pi}, \overline{\pi}]$.
2. Choose initial values for the policy and value functions $\mathcal{X}^r_{start}(b,\tau)$ and $\mathcal{X}^d_{start}(b,\tau)$, $\mathcal{X} \in \{\mathcal{F}, \mathcal{F}^*, \mathcal{M}, \mathcal{G}, \Pi, \mathcal{Q}\}$, at all grid points $(b,\tau) \in [\underline{b}, \overline{b}] \times [\underline{\tau}, \overline{\tau}]$.
3. Set $\mathcal{X}^j_{next} = \mathcal{X}^j_{start}$, $j \in \{r,d\}$ and fix an error tolerance ε.
   (a) For each grid point combination $(\pi, b, \tau) \in [\underline{\pi}, \overline{\pi}] \times [\underline{b}, \overline{b}] \times [\underline{\tau}, \overline{\tau}]$, compute the policies $\tilde{\mathcal{B}}^r(\pi, b, \tau)$ and $\hat{\mathcal{G}}^r(\pi, b, \tau)$ that solve the fiscal policy problem, and calculate the associated values for $\hat{\mathcal{X}}^r(\pi, b, \tau)$, $\mathcal{X} \in \{\mathcal{F}, \mathcal{F}^*, \mathcal{M}\}$.
   (b) For each grid point combination $(b,\tau) \in [\underline{b}, \overline{b}] \times [\underline{\tau}, \overline{\tau}]$, compute the inflation rate $\Pi^r_{new}(b,\tau)$ that solves the monetary policy problem, given the fiscal authority's optimal response functions computed in step 3a, and calculate the associated values for $\mathcal{X}^r_{new}(b,\tau)$, $\mathcal{X} \in \{\mathcal{F}, \mathcal{F}^*, \mathcal{M}, \mathcal{B}, \mathcal{G}, \mathcal{Q}\}$.
   (c) For each grid point combination $(b,\tau) \in [\underline{b}, \overline{b}] \times [\underline{\tau}, \overline{\tau}]$, calculate the bond price $\mathcal{Q}^d_{new}(b,\tau)$, and compute the policies $\mathcal{G}^d_{new}(b,\tau)$ and $\Pi^d_{new}(b,\tau)$ that satisfy the optimality conditions $\alpha\psi_\pi(\Pi^d_{new}(b,\tau)) = 0$ and $\mathcal{G}^d_{new}(b,\tau) = \tau - \phi(\tau)$, as well as the associated values for $\mathcal{X}^d_{new}(b,\tau)$, $\mathcal{X} \in \{\mathcal{F}, \mathcal{F}^*, \mathcal{M}\}$.
   (d) If $\left|\mathcal{X}^j_{new}(b,\tau) - \mathcal{X}^j_{next}(b,\tau)\right| < \varepsilon$, $\mathcal{X} \in \{\mathcal{F}, \mathcal{F}^*, \mathcal{M}, \mathcal{G}, \Pi, \mathcal{Q}\}$, $j \in \{r,d\}$, for all grid point combinations, go to step 4, else set $\mathcal{X}^j_{next} = \mathcal{X}^j_{new}$, $j \in \{r,d\}$ and repeat step 3.
4. Take $\mathcal{X}^j_{new}(\cdot)$, $j \in \{r,d\}$, as approximations of the respective equilibrium objects in the infinite-horizon economy.

Discussion The debt and inflation grids are constructed using Chebyshev nodes, whereas an equidistant grid is used for tax revenues. The bounds for the discrete grids $[\underline{\pi}, \overline{\pi}]$ and $[\underline{b}, \overline{b}]$ are chosen such that the optimal inflation and debt choices always are interior. For the tax revenue grid $[\underline{\tau}, \overline{\tau}]$, the bounds are set to $\pm 4\sigma_\tau$, with $\sigma_\tau = \sigma/\sqrt{1-\rho^2}$. The convergence criterion is $\varepsilon = 10^{-5}$.

Following Hatchondo, Martinez, and Sapriza (2010), I solve for the infinite-horizon limit of a finite-horizon model version. I thus first compute the value and policy functions for the final period problem where no borrowing decision is made and use the resulting objects as initial values $\mathcal{X}^j_{start}$, $j \in \{r,d\}$, for step 2. Note that in the final period, the central bank can effectively choose government spending g via the government budget constraint: $g = \tau - \pi^{-1}\kappa b$. Since no debt can be issued in the final period, the initial values for the equilibrium bond prices are set to zero for all grid point combinations.

For step 3a, the debt policy $\hat{\mathcal{B}}^r(\pi, b, \tau)$ is computed via a global non-linear optimizing routine. First, the algorithm performs a grid search over a pre-defined grid for b'. Then, the solution to this grid search is used as an initial guess for a non-linear derivative-free numerical optimizer. The optimization step delivers values for $\hat{\mathcal{M}}^r(\cdot)$, $\hat{\mathcal{F}}^r(\cdot)$ and $\hat{\mathcal{F}}^{*r}(\cdot)$ that are associated with the optimal debt and government spending response functions $\hat{\mathcal{G}}^r(\cdot)$ and $\hat{\mathcal{B}}^r(\cdot)$.

Given the response functions and continuation values obtained in step 3a, step 3b computes the inflation policy $\Pi^r_{new}(b,\tau)$ that solves the central bank problem for each grid point combination (b,τ) $\in [\underline{b},\overline{b}] \times [\underline{\tau},\overline{\tau}]$. The optimal inflation policy is computed similarly to the debt policy by first obtaining an initial guess via a grid search that is then used as input for a non-linear optimizer. Chebyshev collocation is again used to evaluate functions at off-grid inflation values. Using the inflation policy $\Pi^r_{new}(b,\tau)$, the equilibrium fiscal policies and continuation values are computed by evaluating the functions $\hat{\mathcal{X}}^r(\pi,b,\tau)$, $\mathcal{X} \in \{\mathcal{F},\mathcal{F}^*,\mathcal{M},\mathcal{B},\mathcal{G}\}$, at $(\Pi^r_{new}(b,\tau),b,\tau)$. The equilibrium bond price for the repayment case is computed by evaluating the bond schedule $q(b',\tau)$ at the equilibrium debt policy $\mathcal{B}^r_{new}(b,\tau)$.

In periods of default and autarky, the central bank cannot affect the way fiscal policy is conducted. As a result, the inflation and spending policies always satisfy the conditions $\alpha\psi_\pi(\Pi^d_{new}(b,\tau)) = 0$ and $\mathcal{G}^d_{new}(b,\tau) = \tau - \phi(\tau)$ in this case (see Step 3c). Note that in contrast to the fiscal policies, bond prices and value functions will vary with the beginning-of-period debt position in the default case since they satisfy functional equations that depend on future debt.

When computing expected values for steps 3a and 3c, it is important to account for the discontinuity generated by the discrete default decision. To illustrate this, take a look at the continuation value for the central bank in the repayment case:

$$\mathbb{E}_{\tau'|\tau}\left[\mathcal{M}_{next}(b',\tau')\right] = \int_0^{\hat{\tau}(b')} \mathcal{M}^d_{next}(b',\tau')f(\tau'|\tau)d\tau' + \int_{\hat{\tau}(b')}^{\infty} \mathcal{M}^r_{next}(b',\tau')f_\tau(\tau'|\tau)d\tau',$$

where $f_\tau(\cdot)$ is the conditional probability density function for future tax revenues τ'. One can characterize the default decision of the fiscal authority via the threshold $\hat{\tau}(b)$ for tax revenues that satisfies $\Delta_{\mathcal{F}}(b,\hat{\tau}(b)) \equiv \mathcal{F}^r(b,\hat{\tau}(b)) - \mathcal{F}^d(b,\hat{\tau}(b)) = 0$. Given the debt position b, $\hat{\tau}(b)$ is the lowest τ-value for which the fiscal authority prefers to repay its debt. For $\tau < \hat{\tau}(b')$, the fiscal authority finds it optimal to default. I compute the default threshold $\hat{\tau}(b)$ via bisection method. To approximate the integrals above, I use Gauss-Legendre quadrature nodes and weights as in Hatchondo, Martinez, and Sapriza (2010).

As discussed in detail by Chatterjee and Eyigungor (2015) and Hatchondo, Martinez, and Sosa-Padilla (2016), the combination of long-term debt, default risk and positive debt recovery gives the government an incentive to maximally dilute its debt in periods prior to default. To avoid such counterfactual borrowing behavior, I follow Chatterjee and Eyigungor (2015) and impose the constraint that the probability of defaulting in the next period is not allowed to exceed the upper bound $\iota \in [0,1]$ if the government issues new debt.[46] Effectively, this constraint, which, as argued by Chatterjee and Eyigungor (2015), can be thought of as an underwriting standard, gives rise to a state-dependent debt limit. I use the value $\iota = 0.8$ for all model versions. As in Chatterjee and Eyigungor (2015), this value is high enough such that the underwriting standard never binds during

[46] The government can thus still roll over or buy back its debt when $\mathbb{E}_{\tau'|\tau}[\mathcal{D}(b',\tau')] > \iota$.

model simulation. Tightening the constraint to $\iota = 0.65$ did not affect the results.

A.3 Additional Tables

	$\alpha = \alpha_\theta$	$\alpha = 2\alpha_\theta$	$\alpha = 3\alpha_\theta$	$\alpha = 5\alpha_\theta$	$\alpha = 8\alpha_\theta$	$\alpha \to \infty$
Mean						
Default probability	0.0106	0.0443	0.0508	0.0538	0.0543	0.0477
Debt-to-tax-revenues	0.5281	0.8634	0.8447	0.7897	0.7527	0.6299
Inflation rate	0.1531	0.1148	0.0817	0.0520	0.0345	0
Standard deviation						
Government spending	0.0139	0.0278	0.0301	0.0307	0.0309	0.0288
Inflation rate	0.0130	0.0225	0.0176	0.0118	0.0078	0
Correlation with taxes						
Government spending	0.8998	0.7749	0.7467	0.7264	0.7099	0.7155
Inflation rate	-0.0442	0.2253	0.2614	0.2805	0.2623	-

Table 4: Selected statistics for model version without political distortions ($\theta = \mu = 1$)

	$\alpha = \alpha_\theta$	$\alpha = 2\alpha_\theta$	$\alpha = 3\alpha_\theta$	$\alpha = 5\alpha_\theta$	$\alpha = 8\alpha_\theta$	$\alpha \to \infty$
Mean						
Default probability	0.0107	0.0431	0.0503	0.0535	0.0541	0.0515
Debt-to-tax-revenues	0.5341	0.8495	0.8349	0.7821	0.7488	0.6416
Inflation rate	0.1504	0.1115	0.0791	0.0503	0.0333	0
Standard deviation						
Government spending	0.0143	0.0278	0.0300	0.0306	0.0308	0.0294
Inflation rate	0.0128	0.0213	0.0169	0.0113	0.0075	0
Correlation with taxes						
Government spending	0.8910	0.7828	0.7474	0.7269	0.7093	0.6908
Inflation rate	-0.0518	0.2346	0.2599	0.2758	0.2626	-

Table 5: Selected statistics for model version without political turnover ($\theta > 1$, $\mu = 1$)

References

ADAM, K., AND R. BILLI (2008): “Monetary Conservatism and Fiscal Policy,” *Journal of Monetary Economics*, 55(8), 1376–1388.

AGUIAR, M., AND M. AMADOR (2011): “Growth in the Shadow of Expropriation,” *Quarterly Journal Of Economics*, 126(2), 651–697.

——— (2014): “Sovereign Debt,” in *Handbook of International Economics*, ed. by E. Helpman, K. Rogoff, and G. Gopinath, vol. 4, chap. 11, pp. 1243–1277. Elsevier, Amsterdam.

AGUIAR, M., M. AMADOR, E. FARHI, AND G. GOPINATH (2013): “Crisis and Commitment: Inflation Credibility and the Vulnerability to Sovereign Debt Crises,” Mimeo, Princeton University.

——— (2014): “Sovereign Debt Booms in Monetary Unions,” *American Economic Review: Papers and Proceedings*, 104(5), 101–106.

——— (2015): “Coordination and Crisis in Monetary Unions,” *Quarterly Journal of Economics*, 130(4), 1727–1779.

AGUIAR, M., AND G. GOPINATH (2006): “Defaultable Debt, Interest Rates and the Current Account,” *Journal of International Economics*, 69(1), 64–83.

AISEN, A., AND F. VEIGA (2005): “Does Political Instability Lead to Higher Inflation? A Panel Data Analysis,” IMF Working Papers 05/49.

ALESINA, A., AND G. TABELLINI (1990): “A Positive Theory of Fiscal Deficits and Government Debt,” *Review of Economic Studies*, 57(3), 403–414.

ARAUJO, A., M. LEON, AND R. SANTOS (2013): “Welfare Analysis of Currency Regimes with Defaultable Debts,” *Journal of International Economics*, 89(1), 143–153.

ARELLANO, C. (2008): “Default Risk and Income Fluctuations in Emerging Economies,” *American Economic Review*, 93(3), 690–712.

ARELLANO, C., AND A. RAMANARAYANAN (2012): “Default and the Maturity Structure in Sovereign Bonds,” *Journal of Political Economy*, 120(2), 187–232.

BACHETTA, P., E. PERAZZI, AND E. VAN WINCOOP (2015): “Self-Fulfilling Debt Crises: Can Monetary Policy Really Help?,” NBER Working Paper No. 21158.

BARRO, R., AND D. GORDON (1983a): “A Positive Theory of Monetary Policy in a Natural Rate Model,” *Journal of Political Economy*, 94(4), 589–610.

——— (1983b): “Rules, Discretion and Reputation in a Model of Monetary Policy,” *Journal of Monetary Economics*, 12(1), 101–121.

BATTAGLINI, M., AND S. COATE (2008): "A Dynamic Theory of Public Spending, Taxation, and Debt," *American Economic Review*, 98(1), 201–236.

BECK, T., A. GROFF, P. KEEFER, AND P. WALSH (2001): "New Tools in Cmparative Political Economy: The Database of Political Institutions," *World Bank Economic Review*, 15(1), 165–176.

BOCOLA, L., AND A. DOVIS (2016): "Self-Fulfilling Debt Crises: A Quantitative Analysis," Mimeo, Stanford University.

BOHN, H. (1988): "Why Do We Have Nominal Government Debt?," *Journal of Monetary Economics*, 21(1), 127–140.

CABALLERO, R., AND P. YARED (2010): "Future Rent-Seeking and Current Public Savings," *Journal of International Economics*, 82(2), 124–136.

CAO, D., AND I. WERNING (2016): "Dynamic Savings Choices with Wealth-Dependent Time Inconsistency," NBER Working Paper No. 22007.

CARSTENS, A., AND L. JÁCOME (2005): "Latin American Central Bank Reform: Progress and Challenges," IMF Working Papers 05/114.

CHATTERJEE, S., AND B. EYIGUNGOR (2015): "A Seniority Arrangement for Sovereign Debt," *American Economic Review*, 105(12), 3740–3765.

——— (2016): "Continuous Markov Equilibria with Quasi-Geometric Discounting," *Journal of Economic Theory*, 163(3), 467–494.

——— (2017): "Endogenous Political Turnover and Fluctuations in Sovereign Default Risk," Federal Reserve Bank of Philadelphia Working Paper No. 17-01.

CLARIDA, R., J. GALI, AND M. GERTLER (1999): "The Science of Monetary Policy," *Journal of Economic Literature*, 37(4), 1661–1707.

COLE, H., AND T. KEHOE (2000): "Self-Fulfilling Debt Crises," *Review of Economic Studies*, 67(1), 91–116.

CORSETTI, G., AND L. DEDOLA (2016): "The Mystery of the Printing Press: Monetary Policy and Self-Fulfilling Debt Crises," *Journal of the European Economic Association*, 14(6), 1329–1371.

CRUCES, J., AND C. TREBESCH (2013): "Sovereign Defaults: The Prize of Haircuts," *American Economic Journal: Macroeconomics*, 5(3), 85–117.

CUADRA, G., AND H. SAPRIZA (2008): "Sovereign Default, Interest Rates and Political Uncertainty in Emerging Markets," *Journal of International Economics*, 76(1), 78–88.

DA-ROCHA, J., E. GIMENEZ, AND F. LORES (2013): "Self-Fulfilling Crises with Default and Devaluation," *Economic Theory*, 53(3), 499–535.

DIAS, D., AND C. RICHMOND (2009): "Duration of Capital Market Exclusion: An Empirical Investigation," Mimeo, University of California, Los Angeles.

DU, W., AND J. SCHREGER (2017): "Sovereign Risk, Currency Risk, and Corporate Balance Sheets," Mimeo, Federal Reserve Board.

EATON, J., AND M. GERSOVITZ (1981): "Debt with Potential Repudiation: Theoretical and Empirical Analysis," *Review of Economic Studies*, 48(2), 289–309.

HATCHONDO, J., AND L. MARTINEZ (2009): "Long-Duration Bonds and Sovereign Defaults," *Journal of International Economics*, 79(1), 117–125.

HATCHONDO, J., L. MARTINEZ, AND H. SAPRIZA (2009): "Heterogeneous Borrowers in Quantitative Models of Sovereign Default," *International Economic Review*, 50(4), 1128–1151.

——— (2010): "Quantitative Properties of Sovereign Default Models: Solution Methods Matter," *Review of Economics Dynamics*, 13(4), 919–933.

HATCHONDO, J., L. MARTINEZ, AND C. SOSA-PADILLA (2016): "Debt Dilution and Sovereign Default Risk," *Journal of Political Economy*, 124(5), 1383–1422.

KOCHERLAKOTA, N. (2014): "Central Bank Independence and Sovereign Default," *Financial Stability Review*, 16, 151–154.

KRUSELL, P., B. KURUSCU, AND A. SMITH (2002): "Equilibrium Welfare and Government Policy with Quasi-Geometric Discounting," *Journal of Economic Theory*, 105(1), 42–72.

KYDLAND, F., AND E. PRESCOTT (1977): "Rules Rather Than Discretion: The Inconsistency of Optimal Plans," *Journal of Political Economy*, 85(3), 473–491.

LAIBSON, D. (1997): "Golden Eggs and Hyperbolic Discounting," *Quarterly Journal of Economics*, 112(2), 443–478.

LUCAS, R., AND N. STOKEY (1983): "Optimal Fiscal and Monetary Policy in an Economy without Capital," *Journal of Monetary Economics*, 12(1), 55–93.

MARTIN, F. (2015): "Debt, Inflation and Central Bank Independence," *European Economic Review*, 79, 129–150.

NA, S., S. SCHMITT-GROHÉ, M. URIBE, AND V. YUE (2018): "A Model of Twin Ds: Optimal Default and Devaluation," *American Economic Review*, 108(7), 1773–1819.

NICOLINI, J. (1998): "More on the Time Consistency of Monetary Policy," *Journal of Monetary Economics*, 41(2), 333–350.

NIEMANN, S. (2011): "Dynamic Monetary-Fiscal Interactions and the Role of Monetary Conservatism," *Journal of Monetary Economics*, 58(3), 234–247.

NIEMANN, S., P. PICHLER, AND G. SORGER (2013): "Central Bank Independence and the Monetary Instrument Problem," *International Economic Review*, 54(8), 1031–1055.

NUÑO, G., AND C. THOMAS (2018): "Monetary Policy and Sovereign Debt Sustainability," Mimeo, Banco de España.

PERSSON, T., AND L. SVENSSON (1989): "Why a Stubborn Conservative Would Run a Deficit: Policy with Time-Inconsistent Preferences," *Quarterly Journal of Economics*, 104(2), 325–345.

POUZO, D., AND I. PRESNO (2016): "Optimal Taxation with Endogenous Default under Incomplete Markets," Mimeo, University of California, Berkeley.

ROETTGER, J. (2018): "Discretionary Monetary Policy and Fiscal Policy with Endogenous Sovereign Risk," Mimeo, Univeryity of Cologne.

ROGOFF, K. (1985): "The Optimal Degree of Commitment to an Intermediate Monetary Target," *Quarterly Journal of Economics*, 100(4), 1169–1189.

SCHMITT-GROHÉ, S., AND M. URIBE (2004): "Optimal Fiscal and Monetary Policy under Sticky Prices," *Journal of Economic Theory*, 114(2), 198–230.

SCHOLL, A. (2017): "The Dynamics of Sovereign Default Risk and Political Turnover," *Journal of International Economics*, 108(5), 37–53.

TOMZ, M., AND M. WRIGHT (2007): "Do Countries Default in Bad Times?," *Journal of the European Economic Association*, 5(2-3), 352–360.