Too Much of a Good Thing? Safe Assets, Spillovers, and the Lack of Fiscal Policy Coordination*

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Abstract

Are public debt levels too high and convenience yields too low, or vice versa? Safe asset issuers have market power, which incentivizes them to restrict issuance to raise the convenience yield earned on foreign-held debt. Yet, these governments also tend to over-issue, failing to internalize the fiscal cost they impose abroad by lowering demand for other countries' bonds and, thus, their convenience yields. We develop a model of financially integrated economies and show analytically that the relative strengths of these opposing incentives depend on public expenditure (which exacerbates the fiscal externality) and bond substitutability (which reduces governments' bond market power). Calibrating the model to the euro area over 2015-2023, we find that the fiscal externality dominates. Countries issue *too much* debt by 5% of GDP. Introducing common debt leads to a modest further increase in aggregate debt, whereas outright fiscal coordination can lead to lower, efficient debt levels.

Keywords: Convenience Yield; Sovereign Debt; Fiscal Spillovers; Fiscal Policy Coordination; Safe Assets; EMU

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1 Introduction

Over the past two decades, public debt has risen substantially in advanced economies and is projected to continue rising in the face of various spending pressures.[1] At the same time, convenience yields on this debt—the premia rewarding the services (e.g., collateral usage) provided by these safe assets—have fallen considerably (Jiang et al., 2025; Schnabel, 2025).

Can the strategic interaction of sovereign issuers—absent fiscal coordination—lead to excessively high public debt and inefficiently low convenience yields? The existing literature emphasizes that issuers of safe debt act like monopolists, rationing bonds to earn a high convenience yield on foreign-held debt (Choi et al., 2023; Jiang and Richmond, 2024). As a result, public debt is *too low* from a social perspective. We additionally consider a fiscal externality whereby debt issuance reduces the convenience yield not only for the issuer, but also abroad (Arcidiacono et al., 2024). Lower convenience yields, in turn, require more distortionary taxation (Angeletos et al., 2023). As a result, even among issuers of safe debt, public debt can be *too high*.

This paper studies, both theoretically and quantitatively, the conditions under which public debt among safe issuers becomes inefficiently low or high. To this end, we develop a model of financially integrated economies in which sovereign debt issuance is shaped by two opposing distortions: governments possess market power, which incentivizes underissuance, but also neglect a fiscal externality, which leads to overissuance. We show analytically that the relative strength of these two opposing distortions—and thus whether equilibrium debt is too low or too high— depends on two key determinants: public expenditure, which exacerbates the fiscal externality, and bond substitutability, which reduces governments' market power. Calibrating the model to the euro area, we find that prevailing conditions over the past decade have incentivized countries to issue *too much* debt by around 5% of GDP. We further show that the introduction of common European debt further increases aggregate debt, modestly exacerbating overissuance.

These insights underscore the importance of fiscal policy coordination among financially integrated countries, such as those in the euro area. Absent coordination, sovereign debt can reach inefficiently high levels—even without any default risk. Moreover, the inefficiency is

[1] In advanced economies, general government gross debt (in % of GDP) has risen from 76.3% in 2005 to 110.2% in 2025 and is projected to reach 118.5% in 2030 (International Monetary Fund, 2025b).

amplified when public spending needs increase, as in the current economic environment[2], since governments resort excessively to debt issuance, while neglecting the fiscal costs imposed abroad. Common debt issuance, although beneficial when debt is inefficiently low, cannot improve incentives and outcomes in environments where debt is already too high.

In more detail, we study an environment that combines several key elements from the literature on public debt, sovereign spillovers, convenience yields, and safe assets. First, the model features households subject to a financial friction: private lending, which supports productive investment, requires collateral. Because sovereign debt can serve as collateral, as in Bolton and Jeanne (2011), households are willing to pay a positive but declining premium for it—the "convenience yield." That is, they value not only the bond's cash flow but also its collateral services. As a result, there is a downward-sloping demand curve for government debt.

Second, governments in two countries must finance an exogenous level of public expenditure using a combination of debt issuance and distortionary labor taxation. They internalize the bond demand curve and thus exert market power. Raising "debt revenue" through the convenience yield—by providing collateral services—is beneficial, as it allows governments to reduce distortionary taxation, as in Angeletos et al. (2023).

Third, financial markets are integrated: households can purchase bonds issued by both governments and use them as collateral. However, these bonds are typically imperfect substitutes (Jiang and Richmond, 2024). The reason is that the collateral value of each bond is stochastic. When collateral values are not perfectly correlated, holding both bonds provides diversification benefits, making them less than perfectly substitutable.

We consider a non-cooperative equilibrium in which governments choose debt levels to maximize domestic welfare and contrast them with a cooperative equilibrium benchmark, in which governments coordinate to achieve the socially optimal equilibrium. In a non-cooperative equilibrium, each government's debt policy balances three objectives. First, the government wants to provide collateral to households, while, second, collecting debt revenue to lower distortionary taxation. These two objectives are as in the one-country model of Angeletos et al. (2023). In our two-country setting, a third objective emerges: the government wants to sell bonds abroad to collect revenue and thereby transfer resources from abroad to the domestic economy.

[2] See International Monetary Fund (2025a).

When governments maximize domestic welfare and ignore the effects of their debt issuance abroad, two distortions arise. First, there is a pecuniary fiscal externality. Because bonds are substitutable, issuing debt reduces the convenience yield not only domestically, but also abroad—as documented empirically in Arcidiacono et al. (2024) and Nenova (2025). In turn, this requires higher distortionary taxation abroad to offset the lost revenue. Neglecting this externality leads countries to issue an inefficiently high amount of debt.

The second distortion arises because governments possess bond market power, as in Choi et al. (2023) and Jiang and Richmond (2024). Issuing debt that is held abroad always generates a financial flow reflecting the collateral value that this debt provides. However, by exerting market power and restricting debt issuance, governments can raise the convenience yield and thereby the financial inflow due to international bond holdings. This distortion leads countries to issue an inefficiently low amount of debt.

We first study a stylized two-period version of our model that allows us to obtain analytical results. Our central proposition derives that the relative strength of the two distortions—fiscal externality and bond market power—determines whether the non-cooperative equilibrium features too much or too little debt, compared to the cooperative one. Thus, our model can not only generate an underissuance of safe assets as in Choi et al. (2023) or Jiang and Richmond (2024), but also an overissuance—a novel outcome in this literature that usually abstracts from sovereign default risk.

In addition, we analytically identify two key statistics that determine the strength of the distortions and therefore whether the equilibrium features under- or overissuance of debt. First, when public spending needs are low, the burden imposed on the foreign country when decreasing bond prices via issuance is negligible. Hence, the fiscal externality weakens, reducing the overissuance force. Second, when bonds are highly substitutable, implying large spillovers, countries have little ability to distort bond prices in their favor. Hence, the market power distortion weakens, reducing the underissuance force.

For the quantitative analysis, we calibrate the model to large euro area countries whose sovereign debt has been perceived as safe over the past decade. We choose the euro area as a setting, because it comprises several large issuers of highly substitutable safe debt (Arcidiacono et al., 2024). This setup gives rise to cross-border spillover effects and leads to the strategic interactions at the core of our analysis.

The model's calibrated debt-to-GDP ratio is 75% in a non-cooperative equilibrium. If instead, countries were cooperating, they would choose a debt-to-GDP ratio of only 70%. Thus, we find that the conditions in the euro area over the last decade to give rise to overissuance of debt of around 5% of GDP. This implies that the fiscal externality dominates the market power distortion.

When spending needs rise by 5% of GDP—exacerbating the fiscal externality—overissuance rises from 5% to 6.4% of GDP. Moreover, when the spillover coefficient rises from 0.9 in the baseline to 0.95—weakening the market power distortion—overissuance rises from 5% to 6% of GDP. In turn, rather large changes would be necessary (spending needs below 15% of GDP or the spillover coefficient below 0.65) for the environment to move from over- to underissuance of debt.

In addition, we evaluate the robustness of our main quantitative finding of overissuance to heterogeneites across countries. While heterogeneities change *which* country issues too little or too much debt, they do not change that *in sum*, there is too much debt being issued. For example, with unequal spending needs, the fiscal cost of debt issuance in the low-needs country for the high-needs country is particularly large. In consequence, when countries internalize those spillovers in a cooperative equilibrium, the low-needs country issues less and thereby enables the high-needs country to issue more and collect more debt revenue.

We also use our framework to study the strategic implications of common debt issuance. In cooperative equilibria, maintaining a stock of common debt is irrelevant and does not change the total (national plus common) amount of debt issued, because countries reduce national issuance proportionally. In contrast, in non-cooperative equilibria, common debt *always* raises the total amount of debt issued. By maintaining common debt, which naturally has the same price for both countries, countries effectively commit to have an identical price on a share of their total debt. This weakens the market power distortion, but exacerbates the fiscal externality—both effects pushing towards higher debt issuance. Quantitatively, these effects are modest. With common debt of 30% of GDP, overissuance increases from 5% of GDP (without common debt) to 5.7% of GDP.

Finally, we derive three policy implications from our theoretical and quantitative results for the current economic environment in Europe. First, in light of rising public spending needs, fiscal coordination across countries is becoming increasingly important. We find that the prevailing conditions in the euro area already foster an overissuance of sovereign debt, a problem that will only intensify as spending pressures rise, for instance in areas such as defense and national security (International Monetary Fund, 2025b). Second, European common debt is not a substitute for fiscal coordination. While there are good arguments in favor of common debt issuance, our results indicate that common debt does not address but even modestly exacerbates the overissuance of national debt. Therefore, fiscal coordination remains essential. Third, fiscal rules can be an effective means to not only ensure debt sustainability, but also to achieve the efficient level of debt. Yet, this optimal level of debt is an elusive target, because it is state-dependent and must reflect the benefits and costs of debt issuance not only for the issuer but also abroad.

Related Literature. This paper relates and contributes to the large literature that studies the provision of *safe assets*, the *convenience yields* earned by their issuers, and the economic implications. Our work builds on four strands of this literature. First, many governments earn convenience yields on their sovereign bonds, although this premium tends to erode as the supply of debt increases (Krishnamurthy and Vissing-Jorgensen, 2012; Jiang et al., 2025; Gnewuch, 2022). Second, these convenience yields reflect that investors obtain and are willing to pay not only for the cash flow of bonds, but also for the services that they provide, such as usage as collateral (Angeletos et al., 2023; Bolton and Jeanne, 2011; Woodford, 1990), hedge against aggregate or idiosyncratic risk (Brunnermeier et al., 2022), or liquidity (Benigno and Nisticò, 2017)—as long as safe assets are "scarce" (Caballero et al., 2017). Third, many safe assets offer comparable services and are therefore (imperfectly) substitutable (Nagel, 2016; Krishnamurthy and Li, 2023; Nenova, 2025; Bayer et al., 2023). The degree of substitutability depends on asset and issuer characteristics, such as default risk (Arcidiacono et al., 2024; Nissinen and Sihvonen, 2024). Fourth, governments internalize the effects of their issuance of safe assets, leading them to act and interact strategically (Farhi and Maggiori, 2018; Choi et al., 2023; Jiang and Richmond, 2024).

Most closely related to our work is the literature studying the strategic interaction among safe asset issuers who compete for the "debt revenue" arising from the provision of safe assets. Such interactions among (at least) two issuers that monopolistically provide safe assets to foreign investors are studied in Choi et al. (2023) (perfectly substitutable assets) and Jiang and Richmond (2024) (imperfectly substitutable assets). We enrich these analyses by additionally considering two features that matter for governments' decisions: (i) raising revenue via taxation is distortionary, (ii) a share of safe assets is held and utilized by domestic households—features studied in a one-country setting in Angeletos et al. (2023).

We contribute to this literature by showing that the non-cooperative equilibrium (in comparison to a cooperative equilibrium) can not only feature *too few* safe assets ("underissuance") as in Choi et al. (2023) and Jiang and Richmond (2024), but also *too many* safe assets ("overissuance"). Moreover, we characterize conditions—high government spending needs and high substitutability of bonds—that foster overissuance of safe assets. Third, we quantify the extent of overissuance among large euro area countries over the past decade and assess the strategic implications of common debt issuance.

Finally, our paper relates to two complementary strands of the literature. One studies interactions among *potential* safe asset issuers who compete for the *status* of safe asset provider, either by building reputation (Clayton et al., 2024) or by issuing liquid yet safe debt (He et al., 2019). Another examines the international coordination of fiscal policies (Chang, 1990; Kehoe, 1987), and monetary policy (Bianchi and Coulibaly, 2023) with financially integrated countries.

2 Model

This section develops a two-country model of sovereign debt issuance. Building on the closed-economy framework of Angeletos et al. (2023), debt issuance provides collateral and relaxes private borrowing constraints, but also reduces collateral scarcity and thereby lowers the convenience yield. We extend this framework to two financially integrated economies, where bonds are held and used as collateral across borders, as in Bolton and Jeanne (2011). This setup allows us to study the strategic interactions of sovereign issuers when debt issuance generates both positive spillovers—through collateral provision—and negative spillovers—through the erosion of convenience yields and associated fiscal revenues. In the following, we outline the key ingredients of the model, relegating technical details to Appendix A.

2.1 Environment and Timing

There are two countries $i = \{H, F\}$ for "Home" and "Foreign". Each country is populated by a unit mass of households, a representative firm, and a government. Time t is discrete and infinite. Each period is divided into a morning and an afternoon. This timing allows sovereign bonds to serve as store of value *across* periods and as collateral for private borrowing *within* periods.

Morning. At the beginning of the morning, households in each country are identical and receive an endowment $\bar{y}$. Households are then randomly assigned to be either investors I, with probability ω, or savers S, with probability $1-\omega$, in the current period. Only investors have access to an investment opportunity. The return to the investment opportunity is certain, but investors must borrow from savers to invest beyond their own endowment. These loans must be collateralized with sovereign bonds, purchased in the previous period. Before loans are originated, the stochastic collateral values of bonds, which determine how effectively each countries' bonds can be used to back private borrowing, are drawn.

Afternoon. In the afternoon, investment returns are realized and intra-household loans are repaid. Then, households supply labor to the firm, which produces using a linear technology and pays competitive wages, while governments levy labor taxes. Moreover, governments repay maturing debt, and issue new one-period bonds, which are purchased by households.

2.2 Households and Collateralized Borrowing

Even though the setup of the household block is symmetric across countries, we maintain the superscript i, denoting the country, because household choices may differ across countries as a result of government policies. Households have linear utility over consumption in morning $c^i_{t,m}$ and afternoon $c^i_{t,a}$ and disutility from labor l^i_t. They maximize discounted lifetime utility

$$\max_{\{c^i_{t,m}, c^i_{t,a}, l^i_t, d^i_t, \iota^i_t, b^{i,i}_{t+1}, b^{-i,i}_{t+1}\}} \quad \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[c^i_{t,m} + c^i_{t,a} - \chi \frac{(l^i_t)^{1+\varphi}}{1+\varphi} \right], \tag{1}$$

where expectations are taken with respect to the chance of becoming an investor and stochastic collateral values, which are the only source of aggregate uncertainty. Budget constraints in the morning and in the afternoon are, respectively

$$c^i_{t,m} = \bar{y} - \iota^i_t + d^i_t \tag{2}$$

$$c^i_{t,a} = \iota^i_t + f(\iota^i_t) - d^i_t + \left(1 - \tau^i_t\right) w^i_t l^i_t + b^{i,i}_t - p^i_{t,a} b^{i,i}_{t+1} + b^{-i,i}_t - p^{-i}_{t,a} b^{-i,i}_{t+1} \tag{3}$$

where ι^i_t is investment and $f(\iota^i_t)$ the return to investment, d^i_t borrowing, w^i_t the wage, and τ^i_t the labor tax rate. Moreover, $b^{i,i}_t$ and $b^{-i,i}_t$ denote the beginning-of-period holdings of domestic and foreign sovereign bonds, respectively, for households in country i.

Investors. Investors invest $\iota_t^{i,I}$ in the morning into a technology which returns $\iota_t^{i,I} + f(\iota_t^{i,I})$ in the afternoon, where $f(\cdot)$ is increasing and concave. Investors can borrow individually up to

$$d_t^{i,I} \leq \lambda_t^i b_t^{i,i} + \lambda_t^{-i} b_t^{-i,i}, \tag{4}$$

where λ_t^i and λ_t^{-i} are the stochastic collateral values drawn from a joint distribution $F(\lambda_t^H, \lambda_t^F)$. Because the return to investment is always positive[3] and preferences are linear over consumption, investors always invest up to the maximum permitted by their borrowing constraint. It follows that they consume nothing in the morning and invest

$$\iota_t^{i,I} = \bar{y} + \lambda_t^i b_t^{i,i} + \lambda_t^{-i} b_t^{-i,i}. \tag{5}$$

Savers. Savers cannot invest and supply loans competitively.[4] In the morning, they accommodate the loan demand from investors and consume their remaining endowment.[5]

Labor Supply. Linearity of preferences over consumption implies that savers and investors make identical decisions—labor supply and bond demand—in the afternoon. Labor supply is given by the first-order condition with respect to l_t^i

$$\chi(l_t^i)^\varphi = (1 - \tau_t^i) w_t^i. \tag{6}$$

2.3 Bond Demand and Prices

Next to labor supply, the key choice that households make in the afternoon is their bond portfolio $(b_{t+1}^{i,i}, b_{t+1}^{-i,i})$. For this decision, they take into account (i) the probability of becoming an investor in the next period and (ii) the probability distribution of collateral values. Optimal bond demand implies that bond prices equal the discounted value of repayment plus the expected marginal collateral service provided in the next morning.

Because households' endowments, preferences, and investment technology, are symmetric across countries, bond demand is identical not only within, but also across countries. Hence,

[3]Formally, we assume that $f(\iota_t^{i,I}) \geq 0$ for $\iota_t^{i,I} \geq \bar{y}$ and $f'(\iota_t^{i,I}) \geq 0$.

[4]Because there is no discount factor between morning and afternoon, the intra-period interest rate is 0.

[5]We assume that the loan supply is larger than the available collateral. Formally, $\bar{y} \geq \frac{\omega}{1-\omega}\left(\lambda^i b_t^{i,i} + \lambda_t^{-i} b_t^{-i,i}\right)$, which is identical to imposing that $c_{t,m}^{i,S}$ is non-negative in any state. Otherwise, $d_t^{i,I}$ would be determined by the available loan supply, instead of collateral, and there would be no collateral scarcity and, hence, no convenience yield.

all households choose the same portfolios: $b^{i,i}_{t+1} = b^{i,-i}_{t+1}$.[6] Therefore, the aggregate bond demand schedule that governments face, which follows from households' first-order condition with respect to $b^{i,i}$ (see Appendix A.1 for a formal derivation), only depends on aggregate debt supplies:

$$p^i_{t,a} = \beta \mathbb{E}_t \left[1 + \omega \lambda^i_{t+1} f'\big(\bar{y}_t + \tfrac{1}{2}\lambda^i_{t+1} B^i_{t+1} + \tfrac{1}{2}\lambda^{-i}_{t+1} B^{-i}_{t+1}\big)\right], \tag{7}$$

where $B^i_{t+1} \equiv b^{i,i}_{t+1} + b^{i,-i}_{t+1}$ denotes country i's total government debt issuance in the afternoon of period t and expectations are taken with respect to the joint distribution $F(\lambda^H, \lambda^F)$.

Bond Substitutability. The bond demand schedule (Equation 7) implies that the price of country i's bonds declines not only with its own issuance, but also with foreign issuance. This reflects that bonds are substitutes as collateral, to a degree determined by the joint distribution of stochastic collateral values. In the limiting case of perfectly correlated collateral values, bonds are *perfect* substitutes. Otherwise, they are *imperfect* substitutes, as their values differ across states of the world, incentivizing households to diversify their bond portfolio.

Stochastic collateral values can be interpreted as reflecting liquidity risk, as in Benigno and Nisticò (2017), or sovereign default risk, as in Bolton and Jeanne (2011), both of which induce fluctuations in the value of bonds as collateral. We remain agnostic about the specific microfoundation and instead focus on the implications of (imperfect) bond substitutability.

Convenience Yield. To align with the empirical measurement, we define the convenience yield as the difference between the yield on a sovereign bond and the yield on a synthetic bond that does not provide collateral services. We compute the synthetic yield by setting the collateral value λ to 0, which immediately implies $\tilde{p}_{t,a} = \beta$ (see Equation 7). Using the standard price-yield formula,[7] the convenience yield is: $CY_t = \beta^{-1} - p^{i^{-1}}_{t,a}$.

2.4 Firms

Each country's representative firm produces output in the afternoon using a simple linear technology: $Y^i_{t,a} = L^i_t$. Firms operate competitively, which implies a real wage $w^i_t = 1$.

[6] When collateral values are not perfectly correlated across countries, diversification is strictly optimal. If collateral values were perfectly correlated, portfolio choices would be indeterminate; we abstract from this knife-edge case.

[7] For each bond, we compute the yield-to-maturity from the price using: $p(1+y)^n = 1$, where n is the number of years to maturity (1 in our case), and y is the yield.

2.5 Government

Governments act only in the afternoon. They finance exogenous public expenditure g_t^i and the reimbursement of maturing bonds using labor taxes and one-period bonds.[8] The government budget constraint is

$$p_{t,a}^i B_{t+1}^i + s_t^i = B_t^i + g_t^i, \tag{8}$$

where $s_t^i = \tau_t^i w_t^i l_t^i$ denotes labour tax revenues.

2.6 Equilibrium

Definition 1 characterizes the model equilibrium for *given* government policies. Thereafter, we characterize two distinct government objective functions and policies. First, we consider governments that maximize national welfare ("non-cooperation"). Second, we consider governments that maximize joint welfare ("cooperation").

Definition 1 (Competitive Equilibrium) *Given initial positions B_0^i, and a sequence of government policies $\{B_t^i, s_t^i\}_{i=H,F}$, an equilibrium is a sequence of prices $\{p_{a,t}^i, w_t^i\}_{i=H,F}$ and allocations $\{c_{t,m}^i, c_{t,a}^i, l_t^i, b_t^{i,-i}, b_t^{i,i}, \iota_t^i\}_{i=H,F}$ such that:*

1. *Households optimize; hence conditions (6), (7) and (5) hold for all t and for each i.*
2. *Firms optimize, which implies that $w_t^i = a_t^i$.*
3. *The law of one price holds for bonds:*

$$p_{a,t}^H = p_{a,t}^F$$

4. *The international bond markets and the national labor markets clear.*

2.6.1 Government Problem under Non-Cooperation (Markov Perfect Equilibrium)

We consider a Markov perfect equilibrium, where the government of country i chooses bond issuance B_{t+1}^i taking as given the reaction function of the other country $\mathcal{B}^{-i}(B_{t+1}^i)$. Under this equilibrium concept, each government internalizes the impact of its own debt issuance on both domestic and foreign bond prices, taking as given the debt policy of the other country.

[8] As g_t^i is exogenous, we use the terms government "expenditure" and "spending needs" interchangeably.

However, a government does *not* internalize the effect of its debt choice on the other country's welfare. As a result, a pecuniary externality arises, operating through collateral values and equilibrium bond prices.

The government solves

$$W_t^i(B_t^i, B_t^{-i}) = \max_{B_{t+1}^i, s_t^i} U^i(s_t^i) + V^i(B_t^i, B_t^{-i}) - g_t^i + \Pi^i(B_t^i, B_{t+1}^i, B_t^{-i}, \mathcal{B}^{-i}(B_{t+1}^i)) + \beta \mathbb{E}_t W_{t+1}^i(B_{t+1}^i, \mathcal{B}^{-i}(B_{t+1}^i)), \tag{9}$$

subject to the budget constraint (8), bond pricing equation (7), and households FOCs for labour supply (6). A formal derivation is provided in Appendix A.2. An equilibrium requires that governments have no incentive to deviate from their issuance strategy, i.e. $B_{t+1}^i = \mathcal{B}^i(B_{t+1}^{-i})$ and $B_{t+1}^{-i} = \mathcal{B}^{-i}(B_{t+1}^i)$.

Households' utility is decomposed into three terms which reflect the three objectives that governments balance under non-cooperation:

$$U^i(s_t^i) = w_t^i l_t^i(s_t^i) - \chi \frac{[l_t^i(s_t^i)]^{1+\varphi}}{1+\varphi}, \quad \text{where} \quad l_t^i(s_t^i) \text{ solves } s_t^i = [1 - \chi(l_t^i)^{\varphi}]\, l_t^i \tag{10}$$

$$V^i(B_t^i, B_t^{-i}) = \bar{y}_t + \omega f\left(\bar{y}_t + \lambda_t^i B_t^i + \lambda_t^{-i} B_t^{-i}\right) \tag{11}$$

$$\Pi^i(.) = \left[p_{t,a}^i(B_{t+1}^i, \mathcal{B}^{-i}(B_{t+1}^i))\tfrac{B_{t+1}^i}{2} - \tfrac{B_t^i}{2}\right] - \left[p_{t,a}^{-i}(B_{t+1}^i, \mathcal{B}^{-i}(B_{t+1}^i))\tfrac{\mathcal{B}^{-i}(B_{t+1}^i)}{2} - \tfrac{B_t^{-i}}{2}\right]. \tag{12}$$

Distortionary Taxation. $U^i(s_t^i)$ is utility of consumption out of labour income and net of labour disutility. As in the standard Ramsey optimal debt problem (Barro, 1979), this function is decreasing and concave in labour tax revenue (as shown in Appendix A.2), reflecting the gains from reducing and smoothing tax distortions over time. Labour tax revenue is linked to debt issuance through the government budget constraint (8): exogenous expenditure is financed either with labour taxes or new debt. Issuing debt allows taxes -and thus distortions- to be temporarily lower, but accumulated debt raises future financing needs. Higher issuance therefore increases reliance on distortionary taxation in the future through a lower convenience yield and bond price.

Collateral Provision. The second term, $V^i(B_t^i, B_t^{-i})$, represents utility from endowment and the welfare effects associated with alleviating financial frictions for investors in country

i. An increase in domestic or foreign debt expands collateral capacity, relaxes borrowing constraints, and raises investment, output, and consumption. These welfare effects are reflected in equilibrium bond prices. Accordingly, in Appendix A.1 we show that equation (7) can be expressed as

$$p_{t,a}^{i} = \beta \mathbb{E}_t \left[1 + \frac{\partial V^i(B_{t+1}^i, B_{t+1}^{-i})}{\partial B_{t+1}^i} \right] \tag{13}$$

which implies that, as in Angeletos et al. (2023),the private valuation of public debt and its public value coincide.

The U and V components coincide with the welfare trade-offs emphasized in Angeletos et al. (2023), where governments value both the reduction and intertemporal smoothing of tax distortions and the mitigation of financial frictions.

International Financial Flows. Relative to the autarky setting in Angeletos et al. (2023), our open-economy model features an additional welfare component, $\Pi_t^i(B^i, B^{-i})$, which captures the effects of international financial flows. A fraction of domestic bonds is held abroad, allowing the government to obtain foreign resources to finance public expenditures. Symmetrically, domestic investors hold foreign bonds, generating an outward transfer of resources that benefits the foreign government. The repayment of maturing bonds generates offsetting flows, which need not cancel within a given period and may therefore give rise to a trade surplus or deficit. Accordingly, $\Pi_t^i(B^i, B^{-i})$ corresponds to country i's trade balance.

The trade balance is negative when the domestic deficit (the first term in square brackets) exceeds the foreign deficit (the second term). In this case, the home country derives a net welfare gain from access to international bond markets. This outcome arises when the home country enjoys a higher convenience yield and issues debt at a higher price, and is thus closely related to the notion of *exorbitant privilege* (Farhi and Maggiori, 2018; Gourinchas and Rey, 2022), whereby returns on external assets exceed those on domestic liabilities held by foreign investors.

2.6.2 Government Problem under Cooperation

In the cooperative equilibrium, governments jointly maximize the welfare of households in both countries, internalizing the effects of their debt issuance decisions on foreign welfare and bond prices. The cooperative allocation therefore corresponds to the solution to the following problem

$$W_t^{CO}(B_t^H, B_t^F) = \max_{\{B_{t+1}^i, s_t^i\}_{i=H,F}} U(s_t^H) + U(s_t^F) + 2V(B_t^H, B_t^F) \\ - g_t^H - g_t^F + \beta \, \mathbb{E}_t W_{t+1}^{CO}(B_{t+1}^H, B_{t+1}^F), \tag{14}$$

subject to the same resource constraints as in the decentralized economy. Note that problem (9) and (14) share the same budget constraints. We do not allow cooperative governments to redistribute resources directly across countries, thereby restricting options compared to a case where the countries would enter a fiscal union with a common budget.

3 Stylized Two-Period Model

This section studies a stylized version of the model that allows to characterize debt issuance policies analytically. The purpose is twofold. First, we identify the source and the direction of the two inefficiencies that arise in non-cooperative equilibria as compared to cooperative equilibria. These inefficiencies are a pecuniary fiscal externality operating through bond price spillovers and bond market power. Second, we derive how government spending needs and the substitutability of bonds determine the strength of the two inefficiencies and thereby whether the equilibrium features over- or underissuance of debt.

3.1 Setup

We simplify the full model along five dimensions in order to obtain analytical results. The essential mechanisms of the full model are retained despite the simplifications. In this way, the analytical results provide intuition for the quantitative results obtained with the calibrated full model in the subsequent section.

First, we shorten the time horizon to two periods to turn off dynamic effects. Second, we assume ex-ante symmetry between the two countries and abstract from any differences across countries. Third, we choose a simple stochastic process for collateral values with only two states (high, low). Fourth, we assume that investment excess returns follow a quadratic functional form with constant curvature, which implies linear bond demand schedules. Last, we make the technical assumption that governments can always temporarily raise more resources with additional bond issuance.

Timing. There are only two time periods $t = \{0, 1\}$. In the morning of $t = 0$, no bonds are available yet and investment happens only using exogenous endowments. In the afternoon of period $t = 0$, governments finance spending needs g by issuing debt, which also serves as collateral in the following period. In the morning of period $t = 1$, investment happens using exogenous endowments and loans which are collateralized by the bonds purchased in the previous period. In the afternoon of period $t = 1$, governments repay their debt, but do not issue any new bonds because there is no further period. Furthermore, there is no government expenditure in period 1.

Symmetry. We assume full ex-ante symmetry between countries. Each government faces the same spending needs g, bond collateral values λ^i follow the same distribution, and investors in both countries have the same endowment and rate of return.

Collateral values. Bond collateral values take only two values $\lambda_1^i \in \{1-\sigma,\ 1+\sigma\}$ with equal probability such that $\mathbb{E}_0[\lambda_1^i] = 1$. An increase in σ raises the variance of λ_1^i without changing the mean. We also assume that the collateral values are independently distributed across countries: $\lambda_1^i \perp \lambda_1^{-i}$.

Bond demand. The excess investment returns function $f(i_t)$ is quadratic and with a negative and constant second derivative ($f''(i_t) = -f_1 < 0$). This implies that the inverse bond demand functions are linear in both domestic and foreign issuance, as shown in Appendix A.1. Linear demand, in turn, implies that the government's profits from bond issuance—defined as proceeds net of discounted repayment ($p_{0,a}(B^i, B^{-i}) \cdot B^i - \beta B^i$)—are single-peaked and concave. Government's profits are zero when debt is zero, increasing for small values of B^i, but negative for larger values of B^i, as shown in Figure 5. Thus, governments face what we call a *Debt Laffer curve*. Similar to Angeletos et al. (2023) and Mian et al. (2025), government can generate profits from issuing additional debt, but only up to a certain point.

Technical Assumption. Finally, we impose a technical assumption that improves tractability of the model and simplifies proofs: Debt proceeds are increasing in total debt issuance for all feasible levels of B^i and B^{-i}:

$$\frac{\partial}{\partial B^i}\big[p_{0,a}^i(B^i, B^{-i})\, B^i\big] + \frac{\partial}{\partial B^{-i}}\big[p_{0,a}^i(B^i, B^{-i})\, B^i\big] > 0.$$

This technical assumption ensures that, when both governments marginally increase bond issuance, debt proceeds rise in both countries. Equivalently, the negative *price effect* of additional issuance never dominates the positive *quantity effect*. As shown in Section 4, this assumption has strong empirical support in settings where default risk is negligible.

3.2 Overissuance? Non-Cooperative vs. Cooperative Equilibria

The stylized model allows us to formally characterize the distortions that arise when there is a lack of fiscal coordination. For this purpose, we compare *non-cooperative* equilibria, when governments maximize national welfare, with *cooperative* equilibria, when governments maximize joint welfare. Formal definitions of both equilibria as well as existence and uniqueness proofs are relegated to Appendix B.2.

Welfare. As in the full model, ex-ante welfare in country i can be decomposed into three components: (i) the welfare cost of distortionary taxation (U), which generates incentives to reduce taxes and smooth them over time; (ii) the welfare gains from easing financial frictions (V), as public debt provides collateral that relaxes borrowing constraints and increases investment; and (iii) an open-economy component capturing the net flow of resources due to international bond holdings (Π). In addition, spending needs (g) enter as a constant.

Formally, ex-ante aggregate utility of country i's households is:

$$W_0^i = U(s_0^i) + \beta U^i(s_1^i) + \beta \mathbb{E}_0 V^i(B^i, B^{-i}\ ;\ \lambda_1^i, \lambda_1^{-i}) + \Pi_0(B^i, B^{-i}) + \beta \Pi_1(B^i, B^{-i}) - g$$

$$\begin{aligned} \text{where} \quad \mathbb{E}_0 V_1^i(B^i, B^{-i}) &= \bar{y} + \omega \mathbb{E}_0[f\big(\bar{y} + \lambda^i B^i/2 + \lambda^{-i} B^{-i}/2\big)] \\ \Pi_0^i(B^i, B^{-i}) &= p_{0,a}^i\big(B^i,\ B^{-i}\big)B^i/2 - p_{0,a}^{-i}\big(B^{-i},\ B^i\big)B^{-i}/2 \\ \Pi_1^i(B^i, B^{-i}) &= B^{-i}/2 - B^i/2 \end{aligned} \tag{15}$$

and prices are given by (7) or, equivalently, by (13).

Tu understand the distortions arising in non-cooperative equilibria, it is instructive to compare the first-order conditions (FOCs) for government i in both cases. In the interest of readability we preempt that equilibria will be always be symmetric and evaluate the FOCs at $B = B^i = B^{-i}$, and also suppress the dependency of objects on B.

FOC: Non-Cooperative Equilibrium. In a non-cooperative equilibrium, the government balances three incentives. These are reducing and smoothing tax distortions (I_i), providing collateral (II_i), and affecting international financial flows to their benefit (III), illustrated by the FOC

$$0 = \underbrace{-U'\big(s_0^i\big)\left[p_{0,a}^i + B\,\partial_1 p_{0,a}^i\right] + \beta U'(B)}_{\text{I}_i} + \underbrace{\beta\partial_1 \mathbb{E}_0 V^i}_{\text{II}_i} + \underbrace{\partial_1 \Pi_0 + \beta\partial_1 \Pi_1}_{\text{III}} \tag{16}$$

where we use the notation that for each function $m(B^i, B^{-i})$, $\partial_1 m^i(B^i, B^{-i}) = \frac{\partial m^i}{\partial B^i}$ and $\partial_2 m^i = \frac{\partial m^i}{\partial B^{-i}}$.

FOC: Cooperative Equilbrium. In contrast, in a cooperative equilibrium, two are two differences in the incentives. First, there is not only an incentive to reduce tax distortions at home (I_i), but also to reduce them abroad (I_{-i}). Second, instead of affecting financial flows (III), there is now an incentive to provide collateral abroad (II_{-i}):

$$0 = \underbrace{-U'\big(s_0^i\big)\left[p_{0,a}^i + B\,\partial_1 p_{0,a}^i\right] + \beta U'(B)}_{\text{I}_i} \underbrace{-U'\big(s_0^{-i}\big)\Big[\partial_2 p_{0,a} B\Big]}_{\text{I}_{-i}} + \underbrace{\beta\partial_1 \mathbb{E}_0 V^i}_{\text{II}_i} + \underbrace{\beta\partial_2 \mathbb{E}_0 V^{-i}}_{\text{II}_{-i}} \tag{17}$$

These two differences in incentives encapsulate two distortions—a pecuniary fiscal externality and bond market power—that push the non-cooperative debt policies away from the cooperative policies. We now explain these distortions in more detail.

Fiscal Externality. In non-cooperative equilibria, governments do not account for the fiscal spillover effect of their own debt issuance. This pecuniary externality is captured by the term I_{-i} in the cooperative-equilibrium FOC. Prices and convenience yields decline when *any* country's issuance increases. The resulting loss in the funds raised through debt issuance requires an increase in tax revenue to meet spending needs. Hence, this term captures how an additional unit of i's debt erodes $-i$'s convenience revenue and results in more distortionary taxation.

Ignoring this pecuniary externality leads governments to issue *too much* debt in a non-cooperative equilibrium. Thus, this distortion fosters overissuance of debt.

Bond Market Power. The second distortion arises from the combination of the incentive to affect international financial flows (III) in non-cooperative equilibria and the incentive to provide collateral abroad (II_{-i}) in cooperative equilibria.

Cooperative governments internalize that their own debt provides valuable collateral abroad. This collateral provision generates an efficient international financial flow (II). Non-cooperative governments, however, try to affect international financial flows to their benefit above and beyond this efficient flow, which in turn allows them to reduce their trade balance (i.e, to increase their trade deficit). To see this, it is helpful to split the incentive in the non-cooperative equilibrium (III) into two components.[9] The first component is an efficient "base" effect, reflecting that an additional unit of country i's debt earns the convenience yield—exactly like the incentive in the cooperative case.[10] The second component reflects how issuance affects both bond prices which is precisely the inefficient "bond market power"-incentive: $\frac{1}{2}(\partial_1 p^i_{0,a} - \partial_2 p^{-i}_{0,a})B^{NC}$.

Non-cooperative governments can manipulate bond prices. As in Choi et al. (2023) and Angeletos et al. (2023), governments are not price takers in bond markets. When choosing public debt issuance, each non-cooperative government internalizes the effect of its issuance on the price of both bonds. Cooperative government also internalize these effects but additionally realize that, in a symmetric equilibrium, this is a zero sum game for the cooperation.

Governments have bond market power when bonds are imperfect substitutes and the price spillover parameter $\delta \equiv \frac{\partial p^{-i}_{0,a}}{\partial p^i_{0,a}}$ is strictly lower than one.[11] This parameter captures the relative responsiveness of foreign and domestic bond prices to a debt issuance shock. As shown in (27) (Appendix A.1), in our model $\delta \in [0, 1]$. This implies that the price effect abroad always has the same sign as the domestic price effect and is weakly smaller in magnitude.[12] The

[9]Formally, $\partial_1 \Pi_0 + \beta \partial_1 \Pi_1 = \frac{1}{2}(\partial_1 p^i_{0,a} - \partial_2 p^{-i}_{0,a})B + \frac{1}{2}(p^i_{0,a} - \beta)$.

[10]However, equation (13) states that $\frac{1}{2}(p^i_{0,a} - \beta) = \beta \partial_2 \mathbb{E}_0 V^{-i}(B^{NC})$, meaning that the second component provides the exact same incentives to non-cooperative governments as the previous term. In other words, while a non-cooperative country i fails to internalize foreign investors' need for convenience services (the previous term), it accounts for the convenience yield paid by foreign investors on additional units of its debt (the second component) and the two are equivalent.

[11]In the limit case of perfect substitution, non-cooperative governments cannot benefit from manipulating bond prices. In this case, $\frac{\partial p^i_{0,a}}{\partial B^i} = \frac{\partial p^{-i}_{0,a}}{\partial B^i}$, and changes in debt issuance does not alter the relative price of domestic and foreign bonds, and the government cannot affect net resource inflows from abroad by varying issuance. The derivative of the relative price with respect to B^i is

$$\frac{\partial (p^i_{0,a}/p^{-i}_{0,a})}{\partial B^i} = \left(\frac{\partial p^i_{0,a}}{\partial B^i} - \frac{\partial p^{-i}_{0,a}}{\partial B^i} \right) \frac{1}{p^i_{0,a}}.$$

[12]Other modeling assumptions could yield $\delta < 0$ or $\delta > 1$. If $\delta > 1$, bond market power would push non-cooperative governments to increase bond supply (and not to ration it) relative to the cooperative-equilibrium, as doing so improves relative bond price. If $\delta < 0$, both bond market power and the fiscal externality would instead push toward under-issuance. In both cases, the trade-off disappears and issuance distortions are unambiguous: over-issuance or under-issuance is guaranteed, respectively.

'bond market power component' can be rearranged as $\frac{1}{2}\left(\frac{1}{\delta}-1\right)$. When $\delta < 1$, governments have incentive to reduce bond issuance to increase their own price relatively more than the foreign price. Holding the other government's issuance constant, such price manipulation allows them to raise additional debt revenue, at the expense of the foreign country.

The fact that non-cooperative governments account for their bond market power pushes them to issue less compared to the non-cooperative equilibrium, leading to under-issuance in the non-cooperative equilibrium.

Over- vs. Underissuance. The fiscal externality and bond market power distortions have opposite effects, leading to either over- or underissuance in the non-cooperative equilibrium. We characterize the conditions leading to either of the two cases with the following proposition.

Proposition 1 *We have that $B^{NC} \geq B^{CO}$ (over-issuance) if and only if:*

$$\frac{1}{2}\left(\frac{\partial p^i_{0,a}}{\partial B^i} - \frac{\partial p^{-i}_{0,a}}{\partial B^i}\right) \geq -U'\big(s_0^{NC}\big)\frac{\partial p^{-i}_{0,a}}{\partial B^i} \tag{18}$$

Proof: See Appendix B.2

Proposition 1 is intuitive, because the two sides of the inequality reflect the strength of the two distortions in the non-cooperative equilibrium. When the fiscal externality (RHS of (18)), which incentivizes overissuance dominates, the cooperative equilibrium features less debt. In contrast, when the bond market power distortion (LHS of (18)), which incentivizes underissuance, dominates, the cooperative equilibrium features more debt.

3.3 What drives under- or over-issuance?

What does the size and the direction of the wedge between cooperative and non-cooperative equilibrium debt depend on? This section investigates the role of two factors: spending needs g and the substitutability between bonds as it varies with σ the standard deviation of process governing collateral values.

Spending needs. The following proposition characterize how the level of spending needs in the two countries relates to over- and under-issuance.

Proposition 2 *For any σ, there exists a unique threshold $\tilde{g}(\sigma)$ such that if spending needs are above this threshold ($g \geq \tilde{g}$), then the non-cooperative equilibrium is characterized by over-issuance ($B^{NC} \geq B^{CO}$). Otherwise, if $g < \tilde{g}$, then $B^{NC} < B^{CO}$. Furthermore, $\tilde{g}(0) \leq 0$*

Proof: See Appendix B.3.

The market power distortion is driven primarily by the degree of substitutability between domestic and foreign bonds in investors' portfolios and is orthogonal to government spending needs. By contrast, the over-issuance force induced by the fiscal externality is tightly linked to public expenditure, g.

Spending needs pin down the level of taxation and thus the magnitude of tax distortions, which in turn governs how costly—in welfare terms—the negative price spillover from additional debt issuance is. When spending needs are low, taxes are low. Hence, when country i increases issuance, the resulting fiscal externallity forces the other country to raise taxes, but the associated marginal welfare cost is limited. As a result, a joint-welfare-maximizing planner that internalizes the spillover chooses a level of debt B^{CO} close to the noncooperative level B^{NC}. The opposite is tree when spending needs are high.

Proposition 2 formalizes this mechanism. For any strictly positive level of collateral-value volatility σ, there exists a unique threshold $\tilde{g}$ such that equilibrium debt is issued in too little quantity when $g < \tilde{g}$ and in too much quantity when $g > \tilde{g}$.

Collateral value volatility and substitutability. The second parameter we investigate is the collateral value volatility σ. When σ increases, investors become more uncertain about the future collateral value of bonds. Their portfolio becomes risky and their marginal willingness to pay for each bonds takes into account the portfolio composition and risk considerations.

First, we start by relating σ to the elasticity of substitution between bonds and market power.

Lemma 1 *The Hicksian elasticity of substitution between bonds, in any symmetric allocation, is decreasing in σ.*

$$\varepsilon_{B^i,B^{-i}}(B, B) \propto \frac{1}{\sigma^2}$$

Proof: See Appendix B.1.

As the volatility of the collateral value of two independent bonds increases, their payoffs diverge more across states of the world, raising the dispersion of their return differential [13]. As a result, investors view the bonds as less substitutable. When each bond is risky for its own idiosyncratic reasons, holding both provides a hedge: it is less likely that both bonds perform poorly at the same time, so the portfolio is more stable than concentrating in a single issuer. This makes investors reluctant to swap one bond for the other purely in response to small relative price changes. In other words, higher volatility increases the benefit of holding a mix of the two bonds, reducing investors' willingness to treat them as interchangeable and thereby making them weaker substitutes. When $\sigma = 0$, the elasticity of substitution is infinite and the two bonds are perfect substitutes. The following corollary follows from Proposition 1 and explores this case.

Corollary 1 *If $\sigma = 0$ and $s^{NC} > 0$, $B^{NC} > B^{CO}$*

Proof: If $\sigma = 0$, then $\frac{\partial p^i_{0,a}}{\partial B^i} = \frac{\partial p^{-i}_{0,a}}{\partial B^i}$. This implies that the government has no ability to manipulate the relative price: the right-hand side of (18) is equal to zero. If in equilibrium the government chooses positive tax distortions, the left-hand side is positive and proves the corollary. ■

When $\sigma = 0$, the two bonds deliver the same deterministic collateral value. As a result, any relative price deviation induces investors to shift demand entirely toward the cheaper bond. The two assets are therefore perfect substitutes. As discussed above, perfect substitutability eliminates bond market power: governments cannot manipulate relative bond prices, the under-provision force disappears, and only over-provision of safe debt can arise in equilibrium.

A second polar case is also informative and helps clarify why σ is a key determinant of the direction of the inefficiency.

Corollary 2 *There exists a level of $g = \underline{g}$ such that $s^{NC} = 0$. When $g = \underline{g}$ and $\sigma > 0$, $B^{NC} < B^{CO}$.*

Proof: See Appendix B.3

When tax distortions are absent, the properties of $U(s_t)$ imply that the marginal welfare cost of raising taxes is zero. In this case, the over-issuance force is shut down: an increase in issuance by country H lowers the price of country F's bonds and thus reduces the proceeds collected by government F, but the induced tax adjustment in F entails no welfare loss.

[13] $Var(\lambda^i - \lambda^{-i}) = Var(\lambda^i) + Var(\lambda^{-i}) - 2 \cdot Cov(\lambda^i, \lambda^{-i}) = 2 \cdot \sigma^2$

Consequently, a joint-welfare-maximizing planner would not choose a level of debt B^{CO} below the noncooperative equilibrium level B^{NC}. In addition, if governments possess bond market power—arising when $\sigma > 0$ and the elasticity of substitution between bonds is finite—this environment instead features under-provision of collateral, driven by the incentive to restrict issuance in order to improve relative bond prices and extract convenience-yield rents.

These polar cases clarify the role of collateral-value volatility. A positive σ is necessary for under-provision to arise because it makes the two bonds imperfect substitutes and thereby gives governments bond market power. Moreover, higher σ strengthens the market-power channel, as greater idiosyncratic risk increases investors' desire to hold both bonds and makes relative demands less sensitive to small relative price changes. However, a higher σ does not unambiguously make under-provision more likely. Greater collateral-value volatility also raises the riskiness of each bond and therefore depresses equilibrium bond prices, increasing governments' borrowing costs. This tightens fiscal constraints and shifts financing toward taxation, raising equilibrium tax distortions. Since higher tax distortions increase the marginal welfare cost of spillover-induced tax adjustments, this mechanism amplifies the fiscal externality and strengthens the over-provision force as well.

Which effect dominates is, in general, an empirical question. In the next section, we show that in our calibration to European economies the market-power channel dominates, so that increases in σ tend to tilt the equilibrium toward under-provision. This discussion also highlights a simple mapping from fundamentals to inefficiency: in high-spending environments with highly substitutable bonds, over-provision of safe debt is the primary concern; in low-spending environments where bonds are weak substitutes, under-provision becomes the more salient risk.

4 Quantitative Model Analysis

We use the full model to quantitatively study debt policies in the euro area, focusing on large countries whose debt is perceived as safe. After calibrating the model (Section 4.1), we assess whether the conditions in the euro area over the past decade were such that they foster under- or overissuance of debt (Section 4.2). Next, we conduct two experiments to quantify the consequences of a permanent rise in government spending needs and of further bond market integration. Finally, we examine the role of asymmetries across countries, focusing first on government spending needs (Section 4.3), and second on bond collateral values (Section 4.4).

We choose the euro area for our quantitative analysis because it provides a particularly interesting setting to study strategic debt policies. In the euro area, several large countries individually decide how much debt to issue, while this debt is perceived as safe and highly substitutable (Arcidiacono et al., 2024). This gives rise to the two distortions at the core of our analysis.

4.1 Calibration

We calibrate the model to countries in the euro area whose debt is perceived as safe. We begin with two symmetric countries for two reasons. First, this facilitates the comparison between our quantitative results and our theoretical results, which were derived under the assumption of symmetry. Second, this allows us to focus on euro area-wide circumstances and developments and to abstract from country-specific aspects. In Sections 4.3 and 4.4, we then explore the implications of country heterogeneity.

Since we want the countries in the model to represent large euro area countries whose debt is perceived as safe, we use simple averages of Germany, France, and the Netherlands for country-specific calibration targets. These countries are the three largest low-risk euro area issuers over our sample period 2015-2023.[14] Issuers of relatively safe sovereign debt have been relatively free to decide on their issuance policy. Our calibration matches empirical moments of the data with steady-state values of the non-cooperative equilibrium.

The model is calibrated at an annual frequency. First, we fix some parameters to conventional values. These fixed parameters are listed in Table 1a. The discount factor is set to $\beta = 0.99$, while φ, the inverse of the Frisch elasticity, is set to 3.25.

Second, we choose functional forms. We assume that collateral values are drawn from independent normal distributions with mean μ_λ and standard deviation σ_λ, i.e., $\lambda_t^i \sim \mathcal{N}(\mu_\lambda, \sigma_\lambda^2)$. For the return to investment f, we choose a quadratic functional form, following Mian et al. (2025): $f(i) = f_0 - \frac{f_1}{2}(i - \bar{y}_m - \bar{B})^2 = f_0 - \frac{f_1}{2}(\lambda^i \frac{B^i}{2} + \lambda^{-i} \frac{B^{-i}}{2} - \bar{B})^2$. The parameters $\bar{B}$ and f_1 govern the level and slope of bond demand, respectively. The parameter f_0 is a constant

[14] The start of our sample is constrained by the availability of credit default swap (CDS) contracts based on the 2014 ISDA Credit Derivatives Protocol, which are traded since September 22, 2014. We need these contracts to calculate convenience yields for euro area countries by removing sovereign default or currency redenomination risk premia from bond yields (Krishnamurthy et al., 2018).

Table 1: Model Calibration

Par.	Description	Value
β	Discount Factor	0.99
φ	Inv. Frisch Elasticity	3.25
$\bar{y}_m$	Endowment	2
ω	Share of "Investor"-Households	0.5
μ_λ	Expected Collateral Value	1

(a) Fixed Parameters & Normalizations

Par.	Description	Value	Target	Data	Model
f_0	Benefit Parameter 1	0.02	$f(\bar{y}_m) = 0$		
$\bar{B}$	Max. Collateral	0.89	Avg. Convenience Yield	25bps	26bps
f_1	Benefit Parameter 2	0.05	Conv. Yield Semi-Elast.	-0.01	-0.01
σ_λ	Std. dev. Collateral Value	0.325	Conv. Yield Spillover	0.9	0.90
g	Total Gov. Expenditure	0.4	Gov. Tax Revenue (% of GDP)	0.40	0.41
χ	Labor Disutil. Parameter	0.64	Debt-to-GDP Ratio	0.75	0.75

(b) Fitted Parameters

shifting the return to investment and is set to ensure that $f(\bar{y}_m) = 0$, i.e., that there is no return to investing when no collateral is available.

Third, we normalize parameters that, by themselves, are not consequential for the quantitative results. These normalized parameters are also listed in Table 1a. The exogenous endowment that each household receives in the morning is set to $\bar{y}_m = 2$. This is a high enough endowment such that borrowing is constrained by the scarcity of collateral rather than by savers' (i.e., lenders') resources. It is also a necessary condition for having a positive convenience yield in the model.[15] The share of households becoming "investors" is normalized to $\omega = 0.5$ while the average collateral value of a bond is set to $\mu_\lambda = 1$. As evident from equation (7), these two parameters can be normalized, because they determine the steady-state convenience yield together with the parameter $\bar{B}$, which governs the level of bond demand. We choose to normalize ω and μ_λ while using $\bar{B}$ to match the steady-state convenience yield, as discussed next.

[15] As long as $\bar{y}_m$ is high enough, the precise value is inconsequential. Households receive a positive endowment in the morning, but a negative endowment of the same size in the afternoon, such that the endowment does not show up in the households' period budget constraint. In addition, our functional form for f assumes that there are returns only to the investment of borrowed resources (equal to available collateral), but not to the investment of own endowment ($\bar{y}_m$). Thus, again, the precise value of $\bar{y}_m$ does not matter.

The parameters governing the demand for bonds are central to our analysis and calibrated internally, relying on data and the related literature. These internally calibrated parameters, as well as the targeted moments, are listed in Table 1b. Even though all parameters are calibrated jointly, it is useful to describe which moments are particularly informative about which parameter.

The quadratic functional form for f implies that the convenience yield is a linear function with respect to debt levels. The level of bond demand depends on the parameter $\bar{B}$, which is closely related to the average convenience yield of around 25 basis points.[16] The slope of bond demand is governed by the parameter f_1, for which we target a convenience yield semi-elasticity of -0.01, following Mian et al. (2025).[17] This implies that a 10% increase in one country's debt reduces the convenience yield of that country by 10 basis points. The standard deviation of the collateral value, σ_λ, pins down the convenience yield spillover effect. This target is set to 0.9, based on the high degree of substitutability of safe euro-area bonds estimated in Arcidiacono et al. (2024).

Moreover, we calibrate total government expenditure g by targeting government tax revenue, which is equal to 40% of GDP on average in the data. Because the analysis focuses on government revenue—through debt issuance and taxation—, government expenditure is not disaggregated, with government transfers subsumed within total expenditure g.[18] Finally, we calibrate χ, which governs the disutility of labor and affects the welfare cost of raising taxes, to target a debt-to-GDP ratio of 75%.[19]

[16]This target is computed using the average convenience yield, as defined in Jiang et al. (2025). In more detail, the convenience yield is measured as the interest rate swap (OIS) rate plus the credit default swap (CDS) rate minus the government bond yield. We use the average of the 5-year and the 10-year convenience yields, given the weighted average maturity of around 7-8 years for the three countries in our sample during the sample period (2015-2023).

[17]Mian et al. (2025) survey the literature and find most estimates of the convenience yield semi-elasticity to be between -0.01 and -0.02. Since the only estimate for the euro area is -0.008, we choose a value towards the lower end of the range, i.e., -0.01.

[18]Because household utility is linear in consumption, returning a share of government revenue to households through lump-sum transfers would leave policies and equilibrium outcomes unchanged.

[19]To compute the debt-to-GDP ratio in the model, we use the value of bonds in the beginning of the afternoon.

4.2 Over- or Underissuance? The Role of Spending and Bond Substitutability

We investigate how the non-cooperative equilibrium compares with the equilibrium that would be reached under cooperation with the same model parameters. This allows us to assess which distortion—the fiscal externality or bond market power— dominates in our calibration and whether there is under- or overissuance in the non-cooperative equilibrium.

We find that coordinating debt decisions to maximize joint welfare would result in an equilibrium debt-to-GDP ratio of about 70%. This is around 5% of GDP (7% of steady-state debt) lower than the debt ratio under non-cooperation. This implies that the lack of cooperation leads to overissuance and that the fiscal externality dominates the market power distortion.

We then examine the role two of the two key determinants of over- and underissuance identified in the theoretical section, government spending needs g and the substitutability of bonds as reflected in the convenience yield spillover coefficient δ. This allows us to corroborate our theoretical results and quantify the consequences of changes in these two determinants of debt policies. We maintain our symmetry assumption for now, and consider symmetric changes in these variables.

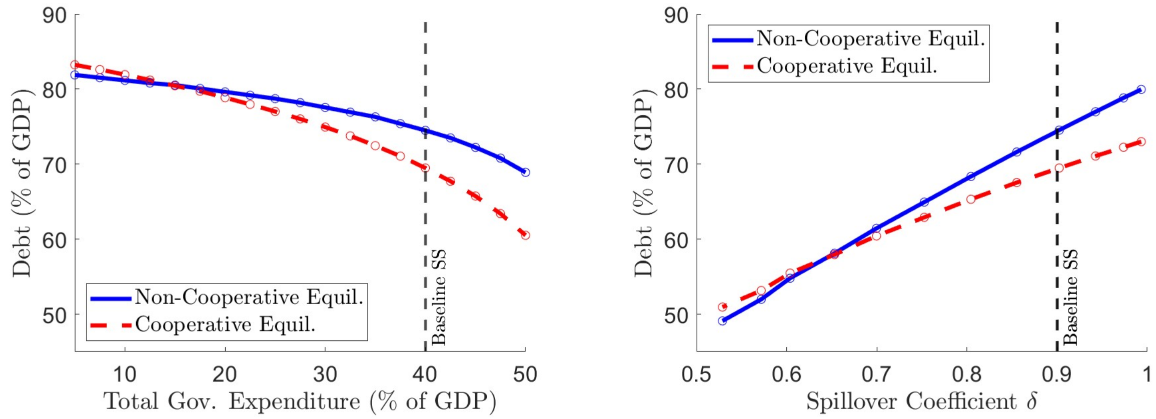
Total Spending Needs. Panel (a) of Figure 1 illustrates that an increase in both countries' spending needs g leads to lower debt, but to larger overissuance relative to the cooperative equilibrium.

The equilibrium level of debt needs to be lower because the increase in spending needs requires governments to raise more funds. They optimally achieve this with a combination of higher taxes and higher debt revenue. In any equilibrium, debt issuance is past the peak of the *Debt Laffer curve*. This is intuitive as government could otherwise finance tax cuts and reduce tax distortions with more debt without increasing financing costs and this would not be a stable equilibrium. In our equilibrium, countries finance higher expenditure by reducing debt, hence moving up the Laffer curve and lowering financing costs (i.e., raising more debt revenue). Of course, this higher debt revenue comes at the cost of a higher scarcity of collateral, which leads to lower investment and lower GDP.

Despite lower debt levels, overissuance is more pronounced because, as governments need to raise more taxes, the marginal cost of (further) taxation rises. This exacerbates the fiscal spillover, hence resulting in even more overissuance. Put differently, in a cooperative equilibrium, governments internalize the elevated fiscal externality and agree on raising even more debt revenue, by decreasing debt issuance even more than in the non-cooperative equilibrium.

The relationship between spending needs and over- and underissuance operates both ways, meaning that lower expenditure reduces overissuance and can even results in underissuance. Quantitatively, it takes a large decline in spending needs to move the equilibrium from over- to underissuance. This case arises when spending needs fall below 15% of steady-state GDP. On the other hand, an increase in spending needs of 5% of GDP, starting from the baseline g of 40% of GDP, would increase overissuance from 5.0% to 6.4% of GDP.

Figure 1: Higher Spending Needs and Substitutability of Bonds Exacerbate Overissuance



(a) Government Spending Needs (b) Bond Substitutability

Notes: Total government expenditure includes both government consumption and transfers.

Bond Substitutability. Panel (b) of Figure 1 illustrates debt policies when bonds become less (more) substitutable, as reflected in a lower (higher) convenience yield spillover coefficient δ. The spillover coefficient is endogenous, and we vary it by changing the volatility of collateral values σ_λ.[20]

As the spillover coefficient falls, governments have more safe asset market power and thus have a larger incentive to optimize international capital flows by rationing debt, exacerbating the market power distortion leading to underissuance. Quantitatively, underissuance arises

[20]It is important to recall that the limit case of "no spillovers" ($\delta = 0$) is not an "autarky" equilibrium, because investor portfolios remain internationally diversified. Therefore, without spillovers, the equilibrium must feature underissuance because only the market power distortion remains.

when the spillover coefficient falls below 0.65. Vice versa, when the spillover coefficient rises from 0.9 to 0.95, overissuance increases from 5% to 6% of GDP.

4.3 Country Differences in Spending Needs

While the symmetric case is convenient to illuminate the main mechanisms of the model, the data clearly point to cross-country differences, starting with differences in government expenditure.[21] This subsection introduces country heterogeneity in spending needs and explore its implications for debt policy and for the distortions in the absence of cooperation. To isolate the role of heterogeneity, we increase spending needs in the home country denoted by H and decrease them abroad (in F) such that average spending needs remain unchanged at 40% of GDP. All other model parameters remain the same.

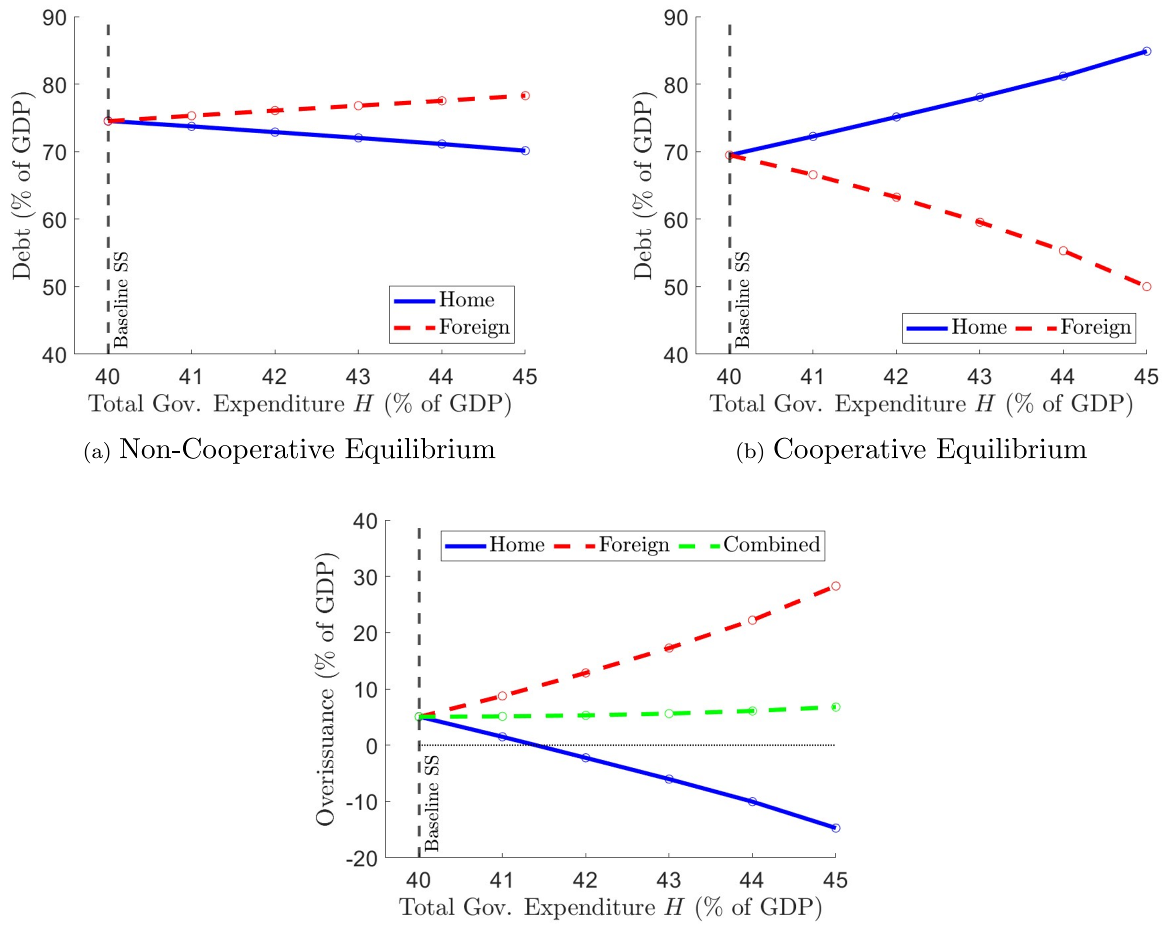
Our main quantitative result is robust. The total amount of issuance in the non-cooperative equilibrium remains higher than in the cooperative equilibrium like in the symmetric case. Moreover, we find interesting differences in debt policy and welfare impacts across countries.

Panel (a) of Figure 2 depicts debt policies in a non-cooperative equilibrium. Faced with higher spending needs, the home country needs to raise more funds, which it achieves by raising taxes and more debt revenue through lower debt issuance—moving up the Laffer curve. In contrast, the foreign country needs to raise fewer funds, not only because of lower spending needs, but also because reduced domestic issuance raises the foreign country's convenience yield. Therefore, the foreign country can afford lower taxes and is willing to issue more, both to take advantage of a higher convenience yield and to provide more collateral to investors. Thereby, it undoes the effects of the home country's debt reduction on convenience yields, but only partially. Because of the indirect effect from higher spending in home that raises convenience yields and the direct effect of lower foreign expenditure, foreign welfare is higher than in the symmetric case. If we focus on the indirect effect and increase home public expenditure without lowering foreign public expenditure, we show in Appendix C.2 that foreign welfare is still higher because of the increase in convenience yields generated by lower domestic debt.

In the cooperative equilibrium, debt policies are markedly different as illustrated in panel (b) of Figure 2. Both countries do exactly the opposite of what they do in the non-cooperative

[21] For example, in our sample period (2015-2023), France had government expenditures-to-GDP ratio above 55%, while those of Germany and the Netherlands were below 50%.

Figure 2: Asymmetric Spending Needs



(a) Non-Cooperative Equilibrium

(b) Cooperative Equilibrium

(c) Overissuance

Notes: Total government expenditure includes both government consumption and transfers.

equilibrium. Faced which higher spending needs, the home country issues more debt, while the foreign country issues less. The foreign country internalizes that higher domestic spending needs exacerbates the fiscal spillover from its own foreign issuance. Therefore, it issues less, effectively engineering a transfer to the home country by raising the domestic convenience yield. Hence, the home country can finance higher expenditure with more debt revenue, including by issuing more, and without resorting to a large tax hike. The increase in domestic taxes is lower while the tax cut at home is smaller compared to the non cooperative equilibrium. Because of the convexity of tax distortion, total welfare is higher. However, this is because of domestic gains and despite foreign losses.

The combination of less overissuance at home (the high-expenditure country) and the exacerbated over-issuance abroad results in total overissuance of a magnitude similar to the symmetric case. Panel (c) of Figure 2 depicts the difference in countries' debt levels and total debt in the non-cooperative and the cooperative equilibrium. Note that sufficiently high increases in government expenditure at home leads to domestic underissuance. Total overissuance (green line) barely changes with the magnitude of the differences in spending needs. In short, asymmetric spending needs substantially change *which* country issues too little or too much debt, but they do not change that *in sum*, there is too much debt being issued.

4.4 Country Differences in Collateral Values

We now consider countries that differ in how valuable their bonds are to investors. Before, we assumed that the two countries issue ex-ante identical bonds and, therefore, face identical bond demand functions. Differences in convenience yields arose exclusively from differences in debt levels. Yet, in the euro area, even countries with similar debt levels often earn different convenience yields (Jiang et al., 2025).[22] This subsection introduces country heterogeneity in expected collateral values μ_λ^i and explores the implications for debt policy and debt distortions. We increase μ_λ^H and simultaneously decrease μ_λ^F, such that their sum remains unchanged, i.e., $\mu_\lambda^H + \mu_\lambda^F = 2$.

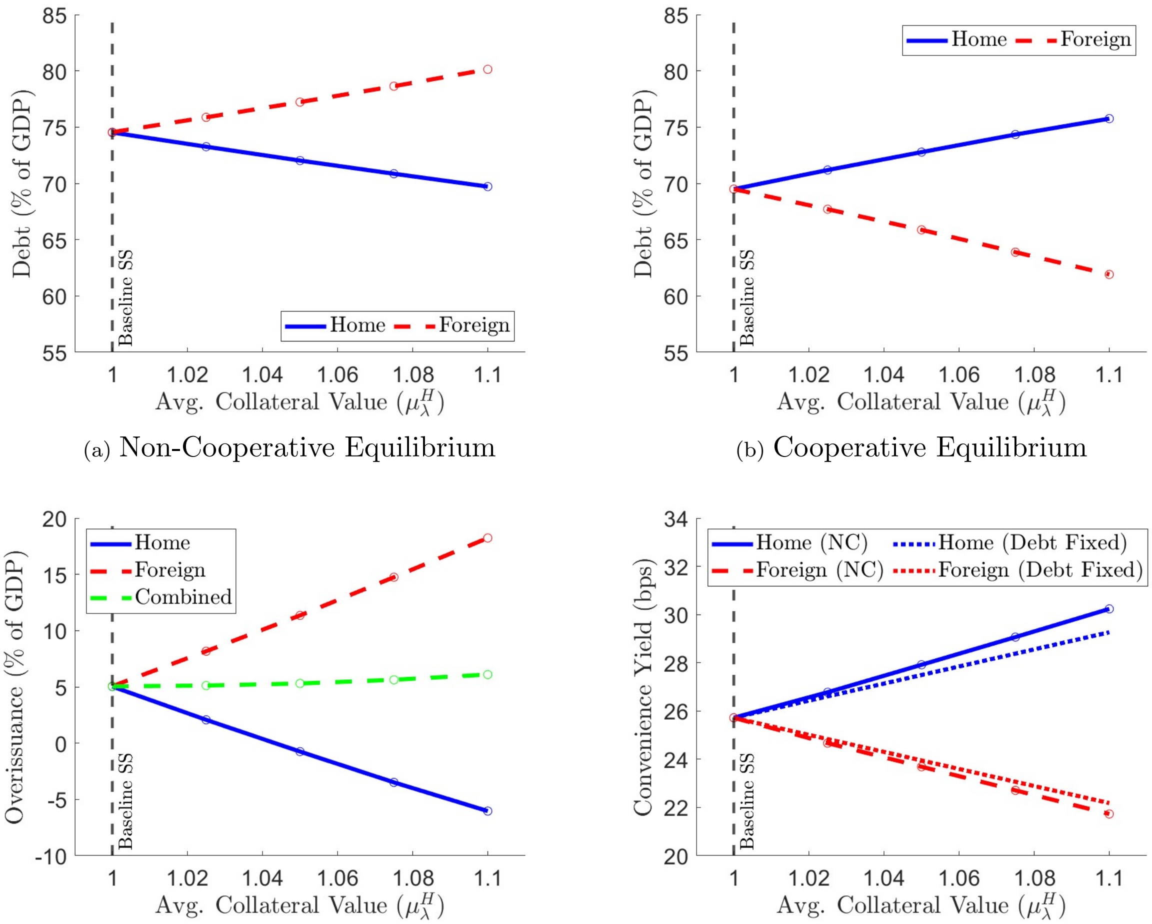
Again, the total amount of issuance in the non-cooperative equilibrium remains higher than in the cooperative equilibrium like in the symmetric case and in the case of asymmetric government expenditure. We also find that this is true even though one country—the one issuing more valuable bonds—can issue less than it would under cooperation.

Panel (a) of Figure 3 considers the non-cooperative equilibrium and shows that a rise in μ_λ^H and a decrease in μ_λ^F lead to less domestic issuance and more foreign issuance. Intuitively, this reflects that the home country has now more pricing power (a steeper demand curve) as it sells the "better" bond, while the foreign country has less pricing power (a flatter demand curve). Therefore, compared to the baseline calibration, the home country can extract more debt revenue by reducing issuance and optimally does so. The opposite is true abroad: the foreign country loses less debt revenue by issuing more debt and optimally does so in order to provide more collateral.

[22]For example, in our sample period (2015-2023), the Netherlands had a lower average debt-to-GDP ratio (54%) than Germany (66%) and nonetheless earned a lower average convenience yield (22bps) than Germany (35bps).

Panel (b) of Figure 3 illustrates that the cooperative equilibrium leads to opposite debt policies. The high-μ_λ (home) country issues more while the low-μ_λ (foreign) country issues less. Intuitively, joint welfare benefits from relatively more supply of the "better" bond providing more collateral services and less of the "worse" bond.

Figure 3: Asymmetric Collateral Values



(a) Non-Cooperative Equilibrium

(b) Cooperative Equilibrium

(c) Overissuance

(d) Convenience Yields (Comp. Equil.)

Notes: Along the x-axis, the average collateral value for H is increased, while the average collateral value for F is decreased, such that their average always remains 1. Panel (d) plots convenience yields at non-cooperative (NC) equilibrium debt levels as depicted in panel (a) (solid and dashed lines) and at baseline NC debt levels (dotted lines) which is around 75%.

We compare the non-cooperative and cooperative equilibria in Panel (c) of Figure 3. It shows that an increase in μ_λ^H (and decrease in μ_λ^F) can strengthen the market power distortion at home to the point that the country starts issuing less when it does not cooperate compared to when it cooperates. The opposite happens in the foreign country, whose market power distortion shrinks, leading to even more overissuance. Total overissuance (green line) barely changes. In short, differences in expected collateral values substantially change *which* country issues too little or too much debt, but do not change that *in sum*, there is too much debt being issued.

Finally, panel (d) illustrates the divergence in convenience yields due to asymmetric average collateral values, in the non-cooperative equilibrium (solid and dashed lines) and also in partial equilibrium-exercise which holds debt levels at the baseline (dotted lines), to isolate the role of the different collateral values.

5 Common Debt

We now study whether common debt issuance has the potential to reduce the inefficiencies that arise in the absence of cooperation, highlighted in our model. In the euro area—the setting for our quantitative analyses—there already exist several debt instruments that are considered common debt. For example, the European Commission issues bonds on behalf of all members of the European Union.[23] Throughout, we assume symmetric countries, thereby abstracting from redistributive effects of common debt, which constitute another important channel often emphasized in analyses of such instruments.

5.1 Setup

National debt policies respond to the introduction of common debt and our objective is to focus on the consequences of these strategic responses. Therefore, we revert to assuming that countries are ex-ante identical as it allows us to abstract from the gains or losses that could arise from transfers operating through the issuance and repayment of common debt. We focus on the steady state and, in every period, both countries receive proceeds from newly issued common bonds and repay the maturing bonds in equal amounts.

We also assume that the common debt, B^C, does not allow investors to diversify risks further. Technically, the collateral value of common bonds, λ_t^C, is equal to the average collateral value of both countries: $\lambda_t^C = 0.5\left(\lambda_t^i + \lambda_t^{-i}\right)$. This implies that the price of common bonds is equal to the price of national bonds. Intuitively, buying two common bonds provides investors with

[23] Other debt instruments considered common debt include bonds issued by the European Financial Stability Facility (EFSF), the European Stability Mechanism (ESM), or the European Investment Bank (EIB).

exactly the same cash flow and collateral services as buying one bond from each country. Hence, the prices of these two portfolios must also be identical.

Extending equation (7), the price of common bonds is

$$p_{t,a}^{C,i} = \beta \mathbb{E}_t \Big(1 + \omega \lambda_{t+1}^{C} f'(\bar{y}_{t,m}^{i} + \lambda_{t+1}^{i} b_{t+1}^{i,i} + \lambda_{t+1}^{-i} b_{t+1}^{-i,i} + \lambda_{t+1}^{C} b_{t+1}^{C,i}) \Big) \tag{19}$$

where, as with national bonds, common bonds will be held by investors in both countries i in equal amounts, $b_t^{C,i} = \frac{B^C}{2}$. The government budget constraint and objective function which take into account a fixed stock B^C of common bonds are relegated to Appendix C.3.

5.2 Strategic Implications of Common Debt

The setup is such that merely replacing national debt with common debt is welfare-neutral. However, the existence of a fixed stock of common debt changes governments' incentives and leads to different national debt policies in a non-cooperative equilibrium.

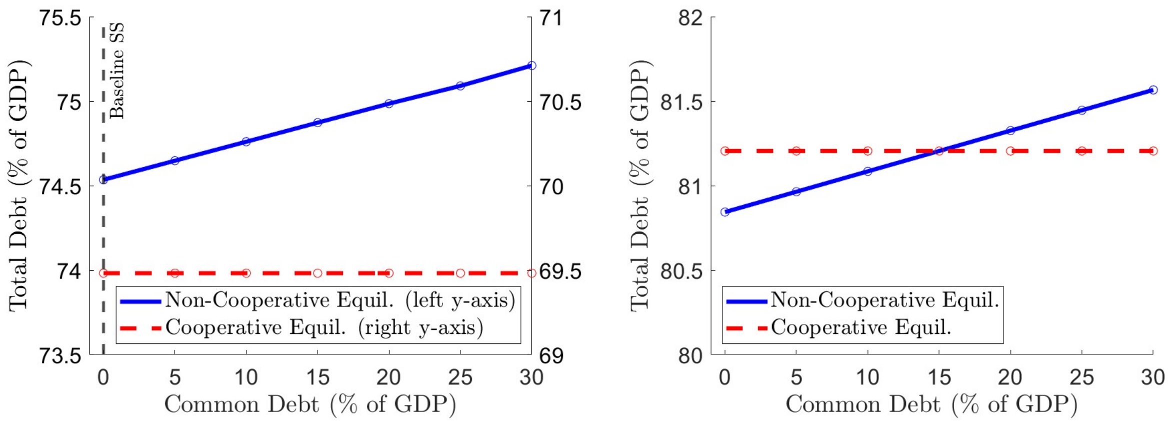
Starting from our baseline calibration, Panel (a) of Figure 4 shows that having a larger stock of common debt raises total (i.e., national + common) debt issuance in a non-cooperative equilibrium (blue lines). In a cooperative equilibrium (red lines), common debt is irrelevant for the total amount of debt, because countries adjust national issuance to ensure that the total amount of debt remains at its optimum.

Therefore, the introduction of common debt in our calibrated model leads to more overissuance. This can be rationalized by analyzing the two debt distoritions.

First, common debt weakens the market power distortion. As before, non-cooperating governments have the incentive to reduce debt issuance in order to raise the price of their own bonds held abroad. However, when investors abroad hold more common bonds and thus fewer national bonds, this incentive weakens. Put differently, by agreeing on common debt, countries agree to receiving the same price (on this debt), which in consequence reduces their incentive to manipulate prices by underissuing.

Second, common debt exacerbates the fiscal externality. In a non-cooperative equilibrium, governments do not internalize the effects of their own issuance on the other government's budget. With common debt, this spillover increases, because the spillover to common bonds is larger than to foreign bonds. When government i, via additional bond issuance, reduces its own price by 1, the bond price of $-i$ falls by 0.9—the targeted spillover coefficient. Since

Figure 4: Common Debt Raises Total Debt Issuance



(a) Baseline SS (Overissuance) (b) Alternative SS (Underissuance)

Notes: The x-axis shows common debt as a share of joint steady-state GDP. The y-axis shows total debt (national plus common) debt as a share of joint steady-state GDP. The baseline steady state (overissuance, panel a) has spending needs of $g = 0.4$, while the alternative steady state (underissuance, panel b) has $g = 0.125$.

the price of common bonds is the average national bond price, the spillover is 0.95. Hence, the more common debt there is, the more the total spillover moves from 0.9 to 0.95.

Combining the two strategic implications, we see that common debt will always *increase* the total stock of debt issued (including common debt). Starting from our baseline calibration, the exacerbation of overissuance leads to a worse equilibrium. Quantitatively however, this effect is modest. While overissuance (as % of steady-state GDP) is around 5% without common debt, it rises to around 5.7% when common debt is at 30% of GDP.

Conversely, common debt can be welfare-improving if the starting point is an equilibrium characterized by underissuance. Panel (b) of Figure 4 illustrates the case where both countries' spending needs are low ($g = 0.125$), implying that the equilibrium without common debt features underissuance. In this case, common debt of around 15% of GDP generates overissuance incentives that offsets the initial debt distortions and leads to the optimal total amount of debt as in the cooperative equilibrium.

In sum, we find that a stock of common debt leads to a better total amount of debt and therefore higher welfare if and only if the steady state features underissuance and countries do not cooperate outright.

6 Policy Implications

Our theoretical and quantitative results have three main policy implications for Europe.

Faced with rising spending pressures (International Monetary Fund, 2025a,b), European fiscal coordination is more important than ever. Our model implies that a permanent increase in public expenditure eventually requires higher tax revenue and higher debt revenue. Raising debt revenue requires *lower* debt levels—echoing the findings of Angeletos et al. (2023).

More importantly, our two-country framework shows that, absent cooperation, governments do not reduce debt sufficiently when spending rises. The reason is that higher public expenditure amplifies the fiscal externality that drives overissuance. Our quantitative results show that current economic conditions in Europe already foster an overissuance of sovereign debt. Higher spending needs therefore magnify existing distortions. A coordinated debt reduction would increase GDP and welfare relative to the non-cooperative equilibrium.. This conclusion is reinforced by evidence which suggests that bond markets are re-integrating (Mosk and de Vette, 2025; Arcidiacono et al., 2024), which weakens governments' bond market power and thereby the countervailing underissuance force.

European common debt is not a substitute for fiscal coordination. Our analysis shows that common debt cannot correct the *overissuance* distortion that likely dominates in the euro area. If anything, common debt modestly exacerbates the problem, emphasizing that fiscal coordination in Europe remains paramount.

Common debt could nonetheless raise welfare if its design made it a *superior* safe asset relative to national bonds. At present, however, this does not appear to be the case: yields on some national bonds, such as German Bunds, remain below those on European bonds. A key limitation of current common debt is its relatively small and fragmented outstanding stock, which limits liquidity. Several proposals (Blanchard and Ubide 2025; Brunnermeier et al. 2017) aim at creating a large and liquid pool of European safe assets without increasing the total (common and national) amount of European debt. In our framework, however, such proposals would induce governments to increase the total stock of debt. Yet, these proposals could still improve welfare if gains from higher collateral values outweigh the additional overissuance they induce. Hence, when it comes to European common debt, the focus should be on creating *better* assets, not on creating *more* assets.

Fiscal rules can be an effective means to not only ensure debt sustainability, but also to achieve the efficient level of debt. Current European fiscal rules focus on debt sustainability, requiring that medium-term debt projections follow a plausibly declining path. While this is a necessary condition for fiscal soundness, it is not sufficient to guarantee that debt eventually approaches its efficient level. Once debt is on a declining trajectory, the relevant policy question shifts toward the appropriate long-run level of debt. In principle, this optimal level can also be achieved by well-designed fiscal rules. However, our analysis highlights two key considerations. First, the optimal level of debt reflects a trade-off between its benefits and fiscal costs, not only for the issuer but also abroad. Even a stable and risk-free level of sovereign debt may be inefficiently high, due to the fiscal costs associated with maintaining it. Second, the efficient level of debt is state-dependent, varying with economic conditions such as public spending needs, making it an inherently elusive target.

7 Conclusion

This paper studies sovereign debt issuance in a setting with two financially integrated countries whose government bonds provide collateral services, while debt issuance generates cross-border spillovers. Because debt issued in one country affects bond prices, convenience yields, and fiscal conditions abroad, governments' issuance decisions interact strategically.

In the absence of coordination, two inefficiencies arise. Debt issuance creates a negative fiscal spillover by lowering bond prices and convenience yields abroad, tightening foreign budget constraints and increasing reliance on distortionary taxation. At the same time, when bonds are imperfect substitutes, governments possess market power in the provision of safe assets and have incentives to restrict issuance to extract convenience-yield rents from foreign investors. These forces work in opposite directions, implying that non-cooperative equilibria can feature either over- or underissuance of debt, depending on which spillover dominates.

We show that high government spending needs and highly substitutable bonds tilt the equilibrium toward overissuance, as fiscal spillovers become more costly while market power weakens. Calibrating the model to large euro area countries over the past decade, we find that prevailing conditions lead to overissuance of sovereign debt of about 5% of GDP. We further show that common debt issuance does not correct both inefficiencies and even mildly exacerbates overissuance. These results highlight the importance of fiscal coordination among financially integrated countries and that common debt issuance is not a substitute for fiscal coordination.

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A Stylized Model

A.1 Bond prices

Households, when deciding to purchase bonds, consider the probability of having an investment opportunity next period (which we assume does not depend on their types in the current period), as well as the probabilities of either (or both) countries defaulting on their bonds. The first-order conditions for $b^{H,i}_{t+1}$ and $b^{F,i}_{t+1}$ determine the demand for the bonds:

$$p^{i,i}_{t,a} = \beta \mathbb{E}_t \Big(1 + \omega \lambda^i_{t+1} f'(\bar{y}^i_{t,m} + \lambda^i_{t+1} b^{i,i}_{t+1} + \lambda^{-i}_{t+1} b^{-i.i}_{t+1}) \Big) \tag{20}$$

$$p^{i,-i}_{t,a} = \beta \mathbb{E}_t \Big(1 + \omega \lambda^i_{t+1} f'(\bar{y}^{-i}_{t,m} + \lambda^i_{t+1} b^{i,-i}_{t+1} + \lambda^{-i}_{t+1} b^{-i.-i}_{t+1}) \Big) \tag{21}$$

We now make the assumption that the two countries have the same level of endowment in the morning, that is $\bar{y}^i_{t,m} = \bar{y}^{-i}_{t,m} = \bar{y}_{t,m}$.

In equilibrium $p^{i,i}_{t,a} = p^{i,-i}_{t,a}$, which under the previous assumption implies that $b^{i,i} = b^{i,-i} = B^i/2$ and $b^{-i,i} = b^{-i,-i} = B^{-i}/2$. Therefore prices are

$$p^i_{t,a} = \beta \mathbb{E}_t \left(1 + \omega \lambda^i_{t+1} f' \left(\bar{y}^i_{t,m} + \lambda^i_{t+1} B^i_{t+1}/2 + \lambda^{-i}_{t+1} B^{-i}_{t+1}/2 \right) \right) \tag{22}$$

$$p^{-i}_{t,a} = \beta \mathbb{E}_t \left(1 + \omega \lambda^{-i}_{t+1} f' \left(\bar{y}_{t,m} + \lambda^i_{t+1} B^i_{t+1}/2 + \lambda^{-i}_{t+1} B^{-i}_{t+1}/2 \right) \right) \tag{23}$$

Note that:

$$\frac{\partial p^i_{t,a}}{\partial B^i_{t+1}} = \frac{\beta \omega}{2} \mathbb{E}_t \left[\lambda^i_{t+1} f'' \left(\bar{y}^i_{t,m} + \frac{\lambda^i_{t+1} B^i_{t+1}}{2} + \frac{\lambda^{-i}_{t+1} B^{-i}_{t+1}}{2} \right) \cdot \lambda^i_{t+1} \right] < 0, \tag{24}$$

$$\frac{\partial p^i_{t,a}}{\partial B^{-i}_{t+1}} = \frac{\beta \omega}{2} \mathbb{E}_t \left[\lambda^i_{t+1} f'' \left(\bar{y}^i_{t,m} + \frac{\lambda^i_{t+1} B^i_{t+1}}{2} + \frac{\lambda^{-i}_{t+1} B^{-i}_{t+1}}{2} \right) \cdot \lambda^{-i}_{t+1} \right] < 0. \tag{25}$$

where inequality signs come from collateral value being positive and f being concave by assumption.

In Section 3, f function is assumed to be quadratic, namely with $f''(.) = -f_1$, with $f_1 > 0$. Furthermore, collateral values λ are assumed to be identically and independently distributed.

Under this additional assumption, price derivatives become:

$$\frac{\partial p^i_{t,a}}{\partial B^i_{t+1}} = -\frac{\beta\omega f_1}{2}\,\mathbb{E}_t\big[(\lambda^i_{t+1})^2\big] < 0, \tag{26}$$

$$\frac{\partial p^i_{t,a}}{\partial B^{-i}_{t+1}} = -\frac{\beta\omega f_1}{2}\,\mathbb{E}_t\big[\lambda^i_{t+1}\big]\cdot\mathbb{E}_t\big[\lambda^{-i}_{t+1}\big] = -\frac{\beta\omega f_1}{2}\,\mathbb{E}_t\big[\lambda^i_{t+1}\big]^2 \geq \frac{\partial p^i_{t,a}}{\partial B^i_{t+1}}. \tag{27}$$

where the last inequality follows from $\mathbb{E}_t\big[(\lambda^i_{t+1})^2\big] = Var_t(\lambda^i_{t+1}) + \mathbb{E}_t\big[\lambda^i_{t+1}\big]^2$.
Furthermore, it follows that

$$\frac{\partial^2 p^i_{t,a}}{\partial (B^i_{t+1})^2} = \frac{\partial^2 p^i_{t,a}}{\partial (B^{-i}_{t+1})^2} = 0 \tag{28}$$

A.2 Welfare and its components

The expected utility in period t calculated in the afternoon of period $t-1$ is:

$$\begin{aligned}\mathbb{E}_{t-1}(u^i_t) = \int \Big\{ & b^{i,i}_t + b^{-i,i}_t - p^i_{t,a}(B^i_{t+1}, B^{-i}_{t+1})b^{i,i}_{t+1} - p^{-i}_{t,a}(B^{-i}_{t+1}, B^i_{t+1})b^{-i,i}_{t+1} \\ & + U^i(s^i_t) + \tilde{V}^i(b^{i,i}_t, b^{-i,i}_t\ ;\ \lambda^i_t, \lambda^{-i}_t) - \tau^i_t w^i_t l^i_t \Big\} dF(\lambda^i_t, \lambda^{-i}_t)\end{aligned}$$

where we introduce two convenient functions:

$$\begin{aligned} U^i(s^i_t) &= w^i_t l^i_t(s^i_t) - \frac{l^i_t(s^i_t)^{1+\varphi}}{1+\varphi} \\ \tilde{V}^i(b^i_t, b^{-i}_t) &= \bar{y}_{t,m} + \omega\Big[f(\bar{y}_{t,m} + \lambda^i_t b^{i,i}_t + \lambda^{-i}_t b^{-i,i}_t)\Big]\end{aligned}$$

and $l^i_t(s^i_t)$ is obtained solving workers FOC (6).

From (8)

$$\begin{aligned}\tau^i_t w^i_t l^i_t = s^i_t &= g^i_t + B^i_t - p^i_{t,a}B^i_{t+1} \\ &= g^i_t + b^{i,i}_t + b^{i,-i}_t - p^i_{t,a}(b^{i,i}_{t+1} + b^{i,-i}_{t+1})\end{aligned}$$

Now we can plug this in ex ante period t utility to obtain:

$$\mathbb{E}_{t-1}(u_t^i) = \int \Big\{ U^i(l_t^i) + \tilde{V}^i(b_t^{i,i}, b_t^{-i,i}\ ;\ \lambda_t^i, \lambda_t^{-i}) - g_t^i + \underbrace{\left[\left(b_t^{-i,i} - p_{t,a}^{-i} b_{t+1}^{-i,i}\right) - \left(b_t^{i,-i} - p_{t,a}^{i} b_{t+1}^{i,-i}\right)\right]}_{\Pi_t(b_t^{i,-i}, b_t^{-i,i}, b_{t+1}^{i,-i}, b_{t+1}^{-i,i}):\ \textit{current account}} \Big\} dF(\lambda_t^i, \lambda_t^{-i}) \tag{29}$$

Welfare cost of taxation $U(s_t^i)$. The function $U^i(s^i)$, which captures the distortion caused by labor income taxation, cannot be written explicitly and hence needs to be solved numerically. First, using the definition of tax revenue (per capita) and the household's labor supply decision

$$s_t^i = \tau^i l_t^i \tag{30}$$

$$\chi(l_t^i)^{\varphi} = 1 - \tau^i \tag{31}$$

determines labor supply l^i as a function of s^i.

In a more compact fashion, we can write:

$$s_t^i = \left[1 - \chi(l_t^i)^{\varphi}\right] l_t^i \tag{32}$$

Note that:

$$\frac{\partial s_t^i}{\partial l_t^i} = 1 - \chi(\varphi+1)(l_t^i)^{\varphi}$$

$$\frac{\partial^2 s_t^i}{\partial (l_t^i)^2} = -\chi(\varphi+1)\varphi(l_t^i)^{\varphi-1} < 0$$

which shows that s (the Laffer curve) is a concave function with a unique maximum at $\bar{l} = \left(\frac{1}{\chi(\varphi+1)}\right)^{1/\varphi} < 1$ and there it takes value

$$\bar{s} = \frac{\chi(\varphi+1) - 1}{\left[\chi(\varphi+1)\right]^{\frac{\varphi+1}{\varphi}}}$$

Notice also that the undistorted (first-best) labor choice would have been $l^* = (\frac{1}{\chi})^{1/\varphi}$.

This implies that the Laffer curve peaks at $\bar{s}$ and government will never choose taxes such that l_t^i would fall below $\bar{l}$. Hence the optimal l_t^i would fall in the interval $(\bar{l}, l^*)$. In this section of the Laffer curve $s_t^i(l_t^i)$, the tax revenues are decreasing and concave in l_t^i. Hence we can think of the government directly choosing tax revenues s_t^i and consequently determining a unique $l_t^i(s_t^i)$.

Hence we can show the following properties of the function $U(s_t)$

Lemma 2 *$U(s_t)$ is decreasing and concave in s_t: $U'(s_t), U''(s_t) < 0$. Furthermore* $\lim_{s\to\bar{s}} U'(s) = -\infty$

Proof.

$$U'(s_t^i) = \frac{\partial l_t^i}{\partial s_t^i}[1 - \chi(l_t^i)^\varphi] = \frac{\partial l_t^i}{\partial s_t^i}\tau < 0$$

since $\frac{\partial l_t^i}{\partial s_t^i} = (\frac{\partial s_t^i}{\partial l_t^i})^{-1} < 0$ and given that $\frac{\partial s_t^i}{\partial l_t^i} < 0$ in the interval of interest $(\bar{l}, l^*)$. By definition of $\bar{s}$, $\frac{\partial s_t^i}{\partial l_t^i} = 0$ if $s = \bar{s}$, implying that $U'(s)$ negatively diverges as s approaches $\bar{s}$

Furthermore,

$$U''(s_t^i) = \frac{\partial^2 l_t^i}{\partial (s_t^i)^2}[1 - \chi(l_t^i)^\varphi] - \chi\varphi(l_t^i)^{\varphi-1}\left[\frac{\partial l_t^i}{\partial s_t^i}\right]^2 = \frac{\partial^2 l_t^i}{\partial (s_t^i)^2}\tau - \chi\varphi(l_t^i)^{\varphi-1}\left[\frac{\partial l_t^i}{\partial s_t^i}\right]^2 < 0 \quad (33)$$

since $\chi, \varphi > 0$ and $\frac{\partial^2 l_t^i}{\partial (s_t^i)^2} = -\frac{\partial^2 s_t^i}{\partial (l_t^i)^2}(\frac{\partial s_t^i}{\partial l_t^i})^{-3} < 0$ (s is concave and decreasing in l). ■

In addition, we impose that τ^i cannot be negative. When $s_t^i < 0$, resources are burned and not redistributed to households. Thus, any $s^i < 0$ achieves $U^i(s^i = 0)$ and $l_t^i = l^*$.

Welfare gain of providing collateral: $\mathbb{E}_t V^i(B_{t+1}^i, B_{t+1}^{-i})$ This function represents the expected utility gain that household get from the provision of collateral. Note that:

$$\mathbb{E}_t\left[\frac{\partial V^i(B_{t+1}^i, B_{t+1}^{-i})}{\partial B_{t+1}^i}\right] = \frac{1}{2}\mathbb{E}_t\left[\omega\lambda_{t+1}^i f'\left(\bar{y}_{t,m} + \lambda_{t+1}^i\frac{B_t^i}{2} + \lambda_{t+1}^{-i}\frac{B_t^{-i}}{2}\right)\right] > 0 \quad (34)$$

$$\mathbb{E}_t\left[\frac{\partial V^i(B_{t+1}^i, B_{t+1}^{-i})}{\partial B_{t+1}^{-i}}\right] = \frac{1}{2}\mathbb{E}_t\left[\omega\lambda_{t+1}^{-i} f'\left(\bar{y}_{t,m} + \lambda_{t+1}^i\frac{B_t^i}{2} + \lambda_{t+1}^{-i}\frac{B_t^{-i}}{2}\right)\right] > 0 \quad (35)$$

and,

$$\mathbb{E}_t\left[\frac{\partial^2 V^i(B^i_{t+1},B^{-i}_{t+1})}{(\partial B^i_{t+1})^2}\right] = \frac{1}{4}\mathbb{E}_t\left[\omega(\lambda^i_{t+1})^2 f''\left(\bar{y}_{t,m}+\lambda^i_{t+1}\frac{B^i_t}{2}+\lambda^{-i}_{t+1}\frac{B^{-i}_t}{2}\right)\right] < 0 \tag{36}$$

$$\mathbb{E}_t\left[\frac{\partial^2 V^i(B^i_{t+1},B^{-i}_{t+1})}{(\partial B^{-i}_{t+1})^2}\right] = \frac{1}{4}\mathbb{E}_t\left[\omega(\lambda^{-i}_{t+1})^2 f''\left(\bar{y}_{t,m}+\lambda^i_{t+1}\frac{B^i_t}{2}+\lambda^{-i}_{t+1}\frac{B^{-i}_t}{2}\right)\right] < 0 \tag{37}$$

$$\mathbb{E}_t\left[\frac{\partial^2 V^i(B^i_{t+1},B^{-i}_{t+1})}{\partial B^i_{t+1}\,\partial B^{-i}_{t+1}}\right] = \frac{1}{4}\mathbb{E}_t\left[\omega\lambda^i_{t+1}\cdot\lambda^{-i}_{t+1} f''\left(\bar{y}_{t,m}+\lambda^i_{t+1}\frac{B^i_t}{2}+\lambda^{-i}_{t+1}\frac{B^{-i}_t}{2}\right)\right] < 0 \tag{38}$$

As in Angeletos et al. (2023), the private and the public value of debt coincide. The *excess* willingness to pay of investors for each bond is always equal to the marginal welfare gain from issuing that bond. In other words, it follows from (34) and (7) that:

$$\beta\mathbb{E}_t\left[\frac{\partial V^i(B^i_{t+1},B^{-i}_{t+1})}{\partial B^i_{t+1}}\right] = \frac{p^i_{0,a}-\beta}{2} \tag{39}$$

A.3 Equilibrium Definitions

In our simplified framework, the equilibrium levels of public debt when each government separately maximizes the welfare of its own households are defined as follows.

Definition 2 A strategy profile $\{\,B^{i,NC},\, s_0^{i,NC},\, s_1^{i,NC}\}_{i\in\{H,F\}}$ and prices $\left(p_{0,a}^{i,NC}, p_{0,a}^{-i,NC}\right)$ are a *Non-Cooperative Equilibrium* if, for each country $i\in\{H,F\}$, the strategy solves

$$W_0^{i,NE} = \max_{B^i} W_0^i(\,B^i,\, s_0^i,\, s_1^i\ ;\ B^{-i},\lambda_1^i,\lambda_1^{-i}) \quad s.t.\ \ s_0^i + p_{0,a}^i\big(B^i,\,B^{-i}\big)\,B^i = g, \qquad s_1^i = B^i, \tag{40}$$

where bond prices are determined by (7) and B^{-i} denotes the debt issued by the other country.

Alternatively, the equilibrium levels of debt when countries jointly maximized aggregate welfare are defined as follows.

Definition 3 A strategy profile $\{\,B^{i,CO},\, s_0^{i,CO},\, s_1^{i,CO}\}_{i\in\{H,F\}}$ and prices $\left(p_{0,a}^{i,CO}, p_{0,a}^{-i,CO}\right)$ are a

Cooperative Equilibrium if the strategy solves

$$\max_{\{B^i, B^{-i}\}} \sum_{i=H,F} U(s_0^i) + \beta U(s_1^i) + \beta \mathbb{E}_0 V^i\big(B^i,\, B^{-i}\big) \;\; s.t. \;\; \begin{aligned} s_0^i + p_{0,a}^i\big(B^i,\, B^{-i}\big)\, B^i &= g, \quad \forall i \\ s_1^i &= B^i, \quad \forall i \end{aligned} \tag{41}$$

where bond prices are determined by (7)

Crucially in the cooperative case, our symmetry assumption implies that international flows cancel out and the Π terms are absent from the objective function.

B Proofs & Propositions

Assumption 1 *Bond demand is inelastic with respect to total issuance for all admissible level of debt B, that is:*

$$\partial_1 p_{0,a} \bar{s} + \partial_2 p_{0,a} \bar{s} + p_{0,a}(\bar{s}, \bar{s}) > 0$$

Lemma 3 *Debt issuance B satisfies both budget constraints if and only if $B \in [\,\underline{B}(g),\, \bar{s}\,]$, where $\underline{B}(g)$ is the unique solution to*

$$g - p_{0,a}^i(\underline{B}, \underline{B})\, \underline{B} = \bar{s}.$$

Moreover, any equilibrium features $B \in (\,\underline{B}(g),\, \bar{s}\,)$. The lower bound $\underline{B}(g)$ is strictly increasing and strictly convex in g.

Proof. Define symmetric debt proceeds $R(B) \equiv p_{0,a}(B, B)\, B$. Because the price function is affine in each argument under the quadratic-f assumption (all second derivatives vanish, equation 28), the symmetric price schedule $p_{0,a}(B, B)$ is itself affine in B:

$$p_{0,a}(B, B) \;=\; p_{0,a}(0, 0) + \big(\partial_1 p_{0,a} + \partial_2 p_{0,a}\big)\, B.$$

Multiplying by B, proceeds are quadratic:

$$R(B) \;=\; p_{0,a}(0, 0)\, B \;+\; \big(\partial_1 p_{0,a} + \partial_2 p_{0,a}\big)\, B^2,$$

with $R(0) = 0$, $\;R'(0) = p_{0,a}(0, 0) > 0$, and $\;R'' = 2\big(\partial_1 p_{0,a} + \partial_2 p_{0,a}\big) < 0$, where the sign of R'' follows from both price derivatives being strictly negative (27).

To establish that R is strictly increasing on the relevant domain, note that Assumption 1 is equivalent to $R'(\bar{s}) > 0$.[24] Since R is strictly concave ($R'' < 0$), R' is a decreasing function and attains its minimum on $[0, \bar{s}]$ at $B = \bar{s}$. Hence $R'(\bar{s}) > 0$ implies $R'(B) > 0$ for all $B \in [0, \bar{s}]$, and R is strictly increasing on this interval.

(i) Upper bound. The period-1 budget constraint requires $s_1 = B$. Since the Laffer curve peaks at $\bar{s}$ and the government never operates beyond this peak, feasibility requires $B \leq \bar{s}$.

(ii) Lower bound. The period-0 budget constraint gives $s_0 = g - R(B)$. Feasibility requires $s_0 \leq \bar{s}$, i.e.

$$R(B) \;\geq\; g - \bar{s}. \tag{42}$$

For $g > \bar{s}$, this is a binding constraint. Because R is continuous and strictly increasing on $[0, \bar{s}]$ with $R(0) = 0$, the equation $R(\underline{B}) = g - \bar{s}$ has a unique solution $\underline{B}(g) \in (0, \bar{s})$ for every $g \in \big(\bar{s},\, \bar{g}\,\big)$, where $\bar{g} \equiv \bar{s} + R(\bar{s})$ is the spending level at which the feasible set collapses to a point ($\underline{B}(\bar{g}) = \bar{s}$).

(iii) Equilibria are interior. The feasible set is the closed interval $[\underline{B}(g),\, \bar{s}]$. At the upper boundary $B = \bar{s}$, period-1 tax revenue equals $s_1 = \bar{s}$; at the lower boundary $B = \underline{B}(g)$, period-0 tax revenue equals $s_0 = \bar{s}$. In either case, $U'(s) \to -\infty$ as $s \to \bar{s}$ (Lemma 2), so the marginal welfare cost of taxation diverges. No optimum of either the non-cooperative or cooperative problem can therefore be attained at a boundary. Hence any equilibrium B lies in the open interval $\big(\underline{B}(g),\, \bar{s}\big)$.

(iv) $\underline{B}(g)$ is strictly increasing and strictly convex. Applying the implicit function theorem to $R(\underline{B}(g)) = g - \bar{s}$:

$$\frac{d\underline{B}}{dg} \;=\; \frac{1}{R'(\underline{B})} \;>\; 0,$$

since $R'(\underline{B}) > 0$ on $(0, \bar{s})$. Differentiating once more,

$$\frac{d^2\underline{B}}{dg^2} \;=\; -\,\frac{R''(\underline{B})}{\big[\,R'(\underline{B})\,\big]^2} \cdot \frac{d\underline{B}}{dg} \;=\; -\,\frac{R''(\underline{B})}{\big[\,R'(\underline{B})\,\big]^3} \;>\; 0,$$

since $R'' < 0$ and $R'(\underline{B}) > 0$. ■

[24]Expanding: $R'(B) = p_{0,a}(B, B) + (\partial_1 p_{0,a} + \partial_2 p_{0,a})\, B$. Evaluating at $B = \bar{s}$ and using linearity of $p_{0,a}(B, B)$ reproduces the expression in Assumption 1.

B.1 Proof of the Lemma 1

At a symmetric allocation $B^i = B^{-i} = B$ with common price $p_{0,a} \equiv p^i_{0,a}(B,B) = p^{-i}_{0,a}(B,B)$, the Hicksian elasticity of substitution between domestic and foreign bonds is

$$\varepsilon_{B^i,B^{-i}}(B,B) \;=\; -\,\frac{p_{0,a}/B}{\dfrac{\partial p^i_{0,a}}{\partial B^i} \;-\; \dfrac{\partial p^{-i}_{0,a}}{\partial B^i}}. \tag{43}$$

Under the maintained assumptions that $f'' = -f_1$ and collateral values λ^i, λ^{-i} are i.i.d. with $\mathbb{E}[\lambda^i] = 1$ and $\mathrm{Var}(\lambda^i) = \sigma^2$, the price derivatives in (27) become

$$\frac{\partial p^i_{0,a}}{\partial B^i} = -\frac{\beta\omega f_1}{2}\,\mathbb{E}\big[(\lambda^i)^2\big] = -\frac{\beta\omega f_1}{2}\left(1+\sigma^2\right), \tag{44}$$

$$\frac{\partial p^{-i}_{0,a}}{\partial B^i} = -\frac{\beta\omega f_1}{2}\left(\mathbb{E}[\lambda^i]\right)^2 = -\frac{\beta\omega f_1}{2}, \tag{45}$$

where the factorization in (45) uses independence. Subtracting,

$$\frac{\partial p^i_{0,a}}{\partial B^i} \;-\; \frac{\partial p^{-i}_{0,a}}{\partial B^i} \;=\; -\frac{\beta\omega f_1}{2}\,\sigma^2. \tag{46}$$

Substituting (46) into (43) yields

$$\varepsilon_{B^i,B^{-i}}(B,B) \;=\; \frac{2\,p_{0,a}(B,B)}{\beta\,\omega\,f_1\,B\,\sigma^2}. \tag{47}$$

It remains to verify that ε is strictly decreasing in σ, which requires signing the dependence of $p_{0,a}$ on σ^2. Under the quadratic specification and the two-point distribution for λ, evaluating (22) at a symmetric allocation gives

$$p_{0,a}(B,B) \;=\; \beta\left[1 + \omega f'(\bar{y}_{0,m} + B/2) - \frac{\omega f_1 B}{4}\,\sigma^2\right],$$

where the first two terms collect the components that are independent of σ. Define their sum as $A \equiv 1 + \omega f'(\bar{y}_{0,m} + B/2) > 1$. Then

$$\varepsilon_{B^i,B^{-i}}(B,B) \;=\; \frac{2\left(A - \frac{\omega f_1 B}{4}\,\sigma^2\right)}{\omega\,f_1\,B\,\sigma^2} \;=\; \frac{2A}{\omega\,f_1\,B}\,\frac{1}{\sigma^2} \;-\; \frac{1}{2}. \tag{48}$$

Expression (48) establishes the result. The elasticity is an affine transformation of $1/\sigma^2$ with a strictly positive coefficient $2A/(\omega f_1 B)$, and is therefore strictly decreasing (in absolute value) in σ^2 (and hence in σ).

B.2 Proof of Proposition 1

We start by studying the two problems - non-cooperation and cooperation- in isolation. We state the FOCs of each problem.

Non-Cooperative Equilibrium Following Definition 2, for each country i we will have the following FOCs:

$$\begin{aligned} 0 = &- U'\big(g - p^i_{0,a}(B^i, B^{-i})\, B^i\big) \left[p^i_{0,a}(B^i, B^{-i}) + B^i\, \partial_1 p^i_{0,a}(B^i, B^{-i})\right] \\ &+ \partial_1 \Pi_0(B^i, B^{-i}) \;+\; \beta \left\{ U'(B^i) + \partial_1 \Pi_1(B^i, B^{-i}) + \partial_1 \mathbb{E}_0 V^i(B^i,\, B^{-i}) \right\}. \end{aligned}$$

where, for each function $m(B^i, B^{-i})$, $\partial_1 m^i(B^i, B^{-i}) = \frac{\partial m^i}{\partial B^i}$ and $\partial_2 m^i = \frac{\partial m^i}{\partial B^{-i}}$

If the two countries are ex-ante symmetric, we can focus on symmetric equilibria where $B^H = B^F = B$. The two FOCs collapse to one:

$$\begin{aligned} 0 = &- U'\big(g - p^i_{0,a}(B, B)\, B\big) \left[p^i_{0,a}(B, B) + B\, \partial_1 p^i_{0,a}(B, B)\right] \\ &+ \partial_1 \Pi_0(B, B) \;+\; \beta \left\{ U'(B) + \partial_1 \Pi_1(B, B) + \partial_1 \mathbb{E}_0 V^i(B,\, B) \right\} = F^{NC}(B). \end{aligned} \tag{49}$$

Note that (dropping the arguments of functions for clarity),

$$\begin{aligned} \frac{\partial F^{NC}(B)}{\partial B} &= U''(.)\left[B\,(\partial_1 p_{0,a} + \partial_2 p_{0,a}) + p_{0,a}\right](p_{0,a} + B\,\partial_1 p_{0,a}) \\ &- U'(.)\left(\partial_1 p_{0,a} + \partial_2 p_{0,a} + \partial_1 p_{0,a} + B\,\partial_1^2 p_{0,a} + B\,\partial_1\partial_2 p_{0,a}\right) + \partial_1^2 \Pi_0 + \partial_2 \partial_1 \Pi_0 \\ &+ \beta\left[U''(.) + \partial_1^2 \mathbb{E}_0 V + \partial_2\partial_1 \mathbb{E}_0 V + \partial_1^2 \Pi_1 + \partial_2 \partial_1 \Pi_1\right] \end{aligned} \tag{50}$$

It follows that:

Lemma 4 *Under Assumption 1, there exists a unique symmetric non-cooperative equilibrium.*

Proof.

Existence. We show that F^{NC} changes sign on the feasible interval $(\underline{B}(g),\, \bar{s})$ established in Lemma 3.

Using the definitions of Π_0^i and Π_1^i from (15), the derivative of net financial flows at a symmetric allocation is

$$\partial_1 \Pi_0(B,B) = \frac{1}{2}\big[p_{0,a} + B\,\partial_1 p_{0,a}\big] - \frac{1}{2}\big[\partial_2 p_{0,a}\, B\big], \qquad \partial_1 \Pi_1(B,B) = -\tfrac{1}{2}.$$

These are polynomial in B (since prices are affine) and therefore bounded on $[0, \bar{s}]$. The same is true of $\partial_1 \mathbb{E}_0 V^i(B,B)$.

We also need that $p_{0,a}(B,B) + B\,\partial_1 p_{0,a}(B,B) > 0$ on $(\underline{B}(g),\, \bar{s})$. Since $\partial_2 p_{0,a} < 0$, we have

$$p_{0,a}(B,B) + B\,\partial_1 p_{0,a}(B,B) \;>\; p_{0,a}(B,B) + B\big(\partial_1 p_{0,a}(B,B) + \partial_2 p_{0,a}(B,B)\big) \;=\; R'(B) \;>\; 0,$$

where the last inequality follows from Assumption 1 and the strict concavity of R, as established in Lemma 3.

Lower boundary. As $B \to \underline{B}(g)^+$, period-0 tax revenue $s_0 = g - R(B) \to \bar{s}$, so $U'(s_0) \to -\infty$ by Lemma 2. Since $p_{0,a} + B\,\partial_1 p_{0,a} > 0$ is bounded away from zero, the first term in (49), $-U'(s_0)\big[p_{0,a} + B\,\partial_1 p_{0,a}\big]$, diverges to $+\infty$. All remaining terms—$\partial_1\Pi_0$, $\beta U'(B)$, $\beta\partial_1\Pi_1$, and $\beta\partial_1\mathbb{E}_0 V^i$—are finite, since $s_1 = B$ is bounded away from $\bar{s}$ and all Π- and V-terms are polynomial. Therefore $F^{NC}(B) \to +\infty$.

Upper boundary. As $B \to \bar{s}^-$, period-1 tax revenue $s_1 = B \to \bar{s}$, so $\beta U'(B) \to -\infty$ by Lemma 2. Meanwhile, period-0 tax revenue $s_0 = g - R(\bar{s})$ is strictly below $\bar{s}$ for $g < \bar{g}$,[25] so $U'(s_0)$ is finite. All Π- and V-terms are also finite. Therefore $F^{NC}(B) \to -\infty$.

Since F^{NC} is continuous on $(\underline{B}(g),\, \bar{s})$ and diverges to opposite signs at the boundaries, the intermediate value theorem guarantees that $F^{NC}(B^{NC}) = 0$ for at least one $B^{NC} \in (\underline{B}(g),\, \bar{s})$.

Uniqueness. Monotonicity of $F^{NC}(B)$ guarantees uniqueness. It is straightforward to verify that

$$\frac{\partial F^{NC}(B)}{\partial B} < 0.$$

[25] Since R is strictly increasing and $\bar{s} > \underline{B}(g)$, we have $R(\bar{s}) > R(\underline{B}(g)) = g - \bar{s}$, so $s_0 = g - R(\bar{s}) < \bar{s}$.

This follows from the following observations.

First, the utility function is strictly concave, so that $U'(\cdot) < 0$ and $U''(\cdot) < 0$, as shown in Lemma 2.

Second, Assumption 1 implies

$$B\,\partial_1 p_{0,a}(B,B) + p_{0,a}(B,B) \;>\; B\big(\partial_1 p_{0,a}(B,B) + \partial_2 p_{0,a}(B,B)\big) + p_{0,a}(B,B) \;>\; 0.$$

Third, prices are decreasing in both arguments, i.e. $\partial_1 p_{0,a}(B,B) < 0$ and $\partial_2 p_{0,a}(B,B) < 0$, as shown in (27).

Fourth, the price function is linear, so that all second-order derivatives vanish:

$$\partial_1^2 p_{0,a}(B,B) = \partial_1\partial_2 p_{0,a}(B,B) = 0,$$

as stated in (28).

Fifth, combining (27) with the definition of net financial flows, yields

$$\partial_1^2 \Pi_0(B,B) + \partial_2\partial_1\Pi_0(B,B) = \partial_1 p_{0,a}(B,B) - \partial_2 p_{0,a}(B,B) < 0.$$

Finally, welfare gain from providing collateral is strictly concave, implying

$$\partial_1^2 \mathbb{E}_0 V(B,B) < 0, \qquad \partial_2\partial_1 \mathbb{E}_0 V(B,B) < 0,$$

as shown in (36), while $\partial_1 \Pi_1 = -\beta/2$ implies $\partial_1^2 \Pi_1 = \partial_2\partial_1\Pi_1 = 0$.

Taken together, these conditions ensure that $\partial F^{NC}(B)/\partial B$ is strictly negative. ■

Cooperative Equilibrium Now we solve the problem under coordination, where each government maximizes joint welfare of the two countries, but it is still constrained by individual countries budget constraints.

Solving the problem defined in Definition 3, for each $i \in \{H, F\}$ we have,

$$\begin{aligned} 0 = & - U'\big(g^i - p^i_{0,a}(B^i, B^{-i})\, B^i\big) \left[p^i_{0,a}(B^i, B^{-i}) + B^i\, \partial_1 p^i_{0,a}(B^i, B^{-i})\right] \\ & - U'\left(g^{-i} - p^{-i}_{0,a}(B^{-i}, B^i)B^{-i}\right)\left[\partial_2 p^{-i}_{0,a}(B^{-i}, B^i)B^{-i}\right] \\ & + \beta\left\{U'(B^i) + \partial_1 \mathbb{E}_0 V^i(B^i,\, B^{-i}) + \partial_2 \mathbb{E}_0 V^{-i}(B^{-i},\, B^i)\right\}. \end{aligned}$$

Now we focus on the symmetric case. Impose $B^H = B^F = B$ and evaluate prices and derivatives at (B, B). Then the two FOCs collapse to the same:

$$\begin{aligned} 0 = & - U'\big(g - p_{0,a}(B,B)\, B\big) \left[p_{0,a}(B,B) + B\, \partial_1 p_{0,a}\right] \\ & - U'\left(g - p_{0,a}(B,B)B\right)\left[\partial_2 p_{0,a} B\right] \\ & + \beta\left\{U'(B) + \partial_1 V(B,\, B) + \partial_2 V(B, B)\right\} = F^{CO}(B). \end{aligned} \tag{51}$$

Note that

$$\begin{aligned} \frac{\partial F^{CO}(B)}{\partial B} = & \, U''(.)\left(p_{0,a} + B\, \partial_1 p_{0,a} + B\, \partial_2 p_{0,a}\right)^2 \\ & - U'(.)\left(\partial_1 p_{0,a} + \partial_2 p_{0,a} + \partial_1 p_{0,a} + \partial_2 p_{0,a} + B\, \partial_1^2 p_{0,a} + B\, \partial_1\partial_2 p_{0,a} + B\, \partial_2^2 p_{0,a} + B\, \partial_2\partial_1 p_{0,a}\right) \\ & + \beta\left[U''(.) + \partial_1^2 \mathbb{E}_0 V + \partial_2\partial_1 \mathbb{E}_0 V + + \partial_2^2 \mathbb{E}_0 V + \partial_1\partial_2 \mathbb{E}_0 V\right] \end{aligned} \tag{52}$$

The following Lemma follows.

Lemma 5 *There exists a unique symmetric cooperative equilibrium.*

Proof. $\frac{\partial F^{CO}(B)}{\partial B} < 0$ guarantees uniqueness of the symmetric cooperative equilibrium. This can be shown analogously to the proof of Lemma 4. ■

Existence. We show that F^{CO} changes sign on the feasible interval $(\underline{B}(g),\, \bar{s})$ established in Lemma 3.

Combining the first two lines of (51),

$$F^{CO}(B) \;=\; -U'\big(g - R(B)\big)\, R'(B) \;+\; \beta\Big\{U'(B) + \partial_1 \mathbb{E}_0 V(B,B) + \partial_2 \mathbb{E}_0 V(B,B)\Big\}, \tag{53}$$

where $R(B) \equiv p_{0,a}(B,B)\,B$ denotes symmetric debt proceeds and $R'(B) = p_{0,a}(B,B) + \big(\partial_1 p_{0,a} + \partial_2 p_{0,a}\big)\,B > 0$ on $[0,\bar{s}]$ by Assumption 1.

Lower boundary. As $B \to \underline{B}(g)^+$, period-0 tax revenue $s_0 = g - R(B) \to \bar{s}$, so $U'(s_0) \to -\infty$ by Lemma 2. Since $R'(B) > 0$ is bounded away from zero near $\underline{B}(g)$, the first term $-U'(s_0)\,R'(B) \to +\infty$. Meanwhile, $s_1 = B$ is bounded away from $\bar{s}$ (since $\underline{B}(g) < \bar{s}$), so $\beta U'(B)$ and both V-derivatives remain finite. Therefore $F^{CO}(B) \to +\infty$ as $B \to \underline{B}(g)^+$.

Upper boundary. As $B \to \bar{s}^-$, period-1 tax revenue $s_1 = B \to \bar{s}$, so $\beta U'(B) \to -\infty$ by Lemma 2. Meanwhile, period-0 tax revenue $s_0 = g - R(\bar{s})$ is strictly below $\bar{s}$ for $g < \bar{g}$,[26] so $U'(s_0)$ is finite. The V-derivatives are also finite at $B = \bar{s}$. Therefore $F^{CO}(B) \to -\infty$ as $B \to \bar{s}^-$.

Since F^{CO} is continuous on $(\underline{B}(g),\, \bar{s})$ and diverges to opposite signs at the boundaries, the intermediate value theorem guarantees that $F^{CO}(B^{CO}) = 0$ for at least one $B^{CO} \in (\underline{B}(g),\, \bar{s})$.

There are three main differences between (49) and (51). First, the absence of effects on the current account. Second and most importantly, the second term of (51) is new and captures how the foreign tax burden increases with domestic issuance and the reduction in bond prices. Third, the very last term in (51) is also new and reflects the fact that coordinating governments fully internalize the benefits of providing collateral to foreign investors.

Comparison Our goal in this section is to provide intuition about the differences between the actions of non-cooperative and cooperative governments. In order to do that, we study the symmetric economy and ask ourselves under which condition there is a difference between the non-cooperative solution, B^{NC}, and the cooperative solution, B^{CO}. We want to understand under which condition we have over-issuance of public debt, i.e. $B^{NC} > B^{CO}$, and under which condition we have under-issuance. The force leading to under-issuance has to do with the *market power* each government has when selling bond abroad, as in Choi et al. (2023). The over-issuance force instead is about each government not internalizing the negative spillover issuing debt has on foreign bond price and hence on foreign fiscal space.

We start by rewriting and comparing the FOCs of the two problems. In order to make the comparison easier, we start by moving to the LHS only terms that are different in the two equations. For the non-cooperative equilibrium, we have

[26] Since $R(\bar{s}) > R(\underline{B}(g)) = g - \bar{s}$, it follows that $s_0 = g - R(\bar{s}) < \bar{s}$.

$$
\begin{aligned}
-\partial_1\Pi_0(B,B) - \beta\partial_1\Pi_1(B,B) = \\
&- U'\big(g - p^i_{0,a}(B{,}B)\,B\big)\,\big[p^i_{0,a}(B,B) + B\,\partial_1 p^i_{0,a}\big] \\
&+\ \beta\Bigg[U'(B) + \partial_1 V^i(B,\ B)\Bigg].
\end{aligned}
\tag{54}
$$

while for the coordinated equilibrium we have:

$$
\begin{aligned}
U'\big(g - p^{-i}_{0,a}(B,B)B\big)\Big[\partial_2 p^{-i}_{0,a}B\Big] - \beta\partial_2 V^{-i}(B,B) = \\
&- U'\big(g - p^i_{0,a}(B{,}B)\,B\big)\,\big[p^i_{0,a}(B,B) + B\,\partial_1 p^i_{0,a}\big] \\
&+\ \beta\Bigg[U'(B) + \partial_1 V^i(B,\ B)\Bigg].
\end{aligned}
\tag{55}
$$

Then we can use the following Lemma in order to compare the two equilibrium allocations.

Lemma 6 *Let $F : \mathbb{R} \to \mathbb{R}$ and $L^{NC}, L^{CO} : \mathbb{R} \to \mathbb{R}$ be continuous. For $k \in \{NC, CO\}$ define*

$$F^k(B) \equiv G(B) - L^k(B).$$

where equations $F^{NC}(B) = 0$ and $F^{CO}(B) = 0$ have unique solutions B^{NC} and B^{CO}, respectively. Then

$$B^{NC} \gtreqless B^{CO} \quad \Longleftrightarrow \quad L^{NC}(B^{CO}) \lesseqgtr L^{CO}(B^{CO}), \tag{56}$$

and equivalently,

$$B^{NC} \gtreqless B^{CO} \quad \Longleftrightarrow \quad L^{NC}(B^{NC}) \lesseqgtr L^{CO}(B^{NC}).$$

Proof. Fix $k \in \{NC, CO\}$ and recall that F^k is strictly decreasing and has a unique zero at B^k. Hence $F^k(B) > 0$ for all $B < B^k$ and $F^k(B) < 0$ for all $B > B^k$.

Because B^{CO} solves $F^{CO}(B) = 0$, we have

$$G(B^{CO}) = L^{CO}(B^{CO}).$$

Evaluate F^{NC} at B^{CO}:

$$F^{NC}(B^{CO}) = G(B^{CO}) - R^{NC}(B^{CO}) = L^{CO}(B^{CO}) - L^{NC}(B^{CO}).$$

Therefore,

$$L^{NC}(B^{CO}) > L^{CO}(B^{CO}) \quad \iff \quad F^{NC}(B^{CO}) < 0.$$

Since F^{NC} is strictly decreasing and crosses zero exactly once at B^{NC}, the inequality $F^{NC}(B^{CO}) < 0$ implies $B^{CO} > B^{NC}$, i.e. $B^{NC} < B^{CO}$. The reverse implication follows analogously, which proves (56).

For the equivalent statement evaluated at B^{NC}, note that $G(B^{NC}) = L^{NC}(B^{NC})$ (because $G^{NC}(B^{NC}) = 0$). Thus

$$F^{CO}(B^{NC}) = G(B^{NC}) - R^{CO}(B^{NC}) = L^{NC}(B^{NC}) - L^{CO}(B^{NC}),$$

and the same monotonicity argument (using that F^{CO} is strictly decreasing with unique zero at B^{CO}) yields

$$B^{NC} \gtreqless B^{CO} \quad \iff \quad L^{NC}(B^{NC}) \lesseqgtr L^{CO}(B^{NC}).$$

■

We apply Lemma 6 to (54) and (55) and focus on the non-cooperative equilibrium where $B = B^{NC}$. From now on we simplify notation: for each function with two symmetric argument we will write $m(B, B) = m(B)$.

We have over-issuance if and only if

$$\partial_1 \Pi_0(B^{NC}) + \beta \partial_1 \Pi_1(B^{NC}) \geq -U'\big(g - p_{0,a}^{-i}(B^{NC})B^{NC}\big)\left[\partial_2 p_{0,a}^{-i}(B^{NC})B^{NC}\right] + \beta \partial_2 V^{-i}(B^{NC}) \tag{57}$$

In equation (57) we can see the three spillovers at play. The RHS of (57) represents the net marginal benefit abroad from issuing another unit of bond i. On the one hand, there is a negative spillover given by the fiscal externality: a marginal increase of bond i issuance deteriorates bond $-i$ price, tightening foreign budget and forcing a tax increase. On the other hand, there is a positive spillover given that bond i can be used as collateral by investors in country $-i$ too. The LHS of (57) represents the net marginal benefit from selling bonds abroad for a non-cooperative government that only maximizes domestic welfare. This term, as mentioned earlier, represents the marginal net financial inflow in the two periods when increasing marginally debt issuance. If positive, it means that by increasing debt issuance country i extracts more resources, over the two period horizon, from country $-i$. It is useful to break this object down:

$$\partial_1 \Pi_0(B^{NC}) + \beta \partial_1 \Pi_1(B^{NC}) = \frac{1}{2}(B^{NC}\ \partial_1 p^i_{0,a} - B^{NC}\ \partial_2 p^{-i}_{0,a} + p^i_{0,a} - \beta)$$
$$= \frac{1}{2}(B^{NC}\ \partial_1 p^i_{0,a} - B^{NC}\ \partial_2 p^{-i}_{0,a}) + \beta \partial_2 V^{-i}(B^{NC}) \quad (58)$$

Where the first equality comes from differentiating $\Pi_0 + \beta\Pi_1$ following (**??**) and (**??**), while the second comes from differentiating (**??**):

$$\beta \frac{\partial\, \mathbb{E}_0 V_1^{-i}}{\partial B^i} = \beta \frac{\omega}{2}\, \mathbb{E}_0 \Big[\lambda^i\, f'\Big(\bar{y}_{1,m} + \tfrac{\lambda^i}{2} B^i + \tfrac{\lambda^{-i}}{2} B^{-i} \Big) \Big] = \frac{1}{2}(p^i_{0,a} - \beta).$$

where the second equality follows from price equation (7)

Hence (58) shows how the non-cooperative government fully internalizes the marginal benefit of collateral provision abroad through the bond price. However, the key distortion stems from the government's ability to manipulate relative prices and thereby create a wedge between domestic and foreign bond prices. Given that $\partial_1 p^i_{0,a} - \partial_2 p^{-i}_{0,a} \leq 0$, the non-cooperative government can reduce issuance to distort this margin and increase net financial inflows from abroad. This is what we later define as the *bond market power* channel, which exists as long as governments can manipulate the relative price of bonds. Absent this ability (i.e., when $\partial_1 p^i_{0,a} = \partial_2 p^{-i}_{0,a}$), there is no such distortion and $\partial_1 \Pi_0(B^{NC}) + \beta \partial_1 \Pi_1(B^{NC}) = \beta \partial_2 \mathbb{E}_0 V^{-i}(B^{NC})$.

Hence, using (58) and simplifying, we can rewrite (57) as (18), proving the proposition. ■

B.3 Proposition 2

Lemma 7 (Debt proceeds respond less than one-for-one) *Let $R(B^{NC}, B^{NC}) \equiv p^i_{0,a}(B^{NC}, B^{NC})\, B^{NC}$ denote symmetric non-cooperative equilibrium debt proceeds and define*

Then

$$0 < \frac{\partial R(B^{NC}(g))}{\partial g} < 1 \quad \textit{and} \quad 0 < \frac{\partial s_0^{NC}(g)}{\partial g} < 1.$$

Proof:
B^{NC} is determined as the unique solution of:

$$
\begin{aligned}
0 = & - U'\big(g - R(B,B)\big)\partial_1 R(B,B) \\
& + \partial_1 \Pi_0(B,B) + \beta \left\{ U'(B) + \partial_1 \Pi_1(B,B) + \partial_1 \mathbb{E}_0 V^i(B,\, B) \right\} = F^{NC}(B).
\end{aligned}
\tag{59}
$$

Let $B^{NC}(g)$ be an interior solution and define $s^{NC}(g) = g - R(B^{NC}(g), B^{NC}(g))$.

Using the implicit function theorem, we have

$$
\frac{\partial B^{NC}}{\partial g} = -\frac{F_g^{NC}}{F_B^{NC}} \qquad \frac{\partial R(B^{NC}, B^{NC})}{\partial g} = \left[\partial_1 R(B^{NC}, B^{NC}) + \partial_2 R(B^{NC}, B^{NC})\right] \frac{\partial B^{NC}}{\partial g}
$$

where

$$
F_g = -U''(s) \; \cdot \partial_1 R(B,B),
$$

$$
\begin{aligned}
F_B = \frac{\partial F^{NC}(B)}{\partial B} &= U''(s)\left[\partial_1 R(B) + \partial_2 R(B)\right]\left(\partial_1 R(B)\right) \\
&- U'(.)\left(\partial_1^2 R(B) + \partial_2 \partial_1 R(B)\right) + \partial_1^2 \Pi_0 + \partial_2 \partial_1 \Pi_0 \\
&+ \beta\left[U''(.) + \partial_1^2 \mathbb{E}_0 V + \partial_2 \partial_1 \mathbb{E}_0 V + \partial_1^2 \Pi_1 + \partial_2 \partial_1 \Pi_1\right]
\end{aligned}
$$

Hence we have

$$
\begin{aligned}
0 < \frac{\partial R(B^{NC}, B^{NC})}{\partial g} &= \frac{\overbrace{U''(s) \; \cdot \partial_1 R(B)\left[\partial_1 R(B^{NC}, B^{NC}) + \partial_2 R(B^{NC}, B^{NC})\right]}^{<0}}{F_B} \\
&= \frac{U''(s) \; \cdot \partial_1 R(B)\left[\partial_1 R(B^{NC}, B^{NC}) + \partial_2 R(B^{NC}, B^{NC})\right]}{U''(s) \; \cdot \partial_1 R(B)\left[\partial_1 R(B^{NC}, B^{NC}) + \partial_2 R(B^{NC}, B^{NC})\right] + H(B^{NC})} < 1
\end{aligned}
$$

since

$$
\begin{aligned}
H(B^{NC}) = & -U'(.)\left(\partial_1^2 R(B) + \partial_2 \partial_1 R(B)\right) + \partial_1^2 \Pi_0 + \partial_2 \partial_1 \Pi_0 \\
& + \beta\left[U''(.) + \partial_1^2 \mathbb{E}_0 V + \partial_2 \partial_1 \mathbb{E}_0 V + \partial_1^2 \Pi_1 + \partial_2 \partial_1 \Pi_1\right] < 0
\end{aligned}
$$

Using $s = g - R(B(g))$, we have

$$\frac{\partial s^{NC}}{\partial g} = 1 - \frac{\partial R(B^{NC}, B^{NC})}{\partial g} > 0$$

■

Lemma 8 *There exists a level of* $g = \underline{g}$ *such that* $s^{NC} = 0$. *When* $g = \underline{g}$ *and* $\sigma > 0$, $B^{NC} < B^{CO}$.

Proof: First we show that if $g = 0$, $B^{NC} > 0$ and hence $s^{NC} < 0$. First note that $U'(s) = 0$ if $s < 0$, as discussed in Appendix A.2. Suppose by contradiction, that $B^{NC} = 0$ if $g = 0$. Hence the non-cooperative FOC (49) collapses to:

$$\partial_1 \Pi_0(0,0) + \beta\big(\partial_1 \Pi_1(0,0) + \partial_1 \mathbb{E}V^i(0,0)\big) = 0$$

where $\partial_1 \Pi_0(0,0) = \frac{1}{2} p^i_{0,a}(0,0) > 0$ and $\partial_1 \Pi_1(0,0) = -\frac{1}{2}$. Notice that by (**??**), we have that

$$\beta\Big(-\frac{1}{2} + \partial_1 \mathbb{E}V^i\Big) = \frac{p^i_{0,a}}{2} - \beta$$

and hence, plugging it in the FOC, we have that $B^{NC} = 0$ is optimal if:

$$p^i_{0,a}(0,0) = \beta$$

which means there is no convenience yield if government issues zero debt. But by assumption we have that $f'(\bar{y}^i_{1,m}) > 0$, implying a positive convenience yield and hence proving that for $g = 0$, $B^{NC} > 0$.

Hence given that s^{NC} is monotonically increasing in g, we have that there exists a unique $\underline{g}$ such that $s^{NC} = 0$, since $s^{NC}(\bar{g}) = \bar{s} > 0$

If $s^{NC} = 0$ and $\sigma > 0$, it follows that $\Phi(\underline{g}, \sigma) < 0$, which implies $B^{NC} < B^{CO}$ ■

Lemma 9 *There exists a level of* $g = \bar{g}$ *such that* $\underline{B}(\bar{g}) = \bar{s}$. *If* g *is close enough to* $\bar{g}$, *then* $B^{NC} > B^{CO}$, *that is:*

$\exists\, \delta > 0$ *such that* $0 < |\bar{g} - g| < \delta \;\Rightarrow\; B^{NC}(g) > B^{CO}(g)$.

Proof: First we need to show that if $g < \bar{g}$, B^{NC} is an interior solution in the sense that $B^{NC} \in \left(\underline{B}(g), \bar{s}\right)$. This follows from the fact that the FOC $F^{NC}(\underline{B}(g)) \to +\infty$ and $F^{NC}(\bar{s}) \to -\infty$, since $U'(\bar{s}) \to -\infty$, as shown in Lemma 2. Hence $B = \underline{B}(g)$ or $B = \bar{s}$ never satisfy the FOC, which implies that it can only be chosen if $B = \bar{s}$ is the only possible choice.

As long as B^{NC} is an interior solution, Proposition 1 holds. However it is easy to show that:

$$\lim_{g \to \bar{g}} \frac{1}{2} \left(\frac{\partial p^{i}_{0,a}}{\partial B^i} - \frac{\partial p^{-i}_{0,a}}{\partial B^i} \right) > \lim_{g \to \bar{g}} -U'\big(s^{NC}_0(g)\big) \frac{\partial p^{-i}_{0,a}}{\partial B^i}$$

since the LHS is finite and the RHS negatively diverges (given that $s(g)$ converges to $\bar{s}$), which proves the Lemma. ■

Lemma 10 (Monotonicity of Φ) *Define* $\Phi = L^{NC}(B^{NC}(g)) - L^{CO}(B^{NC}(g))$. Φ *is differentiable and satisfies* $\frac{\partial \Phi}{\partial g} > 0$

Proof.
Consider that

$$\Phi(g, \sigma) = \frac{1}{2} \left[\partial p^{i}_{0,a}(B^{NC}) - \partial p^{-i}_{0,a}(B^{NC}) \right] B^{NC} + U'\big(s^{-i}_0(B^{NC})\big) \partial p^{-i}_{0,a}(B^{NC}) B^{NC}$$

Then it is easy to show that:

$$\frac{\partial \Phi}{\partial g} = U''\big(s^{-i}_0(B^{NC})\big) \frac{\partial s^{-i}_0}{\partial g} \partial p^{-i}_{0,a}(B^{NC}) > 0$$

Theorem 1 (Single crossing of equilibrium gap) *Let* $I \subset \mathbb{R}$ *be an interval and define*

$$D(\theta) \equiv B^{NC}(\theta) - B^{CO}(\theta), \qquad \Phi(\theta) \equiv G(B^{NC}(\theta), \theta) - H(B^{NC}(\theta), \theta).$$

Suppose that:

1. *For every* $\theta \in I$, *the function* $\Phi(B, \theta) \equiv F(B, \theta) - H(B, \theta)$ *is strictly decreasing in* B *and admits a unique zero* $B^{CO}(\theta)$.

2. *The function* Φ *is differentiable on* I *and satisfies* $\Phi'(\theta) > 0$ *for all* $\theta \in I$.

Then $D(\theta)$ *can change sign at most once on* I. *More precisely, there exists at most one*

$\theta^* \in I$ such that $D(\theta^*) = 0$. If such θ^* exists, then

$$\theta < \theta^* \;\Rightarrow\; D(\theta) > 0, \qquad \theta > \theta^* \;\Rightarrow\; D(\theta) < 0.$$

Proof.
Define $M(B, \theta) \equiv F(B, \theta) - H(B, \theta)$. By assumption, for each $\theta \in I$, $\Phi(\cdot, \theta)$ is strictly decreasing and admits a unique zero $B^{CO}(\theta)$.

Evaluating Φ at $B^{NC}(\theta)$ yields

$$M(B^{NC}(\theta), \theta) = F(B^{NC}(\theta), \theta) - H(B^{NC}(\theta), \theta) = G(B^{NC}(\theta), \theta) - H(B^{NC}(\theta), \theta) = \Phi(\theta).$$

Since $M(\cdot, \theta)$ is strictly decreasing, it follows that

$$M(B, \theta) > 0 \iff B < B^{CO}(\theta), \qquad M(B, \theta) < 0 \iff B > B^{CO}(\theta).$$

Hence,

$$\operatorname{sign}\left(B^{NC}(\theta) - B^{CO}(\theta)\right) = -\operatorname{sign}\left(\Phi(\theta)\right) \quad \text{for all } \theta \in I.$$

By assumption, Φ is differentiable on I and satisfies $\Phi'(\theta) > 0$ for all $\theta \in I$. Therefore, Φ is strictly increasing on I and can admit at most one zero on I. Consequently, $\operatorname{sign}(\Phi(\theta))$ can change at most once as θ varies over I.

Using the sign relation above, it follows that $\operatorname{sign}\left(B^{NC}(\theta) - B^{CO}(\theta)\right)$ can also change at most once on I. In particular, there exists at most one $\theta^* \in I$ such that $B^N(\theta^*) = B^{CO}(\theta^*)$. If such θ^* exists, then

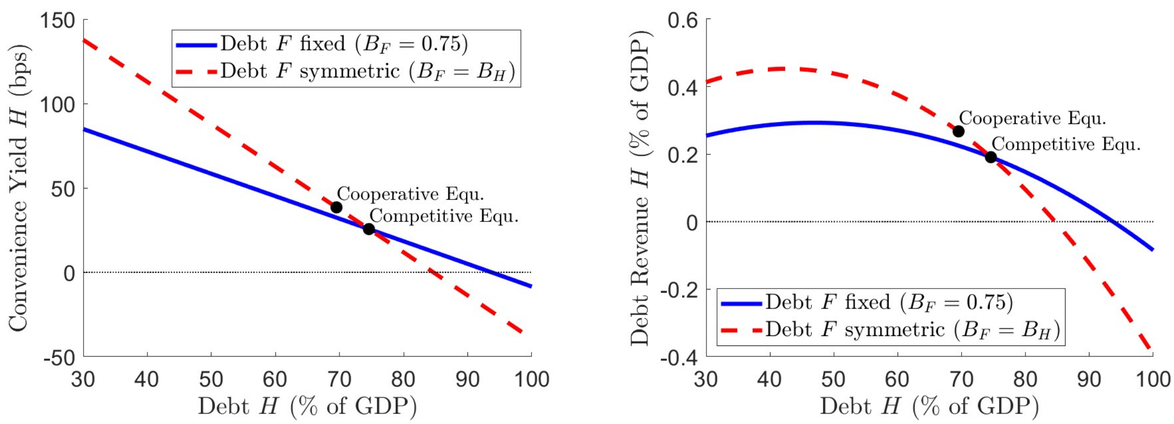
$$\theta < \theta^* \;\Rightarrow\; B^{NC}(\theta) > B^{CO}(\theta), \qquad \theta > \theta^* \;\Rightarrow\; B^{NC}(\theta) < B^{CO}(\theta). \qquad \blacksquare$$

C Appendix: Quantitative Model

C.1 Convenience Yields & The Debt Laffer Curve

Figure 5 illustrates how debt decisions and fiscal outcomes of the two countries are intertwined, by discussing alternative (non-equilibrium) debt policies. Panel (a) shows that if country H unilaterally decreases its debt by 7%—moving from the competitive equilibrium-value to the cooperative equilibrium-value—it can raise its convenience yield by around 7 basis points (blue line). Yet, if both countries simultaneously decrease their debt by 7% (red line), the convenience yield of H increases by an additional 6 basis points, reflecting the spillover effect of F's debt issuance. Thus, in the cooperative equilibrium, convenience yields are in total around 13 basis points higher than in the competitive equilibrium.

Figure 5: Convenience Yields & Laffer Curves



(a) Convenience Yields (b) Laffer Curves

Panel (b) plots the Laffer curves which depict the debt revenue that countries collect at alternative (off-equilibrium) debt policies. When H unilaterally decreases its debt by 7%—moving from the competitive equilibrium-value to the cooperative equilibrium-value—it can raise its debt revenue from 0.19% of GDP to 0.23% (blue line). When both countries simultaneously decrease their debt by 7%, the debt revenue of H increases to 0.27% (red line)—the debt revenue in the cooperative equilibrium.

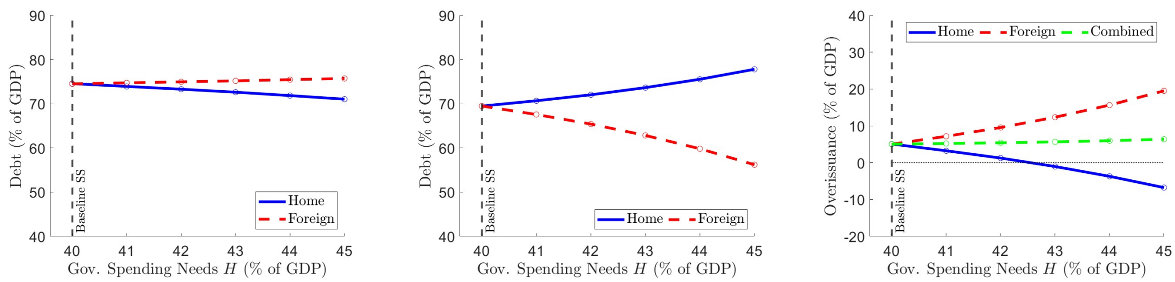
The respective peaks of the Laffer curve for H are at around 45% debt-to-GDP when maximizing individually and at around 42% when maximizing jointly. This shows that the steady-state debt level under individual and under joint maximization is on the declining part of the Laffer curve. This highlights that governments have an incentive to issue more than the revenue-maximizing amount of debt in order to provide collateral to their economies.

C.2 Increase in Spending Needs in One Country Only

In the main text, we consider an increase in spending needs in H while spendings needs decline in F, such that average spending needs remain unchanged. In this Appendix, we study an increase in spending needs in H, while they remain unchanged in F. This experiment isolates the implications for F of lower debt issuance in H.

Figure 6 shows equilibrium debt policies. Evidently, F effectively exploits the higher spending needs in H and is able to extract a disproportionate share of debt revenue. In consequence, it attains a higher welfare as compared to the baseline spending needs in H.

Figure 6: Asymmetric Spending Needs (Only H Is Affected)



(a) Non-Coop. Equilibrium (b) Cooperative Equilibrium (c) Overissuance

C.3 Common Debt

The budget constraint of government i becomes:

$$p^i_{t,a}B^i_{t+1} + \frac{1}{2}p^C_{t,a}B^C_{t+1} + s^i_t = B^i_t + \frac{1}{2}B^C_t + g^i_t \tag{60}$$

Given a stock of common debt of B^C, the objective function of government i (equation **??**) itself remains unchanged, even though the budget constraint (and therefore s^i_t) changes and V^i (and therefore all bond prices) becomes a function of all three bonds:

$$\begin{aligned} W^i_t(B^i_t, B^{-i}_t | B^C) = \max_{B^i_{t+1}} \ & U^i(s^i_t) + V^i(B^i_t, B^{-i}_t, B^C) - g^i_t \\ & + \frac{p^i_{t,a}B^i_{t+1} - B^i_t}{2} - \left(\frac{p^{-i}_{t,a}B^{-i}_{t+1} - B^{-i}_t}{2}\right) \\ & + \beta W^i_{t+1}(B^i_{t+1}, B^{-i}_{t+1} | B^C) \end{aligned} \tag{61}$$