Fiscal Rules and Ambiguous Spending Needs*

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Abstract

We use a sovereign default model to study how fiscal rules should be adjusted after an increase in government spending needs. The optimal debt limit depends critically on the effect of new spending on productivity. Wasteful spending makes the government poorer and reduces the economy's debt-carrying capacity, which implies a lower optimal debt limit. Productivity-enhancing spending raises debt-carrying capacity and implies a higher limit. Thus, a problem arises when adjusting debt limits with ambiguity about the effects of spending on productivity: lowering the limit when spending raises productivity or increasing it when spending is wasteful produces welfare losses. Spread-based rules are more robust. A spread limit equal to the average spread observed before the spending shock produces welfare gains irrespective of the effect of spending on productivity. The optimal spread limit is essentially invariant to the effect of spending on productivity.

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1 Introduction

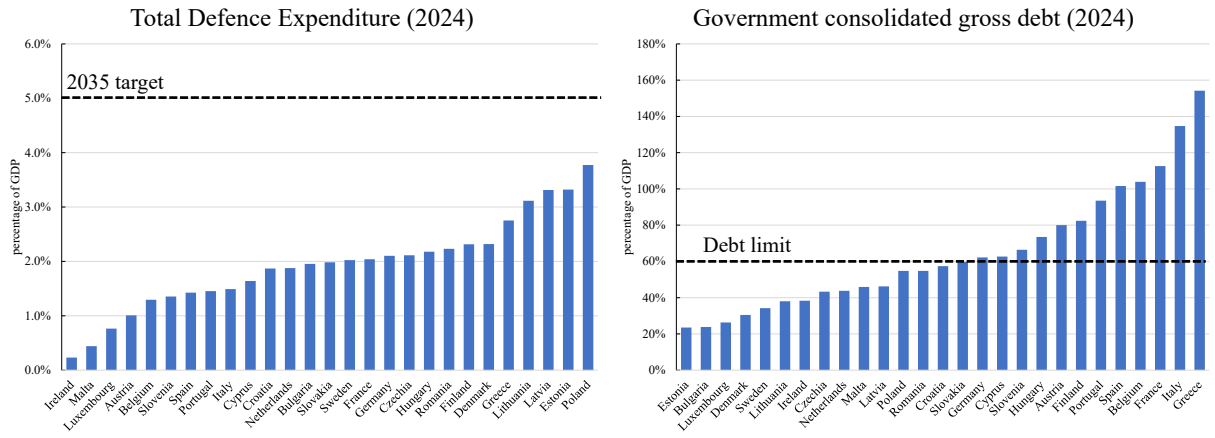
This paper presents a formal analysis of how fiscal rules should accommodate increasing government spending pressures, a rapidly growing topic of discussion in policy circles (Heimberger, 2025; Pench, 2024, 2025; Conigrave and Shin, 2026). Many governments are facing a significant increase in spending needs. Aging populations put growing pressure on pensions and healthcare spending, the climate transition often requires large public investments, there are investment needs and opportunities in infrastructure and technology, and geopolitical tensions demand higher defense spending. Furthermore, these spending pressures arise when many governments deal with limited fiscal space, as evidenced by historically high public debt levels after the COVID-19 pandemic (Gelpern et al., 2020; IMF, 2021; Reinhart and Rogoff, 2020). For example, the left panel of Figure 1 shows that in all members of the European Union, defense expenditure is below the 2035 target of 5 percent of GDP. The right panel of Figure 1 shows that in more than a third of the members of the European Union, public debt levels exceed the 60 percent of GDP reference limit.

We use a sovereign default model to study the optimal changes to fiscal rules under different spending scenarios. As in the quantitative sovereign default literature that follows Eaton and Gersovitz (1981), Aguiar and Gopinath (2006), and Arellano (2008), the government cannot commit to repaying its debt. The model features a small open economy populated by identical households, a competitive firm, and a benevolent government. Households own the capital stock and make investment decisions (Gordon and Guerron-Quintana, 2018; Esquivel, 2024). Households cannot borrow from abroad, and the government borrows on their behalf by issuing long-term debt to risk-neutral foreign lenders. We consider fiscal rules with either a debt or a sovereign spread limit. A debt limit caps the debt-to-GDP ratio and imposes a gradual consolidation when debt is above the limit, mimicking the rules implemented by several governments (Acalin et al., 2025). A spread rule caps the sovereign spread at which the government can issue new debt (Hatchondo et al., 2022a,b). In both cases, lower default risk derived from the fiscal rule incentivizes households to invest more, which expands the economy in the long-run and increases welfare gains from fiscal rules (Esquivel and Samano, 2026).

We first assume that the increase in government spending needs makes the economy poorer. We show that this lowers the government's debt-carrying capacity and implies that it is optimal for the government to lower the debt limit in its fiscal rule (with respect to the one chosen before the new spending needs).[1]

[1]The IMF defines debt-carrying capacity as a country's ability to carry debt without significant risk of debt distress and cites among the determinants of debt-carrying capacity the quality of institutions, debt management capacity, and macroeconomic fundamentals (Hakura, 2020). In our model, debt-carrying

Figure 1: Defense expenditure and public debt in Europe



Note: The left panel shows total defense expenditure as a percentage of GDP in 2024 for European Union members. The dashed line marks the 2035 target of 5 percent of GDP. The right panel shows government consolidated gross debt as a percentage of GDP in 2024. The dashed line marks the 60 percent of GDP reference limit of the European fiscal framework. Sources: Eurostat and NATO.

We then assume that the increase in spending increases productivity, making the economy richer and increasing debt-carrying capacity. We show that in this case, it is optimal for the government to increase the debt limit in its fiscal rule.

The results above highlight an important constraint for answering how fiscal rules should be changed in response to new government spending needs: it is often difficult to identify how this new spending would affect the government's debt-carrying capacity, for instance, by making the economy poorer or richer. For example, for military buildups, several studies find small output multipliers and little evidence of productivity gains (Ramey and Shapiro, 1998; Barro and Redlick, 2011; Ramey and Zubairy, 2018), while several others find that defense spending can raise growth and productivity (Benoit, 1973; Aizenman and Glick, 2006; Hall, 2009).

We next focus on this ambiguity about the effects of new spending on the government's debt-carrying capacity. We first show that, as expected, if the government changes its fiscal rule with the wrong beliefs about these effects, it generates welfare losses. That is, if the government lowers (increases) its debt limit when new spending increases (lowers) its debt-carrying capacity, welfare is lower than when the government does not change its fiscal rule.

Next, we show that replacing the debt rule with a spread rule would resolve this ambiguity problem. First, we assume that the government cannot find the optimal spread limit for its fiscal rule and simply replaces the original debt rule (chosen before the increase in spending needs) with a spread rule that has a limit equal to the average spread in the economy with

capacity is determined by productivity, the capital stock, and the level of government spending.

the original debt rule. We find that after the increase in spending, replacing the original debt rule with the average-spread rule produces welfare gains irrespective of the effect of spending on debt-carrying capacity. Furthermore, the average-spread rule is more robust without implying a significant sacrifice in terms of welfare: the average-spread rule yields about the same welfare gains that could be achieved with the optimal debt limit derived knowing the effect of spending on debt-carrying capacity.

We also find that the optimal spread limit is essentially invariant to the effect of spending on productivity. The simple average-spread rule yields between 86 and 94 percent of the welfare gain of the optimal spread limit (with the better performance corresponding to the case in which spending increases the government debt-carrying capacity).

Overall, these findings show that spread-based fiscal rules are more robust to the ambiguity about the effect of spending on debt-carrying capacity. These results are encouraging because they suggest that building a perfectly specified model to exactly compute the optimal anchor for fiscal rules is not necessary if we rely on a spread anchor. When faced with new spending needs, the government could simply commit to not increasing fiscal risk (as priced by the market), irrespective of the effects of new spending on debt-carrying capacity.

The intuition behind our results is simple. The ambiguity problem arises because the effects of spending on debt-carrying capacity are not known at the time the fiscal rule is decided. While these effects will be learned over time, one important characteristic of fiscal rules is that they should not be updated frequently (so the government can effectively commit to future borrowing policies). Thus, we take seriously the constraint of choosing the fiscal rule without knowing the effects of spending on debt-carrying capacity, a typical problem of having to commit before the realization of uncertainty (Amador et al., 2006). A spread rule solves this problem because as we learn that spending increases (lowers) debt-carrying capacity, the spread rule allows the government to borrow more (forces the government to borrow less). Thus, our results are relevant for other situations in which fiscal rules are implemented when changes in debt-carrying capacity are expected, for example, because the country is joining a monetary union or experiencing significant political or institutional changes.

Layout.—The rest of the paper is organized as follows. Section 2 presents the model. Section 3 presents the quantitative analysis. Section 4 concludes.

2 Model

There is a small-open economy populated by a large number of identical households, a competitive firm, and a benevolent government. Production of the final consumption good is

carried out by the firm, which rents capital from households. Households own the firm and all the capital in the economy but do not have access to international financial markets. The benevolent government borrows on behalf of the households by issuing long-term debt that is purchased by risk-neutral foreign lenders. In addition to servicing its debt, the government must finance a required expenditure $G_t \geq 0$. We assume $G_t = 0$ in our benchmark parameterization and interpret $G_t > 0$ in alternative parameterizations as representing additional unanticipated spending needs such as those arising from defense, the climate transition, or an aging population. The government makes lump-sum transfers (or levies lump-sum taxes) to households and cannot commit to repaying its debt.

Preferences and technology.—Each period, households have preferences for consumption of a tradable good c_t represented by $u(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}$. They discount the future at a rate β and are relatively more impatient than foreign lenders ($\beta(1+r^*) < 1$, where r^* is the international risk-free interest rate). Households own all the capital in the economy and rent it to the firm for r_t. Capital depreciates at a rate δ and households face a quadratic capital adjustment cost $\frac{\phi}{2}\frac{(k_{t+1}-k_t)^2}{k_t}$, where $\phi > 0$. The budget constraint of a representative household is:

$$c_t + i_{k,t} + \frac{\phi}{2}\frac{(k_{t+1}-k_t)^2}{k_t} \leq r_t k_t + \Pi_t + T_t, \tag{1}$$

where $i_{k,t} = k_{t+1} - (1-\delta)k_t$ is investment, Π_t are profits from the firm, and T_t is a lump-sum transfer from the government.

The consumption good is produced by the competitive firm using technology $Y_t = z_t K_t^{\alpha}$, where K_t is the capital rented by the firm, α is the capital share of income, and z_t is a productivity shock.[2] The productivity shock follows an AR(1) process:

$$\log z_{t+1} = (1-\rho)\log \mu_z + \rho \log z_t + \epsilon_t,$$

where ρ is the persistence parameter, $\epsilon_t \sim N(0, \sigma_z^2)$, and μ_z is mean productivity in the long run. As we explain below, we capture the productive component of government spending through its permanent effect on long-run productivity μ_z.

Government debt and default.—The government issues long-term, non-contingent debt B_t that matures at a rate γ. The law of motion of debt is $B_{t+1} = (1-\gamma)B_t + i_{b,t}$, where $i_{b,t}$ is net debt issuance in period t. The government's budget constraint when it is in good financial standing is:

$$T_t + G_t + \gamma B_t = q_t i_{b,t}, \tag{2}$$

[2]For simplicity, we abstract from an endogenous labor supply. Implicitly, we assume that there is a unit of labor that is supplied inelastically by households.

where q_t is the market price of government debt and $G_t \geq 0$ is the required expenditure. Government debt is purchased by a large number of risk-neutral investors with deep pockets. Investors pay the price q_t and have access to a one-period risk-free bond that pays the risk-free interest rate r^*.

At the beginning of each period, the government decides whether to default. If it does, it is excluded from financial markets for a stochastic number of periods, and the productivity in the economy drops to $z_D(z_t) = z_t - \max\{0, \xi_0 z_t + \xi_1 z_t^2\}$, where $\xi_0 < 0 < \xi_1$ (we use the quadratic formulation for the cost of defaulting introduced by Chatterjee and Eyigungor, 2012). As discussed by Arellano (2008), an asymmetric cost of default that is increasing in z_t (as the one we assume) allows the model to generate a counter-cyclical current account and spreads, and default episodes "in bad times", all of which are features of the data for emerging economies.[3]

While in default the government cannot borrow and must run a balanced budget, so that $T_t + G_t = 0$. With probability θ, a government in default is readmitted to financial markets without debt (all debt forgiven and $B = 0$).

Spending needs.—A central feature of our analysis is that the effect of the required expenditure G_t on the economy is ambiguous. We consider three scenarios that differ in the size of the required expenditure and in its effect on productivity. In the *baseline* scenario, there are no spending needs ($G_t = 0$) and $\mu_z = 1$. We then introduce spending needs $G_t > 0$ and distinguish between two polar cases for their effect on the economy. When spending is *wasteful*, it consumes resources without altering the economy's productive capacity, so that $\mu_z = 1$. When spending is *productive*, it raises the economy's long-run productivity, $\mu_z > 1$, capturing expenditures that expand future output. The distinction matters for the economy's debt-carrying capacity. Wasteful spending makes the economy poorer and reduces its capacity to carry debt, whereas productive spending makes it richer and increases that capacity.[4] As we show in the quantitative analysis, this difference is what determines whether a debt limit should tighten or loosen in response to new spending needs.

Fiscal rules.—In general, a fiscal rule is a correspondence $\mathcal{F}$ that maps the state space of the economy into the power set of government policy instruments. We restrict attention to rules that constrain next-period debt, so that $B_{t+1} \in \mathcal{F}(z_t, K_t, B_t)$, and we study two types of rules. Under a *debt rule*, the government cannot borrow to bring the debt-to-GDP

[3]Mendoza and Yue (2012) show that these types of costs from default can be the result of a richer production structure in which some imported materials require working capital financing. For simplicity, we assume this exogenous form instead.

[4]Note that the standard assumption of the cost of default being increasing with respect to the productivity level implies that spending needs that increase average productivity μ_z also increase, on average, the cost of defaulting and, thus, debt-carrying capacity. This will imply fewer defaults with higher permanent productivity, which is consistent with richer and more productive countries having higher debt levels.

ratio above a threshold DL, and if debt is above DL, the government must reduce debt by at least a fraction χ of output each period (Acalin et al., 2025):

$$\mathcal{F}(z_t, K_t, B_t; DL) = \{B_{t+1} \mid B_{t+1} \leq \max\{DL \cdot GDP_t,\ B_t - \chi \cdot Y_t\}\}, \tag{3}$$

where $GDP_t = 4Y_t$ is annualized output.[5]

Under a *spread rule*, similar to the spread brake studied by Hatchondo, Martinez and Roch (2022a,b), the government cannot issue debt at a spread above a threshold SL:

$$\mathcal{F}(z_t, K_t, B_t; SL) = \left\{B_{t+1} \mid B_{t+1} \leq \max\left\{\bar{B}(z_t, K_t, B_t; SL),\ B_t - \chi \cdot Y_t\right\}\right\}, \tag{4}$$

where $\bar{B}$ is the highest level of debt consistent with a spread no greater than SL; that is, the largest B_{t+1} such that $spr(z_t, K_t, B_{t+1}) \leq SL$. The spread is the difference between the annualized yield to maturity on government debt and the annualized risk-free rate. With our model calibrated at a quarterly frequency:

$$spr(z, K, B') = \left(\frac{\gamma + (1-\gamma)\, q(z, K, B')}{q(z, K, B')}\right)^4 - (1 + r^*)^4.$$

The debt limit caps the *quantity* of debt relative to the size of the economy, whereas the spread limit caps the *price* of default risk that the government is willing to bear. As we discuss in the quantitative analysis, this distinction is central to how each rule responds to ambiguous spending needs.

Timing.—At the beginning of a period, the government observes (z_t, K_t, B_t) and makes its default and borrowing decisions. Then, the households observe the government's choices and make their consumption and investment decisions. Finally, at the end of the period, lenders observe all choices and price the debt accordingly. We assume that the government can commit to policy within the same period. That is, if at the beginning of the period the government announces repayment and a debt issuance $i_{b,t}$, then it issues that amount at the end of the period and pays γB_t to the lenders. These assumptions allow us to rule out the multiplicity of equilibria studied by Cole and Kehoe (2000) because lenders price the debt after the government announces its policy and commits to it within the same period. These timing assumptions also rule out the multiplicity studied by Galli (2021) because lenders price the debt after the capital allocation has been chosen.

[5]The model is calibrated at a quarterly frequency and, therefore, we annualize output when expressing debt limits in fiscal rules in terms of GDP.

2.1 Recursive formulation and equilibrium

The aggregate state of the economy is (z, x), where $x = (K, B)$ is the endogenous aggregate state. Let $g = (T, B')$ be the vector of fiscal policy in a given period, and let $d = 0$ denote that the government is in good financial standing and $d = 1$ that the government is in default.

Households.—The value of a representative household when $d = 0$ is

$$\begin{aligned} H^P(z,k,x,g) = \max_{c,i,k'} \big\{ & u(c) + \beta \mathbb{E}\left[(1-d')\, H^P\left(z',k',x',g^P\right)\right] \\ & + \beta \mathbb{E}\left[d' H^D(z',k',K')\right] \big\} \\ s.t. \quad c + i + \frac{\phi}{2}\frac{(k'-k)^2}{k} & \leq r(z,K)\,k + \Pi(z,K) + T \\ i &= k' - (1-\delta)\,k \\ x' &= \Gamma_x^P(z,x,g), \quad g^P = \Gamma_g^P(z',x'), \quad d' = \Gamma_d(z',x'), \end{aligned} \tag{5}$$

where Γ_x^P is the household's belief about the law of motion of the endogenous aggregate state x in repayment, Γ_g^P is the household's belief of fiscal policy in repayment, Γ_d the household's belief about the government's default decisions, the rental rate of capital is $r(z,K) = z\alpha K^{\alpha-1}$, and firm profits are $\Pi(z,K) = z(1-\alpha)K^{\alpha}$. The value of the household when $d = 1$ is

$$\begin{aligned} H^D(z,k,K) = \max_{c,i,k'} \big\{ & u(c) + \beta \mathbb{E}\left[\theta(1-d')\, H^P\left(z',k',x',g^P\right)\right] \\ & + \beta \mathbb{E}\left[(1-\theta+\theta d') H^D(z',k',K')\right] \big\} \\ s.t. \quad c + i + \frac{\phi}{2}\frac{(k'-k)^2}{k} & \leq r(z_D(z),K)\,k + \Pi(z_D(z),K) + T \\ i &= k' - (1-\delta)\,k \\ x' &= \Gamma_x^D(z,K), \quad g^P = \Gamma_g^P(z',x'), \quad d' = \Gamma_d(z',x'), \end{aligned} \tag{6}$$

where Γ_x^D is the household's belief about the law of motion of the endogenous state x in default, and the transfer satisfies the government's balanced-budget requirement in default, $T = -G$.

Government.—At the beginning of a period in which the government is in good financial standing, its value is

$$V(z,x) = \max_{d \in \{0,1\}} \left\{ d V^D(z,K) + (1-d)\, V^P(z,x) \right\}, \tag{7}$$

where d is its default decision. The value of repaying the debt is

$$V^P(z,x) = \max_{T,B' \in \mathcal{F}(z,x)} \left\{ u\left(c^P(z,K,x,g)\right) + \beta \mathbb{E}\left[V(z',x')\right] \right\} \tag{8}$$
$$s.t. \quad T + G + \gamma B = q(z,x')\left[B' - (1-\gamma)B\right]$$
$$K' = k^P(z,K,x,g), \quad g = (T,B'),$$

where c^P and k^P are the household's policy functions for consumption and capital in repayment, respectively. The government chooses its fiscal policy g subject to the constraints implied by the fiscal rule $\mathcal{F}$ and to its budget constraint, and takes into account how fiscal policy affects aggregate household decisions. The value of defaulting is

$$V^D(z,K) = u\left(c^D(z,K,K)\right) + \beta \mathbb{E}\left[\theta V^D(z',K') + (1-\theta)V(z',x')\right], \tag{9}$$

where $K' = k^D(z,K,K)$, and c^D and k^D are the household's policy functions for consumption and capital in default.

Equilibrium.—An equilibrium is value and policy functions for the government, value, policy, and beliefs functions for the households, and a price schedule for government debt q such that: (i) given q and the policy functions for the households, the value and policy functions of the government solve the problems in (7) through (9); (ii) given all prices and beliefs, the value and policy functions for the households solve the problems in (5) and (6); (iii) household beliefs are consistent with government policy functions and household policy functions evaluated at the aggregate state; and (iv) the price schedule of debt satisfies

$$q(z,x') = \frac{\mathbb{E}\left[(1-d')\left(\gamma + (1-\gamma)q(z',x'')\right)\right]}{1+r^*}, \tag{10}$$

where $x'' = \left(k^P\left(z',K',x',\Gamma_g^P(z',x')\right), B(z',x')\right)$.

3 Quantitative Analysis

We first calibrate the benchmark economy without a fiscal rule to quarterly data for Portugal between 2008 and 2025. Next, we solve for the debt limit DL that maximizes household welfare in the baseline scenario without spending needs ($G_t = 0$). We then introduce spending needs $G_t > 0$ and solve for the optimal adjustment of DL when G_t is wasteful ($\mu_z = 1$) and when G_t is productive ($\mu_z > 1$). Finally, we focus on the case in which, at the moment of choosing its fiscal rule, the government does not know how G_t will affect productivity. We compute the effects of implementing the debt limit that correspond to the incorrect beliefs

Table 1: Calibration

Independent parameters					
Parameter	Value	Parameter	Value	Parameter	Value
σ	2	r^*	0.01	χ	0.03
γ	0.05	θ	0.083	δ	0.05
ρ	0.95	σ_z	0.017	α	0.33
Parameters set to target moments from data (Portugal 2008–2025)					
Parameter	Value	Target	Data	Model	
ϕ	17.4	σ_i/σ_y	2.4	2.6	
β	0.958	$100 \cdot B/GDP$	115	111	
ξ_0	-0.593	μ_{r-r^*}	2.4	2.5	
ξ_1	0.896	σ_{r-r^*}	2.5	1.9	

Note: The moments in the model are calculated using a simulation of 10,000 periods after dropping the first 1,000. We take the natural logarithm of GDP, consumption, and investment and detrend each series using an HP filter with a smoothing parameter of 1600.

about these effects. Then, we show the effects of implementing a spread limit equal to the average spread of the economy with the original rule (i.e., the optimal rule for $G_t = 0$), and we show that the optimal spread limit is essentially invariant to the government's beliefs about the effects of G_t on productivity.

3.1 Calibration

One period in the model corresponds to a quarter. Table 1 summarizes the calibration of the benchmark economy, which has no spending needs ($G_t = 0$ and $\mu_z = 1$) and no fiscal rule. The parameters in the top panel are set independently. The risk aversion coefficient $\sigma = 2$, the risk-free rate $r^* = 0.01$, the capital share $\alpha = 0.33$, the depreciation rate $\delta = 0.05$, and the persistence and volatility of the productivity shock, $\rho = 0.95$ and $\sigma_z = 0.017$, are standard values. The maturity rate $\gamma = 0.05$ is taken from Chatterjee and Eyigungor (2012) and implies an average debt maturity of five years. We set the readmission probability $\theta = 0.083$ so that a defaulting government is excluded from financial markets for three years on average. Finally, we set the parameter of the robust correction mechanism to $\chi = 0.03$, so that a government with debt above the limit must reduce it by at least 3 percent of output each quarter (Hatchondo et al., 2022a).

The four parameters in the bottom panel of Table 1 are jointly chosen so that simulations of the benchmark economy match four targets in the data (all parameters affect all data moments, but the capital adjustment cost ϕ is more closely related to the volatility of investment relative to that of output). The model matches the four targets reasonably well.

Table 2 reports moments that were not targeted in the calibration. As in the data and

Table 2: Untargeted moments

Moment	Data	Model
σ_c/σ_y	1.1	1.6
σ_y	3.2	3.6
$\sigma_{TB/y}$	4.0	6.7
$\rho_{r-r^*,y}$	-0.02	-0.37
$\rho_{TB/y,y}$	0.11	-0.48

Note: The moments in the model are calculated using a simulation of 10,000 periods after dropping the first 1,000. We take the natural logarithm of GDP, consumption, and investment and detrend each series using an HP filter with a smoothing parameter of 1600.

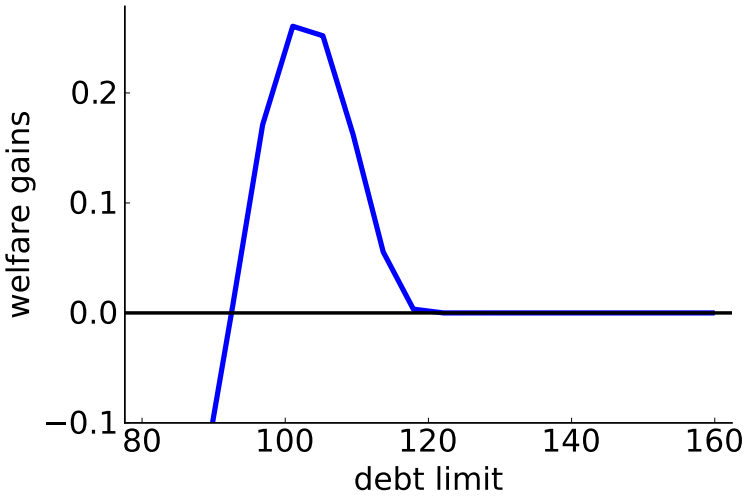
as is standard in the literature, the model generates consumption that is more volatile than output, a volatile trade balance, and countercyclical spreads. The main discrepancy with the data for Portugal is that spreads and the trade balance are more countercyclical in the model. This is because, for our sample period, the procyclicality of the current account in Portugal is different from the countercyclicality observed in other economies studied in the literature.

3.2 Optimal Debt Limit in the Baseline Economy

We next solve for the optimal debt limit DL in the baseline economy without spending needs ($G_t = 0$). Restricting borrowing may be beneficial because committing to borrowing less in future periods $t + n$ allows the government to issue debt at higher prices in period t (Hatchondo et al., 2020). Such commitment to lower borrowing can be achieved with debt limits (Aguiar et al., 2020; Espino et al., 2025). In our environment, the decrease in default probabilities brought about by lower borrowing has the additional benefit of mitigating an underinvestment distortion (Esquivel, 2024).

Figure 2 shows that for the average state in the baseline economy, households' welfare is maximized with a debt limit of 101 percent of GDP. Debt limits that are loose enough are never binding and generate no gains. As the limit becomes tighter, it curbs borrowing in more states, which lowers default risk. Lenders offer better prices for the debt, and households, facing less sovereign risk, invest more. Table 3 shows that the optimal debt limit reduces the default probability and, thus, the average spread, and also lowers the volatility of the spread, output, and the trade balance. Implementing a tighter limit, however, is costly for two reasons. First, it forces an addition initial fiscal consolidation in which consumption temporarily drops. Second, it eliminates beneficial trades between the government and investors. For limits that are too tight, these costs dominate and the rule generates welfare losses.

Figure 2: Welfare gains from introducing a debt limit in the baseline economy



Note: Welfare gains are expressed in consumption equivalent units. Gains are computed from the average state of the baseline economy with $G_t = 0$ and without a fiscal rule.

Table 3: Effects of re-optimizing the debt limit

	Baseline: no G_t		Wasteful G_t		Productive G_t	
	no rule	optimal DL $DL = 101$	old DL $DL = 101$	optimal DL $DL = 97$	old DL $DL = 101$	optimal DL $DL = 122$
default pr.	1.1%	0.2%	0.5%	0.2%	0.04%	0.3%
μ_{r-r^*}	2.5	0.8	1.7	1.1	0.1	0.9
σ_{r-r^*}	1.9	0.9	1.5	1.0	0.1	0.8
$100 \cdot B/GDP$	111	103	101	98	103	124
σ_y	3.6	2.4	2.7	2.4	2.3	2.5
σ_c/σ_y	1.6	1.6	1.7	1.6	1.5	1.7
$\sigma_{TB/y}$	6.7	3.3	4.3	3.2	2.5	4.0
$\rho_{r-r^*,y}$	−0.37	−0.42	−0.43	−0.46	−0.26	−0.44
$\rho_{TB/y,y}$	−0.48	−0.55	−0.49	−0.54	−0.61	−0.51

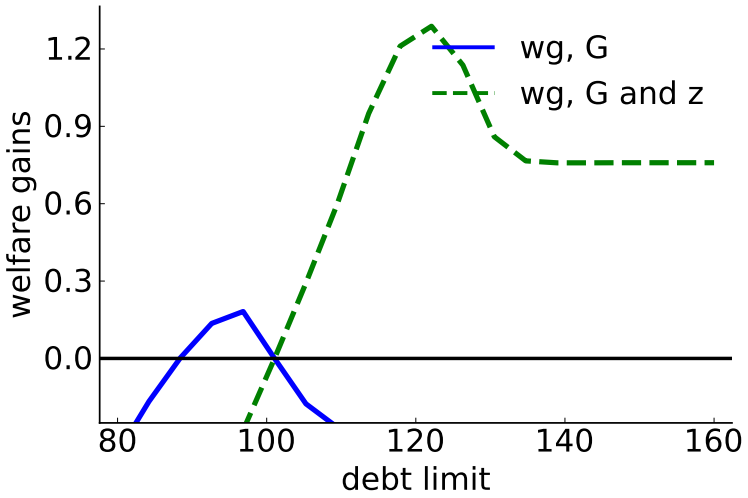
Note: The moments in the model are calculated using a simulation of 10,000 periods after dropping the first 1,000. We take the natural logarithm of GDP, consumption, and investment and detrend each series using an HP filter with a smoothing parameter of 1600.

3.3 Change in the Optimal Debt Limit with "Wasteful" Spending

Next, we assume that there are new spending needs in the economy $G_t = 0.05Y_t$ equal to five percent of output (the European 2035 target for defense spending).[6] We first assume that this spending is "wasteful" and does not affect productivity ($\mu_z = 1$). One can think, for example, that this "wasteful" spending prevents a productivity decline, or that it has

[6]We modeled the increase in spending needs as permanent, but our analysis could be extended to consider temporary spending needs.

Figure 3: Welfare gains from adjusting the debt limit relative to keeping the old DL=101



Note: Welfare gains are expressed in consumption equivalent units. Gains are computed starting from the average state of the baseline economy without a fiscal rule and are relative to keeping the original debt limit $DL = 101$ in place after the arrival of the spending needs. The solid (dashed) line presents the welfare gains when average productivity does not increase (increases 5 percent) after an increase in spending needs G_t from 0 to 5 percent of output.

other benefits outside our model that make the spending necessary.

Table 3 shows that if the government keeps the 101 percent debt limit, the new wasteful spending needs would increase sovereign spreads significantly by 90 basis points. This illustrates how, by making the economy poorer, wasteful spending reduces the government's debt-carrying capacity. The volatility of spreads, output, and the trade balance would also increase.

How should the debt limit in the fiscal rule be changed to accommodate new wasteful spending? To answer this question, we calculate the optimal debt limit of the economy with wasteful spending. As in the previous subsection, we consider the average state in the baseline economy. Thus, we can attribute any change in the optimal debt limit with respect to the 101 percent for $G_t = 0$ to the increase in spending to $G_t = 0.05Y_t$.

Figure 3 shows the welfare gains from replacing the original limit of 101 percent with a new limit when there are new wasteful spending needs (solid blue line). The figure shows that to respond to the lowered debt-carrying capacity implied by wasteful spending, the government should choose a lower debt limit of 97 percent of GDP. Table 3 shows that lowering the debt limit would allow the government to reduce the default probability and, thus, the average spread, as well as lower the volatility of the spread, output, and the trade balance.

Wasteful spending is a permanent drain on the government's budget in (2). Financing

$G_t = 0.05Y_t$ requires higher lump-sum taxes, which reduce consumption and make debt service more painful at the margin. Default incentives increase, and lenders anticipate this and demand higher spreads. This implies that the optimal debt level is lower and, thus, the debt limit in the fiscal rule should be tightened.

3.4 Change in the Optimal Debt Limit with Productive Spending

In this subsection, we again assume that there are new spending needs in the economy equal to five percent of output ($G_t = 0.05Y_t$), but we assume that this spending has a positive and permanent effect on productivity and $\mu_z = 1.05$. This productivity increase is at the high end of plausible values and allows for a sharp illustration of the mechanism we want to underscore.[7] Table 3 shows that if the government keeps the 101 percent debt limit, higher productivity implies much lower sovereign spreads for the same average level of debt to GDP. This shows how, in the economy with higher productivity, the government benefits from a stronger debt-carrying capacity.

Figure 3 shows significant welfare gains from replacing the original debt limit of 101 percent with the optimal limit for the higher-productivity economy of 122 percent (dashed green line). Recall that the cost of default is increasing in productivity. Therefore, the higher productivity triggered by the higher spending $G_t = 0.05Y_t$ makes default more costly, which strengthens repayment incentives. This makes the optimal level of debt in the economy higher and implies that the debt limit in the fiscal rule should be increased. Figure 3 also shows that in the economy with productive spending, even a limit that is never binding generates welfare gains when compared to the original 101 percent limit, indicating that removing the 101 percent limit altogether is preferable to keeping it.

Table 3 also shows that the higher debt limit would allow for a large increase in borrowing while keeping default risk at a level similar to the one observed before the increase in spending G_t (which is implied by implementing the optimal debt limit before the increase in G_t). Overall, Table 3 suggests that across the three scenarios we consider, the optimal fiscal rule implies significant differences in debt levels but comparable levels of sovereign risk and, thus, sovereign spreads. This is reflected in the results we present in the next subsections.

[7] Ramey (2019) surveys that spending fiscal multipliers range between 0.6 and 1. We consider a multiplier that is potentially larger than 1 because that is the basis of recurring arguments in favor of relaxing fiscal constraints in the face of new challenges or opportunities (military buildups, infrastructure in developing economies, climate resilience). Moreover, as we show below, such a large ambiguity regarding the magnitude of the multiplier weakens the case for debt-anchored fiscal rules in favor of spread-anchored fiscal rules.

Table 4: Welfare gains relative to keeping the old debt limit $DL = 101$

New limit	$DL = 97$	$DL = 122$	$SL = 0.84$	$SL = 0.62$
G_t wasteful	0.18	−0.30	0.24	0.28
G_t productive	−0.28	1.29	1.27	1.35

Note: Welfare gains are expressed in consumption equivalent units. Gains are computed from the average state of the baseline economy without a fiscal rule and are relative to keeping the original debt limit $DL = 105$ in place after the arrival of spending needs ($G_t = 0.05Y_t$).

3.5 Ambiguity: Effects of Choosing the Wrong Debt Limit

The exercises in the previous subsections assume that when the government adjusts the rule, it knows the effect of the new spending G_t on debt-carrying capacity. This is a strong assumption, as, for example, the effect of investment on productivity may be difficult to anticipate at the time changes in the fiscal rule are decided. While changes in productivity (and debt-carrying capacity) may be learned over time, one important characteristic of fiscal rules is that they should not be updated frequently, and there may also be uncertainty about the political will for changing the fiscal rule in the future.

In this subsection, we study the effects of choosing the fiscal rule with the wrong beliefs about debt-carrying capacity. Table 4 shows that if G_t is productive (wasteful), but the government lowers (increases) the debt limit believing G_t is wasteful (productive), this generates welfare losses.

3.6 Ambiguity: Average-Spread Limit

Next, we focus on the effects of replacing the debt rule with a spread rule when the new spending needs arise. In this subsection, we assume the government does not know how spending will affect debt-carrying capacity and does not have the technology to solve for the optimal spread limit. We show that even in this case, switching to a spread rule may be beneficial, and it may eliminate the risk of generating welfare losses because of ambiguity about the effects of spending on debt-carrying capacity. We assume that the government uses a spread limit of 0.84 percent, which is the average spread observed without the new spending needs (i.e., with $G_t = 0$) and with the original debt limit of 101 percent (Table 3). That is, we assume the government commits to the new spending ($G_t = 0.05Y_t$) and to not allowing this new spending to increase sovereign risk (irrespective of the effect of spending on debt-carrying capacity).

Table 4 shows that, in contrast to debt limits, the average-spread limit generates welfare gains both when spending is wasteful and when it is productive. Thus, replacing the

Table 5: Effects of the average spread limit

	Wasteful G_t			Productive G_t		
	old DL	optimal DL	spread limit	old DL	optimal DL	spread limit
	$DL = 101$	$DL = 97$	$spr \leq 0.84$	$DL = 101$	$DL = 122$	$spr \leq 0.84$
default pr.	0.5%	0.2%	0.3%	0.04%	0.3%	0.3%
μ_{r-r^*}	1.7	1.1	1.2	0.1	0.9	1.2
σ_{r-r^*}	1.5	1.0	0.9	0.1	0.8	0.9
$100 \cdot B/GDP$	101	98	101	103	124	127
σ_y	2.7	2.4	2.6	2.3	2.5	2.7
σ_c/σ_y	1.7	1.6	1.8	1.5	1.7	1.8
$\sigma_{TB/y}$	4.3	3.2	4.2	2.5	4.0	4.8
$\rho_{r-r^*,y}$	−0.43	−0.46	−0.44	−0.26	−0.44	−0.44
$\rho_{TB/y,y}$	−0.49	−0.54	−0.55	−0.61	−0.51	−0.55

Note: The moments in the model are calculated using a simulation of 10,000 periods after dropping the first 1,000. We take the natural logarithm of GDP, consumption, and investment and detrend each series using an HP filter with a smoothing parameter of 1600.

debt rule with a simple average-spread rule solves the ambiguity problem described above. Furthermore, the average-spread performs as well as the optimal debt limit the government could choose if it had the technology to do so and knowledge about the effects of new spending $G_t = 0.05Y_t$ on debt-carrying capacity: welfare gains with the average-spread limit are comparable to welfare gains with the optimal debt limits.[8]

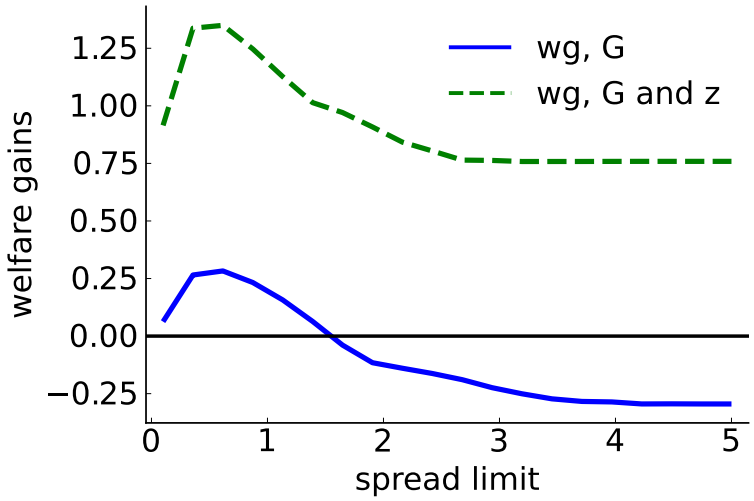
Table 5 reports the effects of the average-spread rule in the simulations. The table shows that the average-spread rule allows the level of debt to adjust to the debt-carrying capacity implied by the new spending $G_t = 0.05Y_t$, with an average debt of 101 percent of GDP when spending is wasteful and 127 percent when spending is productive. For each economy, since the average-spread limit allows for higher debt levels than the optimal debt limit, the average-spread limit also implies more sovereign risk. But recall that this is not the optimal spread limit for these economies.

3.7 Ambiguity: Optimal Spread Limit

Figure 4 shows the welfare gains from replacing the original debt limit with different spread limits when the new spending is wasteful (solid blue line) and when it is productive (dashed

[8]Without ambiguity about the characteristics of the economy, it should be possible to obtain equivalent welfare gains with either the optimal spread limit or the optimal debt limit, provided that fiscal rules are designed in a way that both limits imply the same cyclicality of fiscal consolidations (Hatchondo et al., 2022a,b). Therefore, in this paper, we do not discuss differences between debt and spread limits that arise because of the cyclicality of fiscal consolidations. We focus instead on the advantage of spread limits for mitigating the problem that arises because of ambiguity about the effects of spending on debt-carrying capacity.

Figure 4: Welfare gains from spread limits relative to keeping old DL=101



Note: Welfare gains are expressed in consumption equivalent units. Gains are computed from the average state of the baseline economy without a fiscal rule and are relative to keeping the original debt limit $DL = 101$ in place after the arrival of the spending needs. The horizontal axis shows the spread limit in basis points. The solid (dashed) line presents the welfare gains when average productivity does not increase (increases 5 percent) after an increase in spending needs G_t from 0 to 5 percent of the output.

green line). The figure shows that the optimal spread limit is virtually invariant to the effect of the new spending on productivity. That is, in our model economy, if the government has the technology to find the optimal spread limit (as we assumed it has for finding the optimal debt limits), ambiguity about the effects of new spending on debt-carrying capacity is irrelevant. In contrast to what happens when choosing the optimal debt limit, there would be no cost to choosing the optimal spread limit with the wrong beliefs about the effects of spending on debt-carrying capacity. Furthermore, even if the government does not have the technology to choose the optimal spread limit, using the average spread observed before the increase in spending as the spread limit yields over 85 percent of the welfare gains obtained with the optimal spread limits (Table 4).

The role of sovereign spreads in solving the ambiguity problem is clear. This problem arises because the effects of spending on debt-carrying capacity are not known at the time the fiscal rule is decided. But these effects will be learned over time and will be reflected in sovereign spreads. For the same debt level, higher (lower) spreads would signal that spending lowered (increased) debt-carrying capacity, and the spread rule would automatically force the government to borrow less (allow the government to borrow more). For simplicity, we assumed that the effect of spending on debt-carrying capacity is learned immediately after the rule is decided, but the informational advantage of spreads would be relevant even if this learning is gradual. Of course, one would want to set the rule in a way that correction

mechanisms are triggered by the effects of spending on debt-carrying capacity and not by short-term spread volatility, for example, by making the rule a function of the average spread over the previous budget cycle (Hatchondo et al., 2022a).

4 Conclusions

We studied how fiscal rules should be adjusted when governments face new spending needs. We showed that the effect of new spending on optimal debt limits depend on the nature of this spending. Spending that makes the economy poorer reduces its debt-carrying capacity and calls for a tighter limit. Spending that increases productivity and thus debt-carrying capacity calls for a higher debt limit. Therefore, adjusting a debt limit with the wrong beliefs about the effects of spending on debt-carrying capacity would generate welfare losses.

We also showed that rules that use sovereign spread limits instead of debt limits are robust to the ambiguity about the effect of spending on debt-carrying capacity. The optimal spread limit is virtually the same regardless of the effect of the new spending on debt-carrying capacity. The robustness of spread limits also implies that the government could simply cap spreads at the average level observed before the spending increase, and this would generate more than 85 percent of the welfare gains obtained with the optimal spread limit, for any effect of spending on debt-carrying capacity. In other words, the government could commit to preventing new spending from raising sovereign risk, adjusting its debt as it uncovers how that spending impacts debt-carrying capacity. Our findings apply to other contexts involving anticipated shifts in debt-carrying capacity, such as a country entering a monetary union or undergoing major political and institutional transformations.

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