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Dilemma for fiscal policies: supporting economic activity, or ensuring public debt sustainability?

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ABSTRACT

We study analytically the conflict of goals between stabilizing economic activity and public debt sustainability, for the fiscal authorities. In the short run, an active and expansionary fiscal policy, increasing public investment or reducing the labor taxation rate, is growth enhancing. However, as these short term fiscal policies also decrease government revenue and increase the public debt, budgetary and fiscal multipliers are reduced in the long run. In the framework of a potential ZLB constraint for monetary policy, an expansionary fiscal policy is thus appropriate only if long term labor and consumption taxation rates are small, and if the share of public expenditure in GDP is high. On the contrary, fiscal policy should be contractionary, in order to insure the sustainability of the long term public debt, if long term labor and consumption taxation rates are high. A contractionary fiscal policy is then also all the more appropriate as the sensitivity of government expenditure to the public debt is high, and as the labor share in the production function is high.

KEYWORDS

Economic stabilization; Public debt sustainability; Public expenditure; Fiscal policy

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1. Introduction

Fiscal authorities often face a dilemma between many various and sometimes contradictory goals. Indeed, the budget deficit should ensure public debt sustainability, and therefore, public expenditure is limited by the future reimbursement capacities of the government. However, government expenditure must also be sufficiently high to ensure the production of fundamental public goods: defense, justice, health, education, etc. Finally, this expenditure must also satisfy a goal of stabilization of economic activity in case of shocks. Indeed, in case of recession, fiscal policy should be expansionary and counter-cyclical in order to compensate for the lack of private demand, whereas in case of high economic growth, fiscal policy should be contractionary in order to avoid excessive inflationary tensions. The usefulness of budgetary policy is then obvious in case of asymmetric shocks, or in case of symmetric shocks when the efficiency of monetary policy is limited by the Zero Lower Bound. So, these various goals are not always compatible, and they may even be contradictory, particularly when in recession, the necessity to sustain economic activity by an expansionary budgetary policy put into danger the long term sustainability of the public debt. For example, in the context of the COVID-19 health crisis, all governments strongly increased their government expenditure in order to avoid the bankruptcy of firms and to sustain the purchasing power of households. However, public debt levels then dramatically increased in all countries, reaching excessive levels which sometimes endangered the sustainability of these public debts. Therefore, should fiscal policies sustain economic activity, or should they ensure the long term public debt sustainability?

This paper aims at giving some answers to this important question for the fiscal authorities. To solve the dilemma between economic stabilization and public debt sustainability, the absolute value of the initial public debt level is fundamental. Indeed, the economic literature has underlined that a highly indebted country is more constrained and is less able to conduct a counter-cyclical fiscal policy in case of recession, whereas a more weakly indebted country has more room of manoeuvre. So, a healthy fiscal situation, an initially limited public indebtedness and a sustainable path for sovereign debt, affect the use of fiscal policy in stabilizing macroeconomic conditions. When public debt levels are excessively high, countries are poorly equipped to carry out their stabilization task. Besides, the global policy-mix is also important. Indeed, monetary policy defines the nominal interest rate, and thus the real interest rate, affecting saving for households, capital returns for firms, and the costs of the reimbursement of the public debt for the government. So, the coordination between monetary and fiscal policies can affect the arbitrage between stabilizing economic activity and ensuring a sustainable path for the public debt. Finally, the short term stabilization goal of fiscal policy is mainly a question of flows adjustment, for example in a context of economic crisis. On the contrary, long term public debt sustainability is a question of stock of indebtedness, largely inherited from the past. So, the appropriate fiscal policy in the short run can differ from the appropriate policy in the long run, and both equilibria must be clearly distinguished.

The current paper sheds light on the question of the dilemma for fiscal policies between supporting economic activity and ensuring public debt sustainability, with a help of a simple modelling. The contribution of the paper is then to underline analytically the importance of the activeness and of the efficiency of monetary policy, as well as the importance of various sensitivity parameters and of the long term consumption and labor taxation rates, i.e. of the weight of the government and of public expenditure in GDP for a given country. In the short run, we show that an active and expansionary fiscal policy, increasing public investment or reducing the labor taxation rate, is growth enhancing. However, an expansionary fiscal policy seems appropriate only if long term labor and consumption taxation rates are small, and if the share of public expenditure in GDP is high. On the contrary, fiscal policy should be contractionary, in order to insure the sustainability of the long term public debt, if long term labor and consumption taxation rates are high, if the sensitivity of government expenditure to the public debt is high, and if the labor share in the production function is high.

The rest of the paper is organized as follows. The second section provides a list of some contributions of the economic literature. The third section presents a simple model with a precise definition of the public sector and of the government. The fourth section assesses the results of the model, and the theoretical importance of some parameters and sensitivities for the arbitrage between the goals of the government. The fifth section concludes the paper.

2. Economic literature

Economic theory underlines a fundamental dilemma for fiscal policy. Public debt sustainability is the first and main goal of any government. Sound public finances are necessary in order to let to the fiscal policy enough room of manoeuvre to play an efficient role in macroeconomic stabilization, in particular in case of a large health and economic crisis as the COVID-19 crisis. Without being 'sane' in normal times, fiscal policy risks to be pro-cyclical. But fiscal policy has a second goal which is as important: it must have enough flexibility, as fundamental economic

stabilization tool, to keep its shock-absorbing role. Therefore, provided the public debt is sustainable, fiscal policy must be able to allow a fiscal space to stabilize and to absorb large shocks; it must be compatible with the stabilization function of budgetary policy, and with demand management. For example, using panel data covering close to 40 EU and non-EU countries, typically from 1970-80 until 2017, Larch *et al.* (2021) show that discretionary fiscal policies are usually ill-timed and therefore harmfully pro-cyclical for stabilizing aggregate demand and economic activity (except in case of large economic crisis). Furthermore, deviations from fiscal rules and the accumulation of a high government debt would foster pro-cyclical fiscal policy. Therefore, according to the authors, fiscal rules and avoiding to over-spend in good times would be useful to provide a sufficient margin of manoeuvre to conduct a counter-cyclical fiscal policy in bad times.

In the same way, Nerich and Reuter (2015) analyze the interaction of fiscal rules and fiscal space for the EU 27 countries, between 1990 and 2014. They find strong evidence for fiscal rules being associated with higher fiscal space. Furthermore, their analysis shows that countries with more fiscal space tend to have higher discretionary expenditures, and that their fiscal policy is more pro-cyclical, but that this effect is significantly reduced if fiscal rules are in place. Burriel *et al.* (2020) also show, in the framework of three large scale Dynamic Stochastic General Equilibrium (DSGE) New-Keynesian models, that the goals of economic stabilization and public debt sustainability are difficult to achieve at the same time, when the initial public debt level is high. Indeed, the economy is less resilient to macroeconomic shocks in case of an excessive public debt level, which restrains the room of manoeuvre for counter-cyclical fiscal policy.

In this framework, many papers underline the importance of the policy-mix and of the coordination between the monetary and budgetary policies for the appropriate debt consolidation strategy of the government. Bonam and Lukkezen (2019) introduce a sovereign risk premium for government bonds on the risk-free interest rate, increasing with the indebtedness level and the probability of default. Then, they show analytically that when government debt is risky, a counter-cyclical fiscal policy and budget deficits raising interest rates crowd out private consumption. Indeed, in case of a negative shock, a counter-cyclical fiscal policy raises the budget deficit, the public debt, the risk premium and the interest rate. So, agents save more and consume less, causing output and inflation to fall. Consequently, counter-cyclical fiscal policies endanger the potentiality to reach a stable and unique equilibrium for the public debt level; they are feasible only if complemented with a more aggressive debt consolidation and/or active monetary policy. Therefore, an active debt consolidation strategy should consist in a more pro-cyclical fiscal stance, the primary surplus of the government increasing and the public debt decreasing in case of a negative shock, which allows to maintain a low risk premium and to sustain private consumption. Or if the interest rate depends on the public debt, the monetary policy should be more expansionary and the risk-free interest rate should decrease, in order to compensate for the higher risk premium and to sustain private consumption. Anyway, according to the authors, reaching a stable and unique equilibrium depends on the policy-mix and on the coordination between monetary and budgetary authorities.

In the same way, Andrès *et al.* (2020) develop a DSGE model of a two-country monetary union, calibrated to match the characteristics of Spain and Germany, in which debt sustainability is endogenously determined to shape the responses of the risk premium on public debt. They find that in normal times, the costs of a government spending driven fiscal consolidation in the high-debt country are greatly diminished when this consolidation improves endogenously its debt sustainability prospects. On the contrary, when monetary policy is constrained at the Zero Lower Bound (ZLB), fiscal consolidation generates deflationary expectations which increase the real interest rate and may compensate the benefits from a lower risk premium. In this context, a fiscal expansion in the low-debt country and a consolidation in the high-debt country delivers the greatest positive impact on union-wide output. Besides, Corsetti *et al.* (2013) analyze the impact of constrained government finances on macroeconomic stability and on the transmission of fiscal policy. They study a 'sovereign risk channel' through which sovereign default risk raises funding costs in the private sector. If monetary policy is constrained (in particular because of the ZLB), the sovereign risk channel exacerbates indeterminacy problems: private-sector beliefs of a weakening economy may become self-fulfilling. In addition, sovereign risk (a high public debt) amplifies the effects of negative cyclical shocks; the spending multiplier is reduced. Under those conditions, fiscal retrenchment (a pro-cyclical fiscal policy) can help to curtail the risk of macroeconomic instability and, in extreme cases, even stimulate economic activity.

Furthermore, with a DSGE model, Battistini *et al.* (2019) find that the possibility of a binding ZLB may have detrimental effects on debt sustainability, as a kink in the Laffer curve induces a dead-weight loss in the present discounted value of future primary surpluses. By changing the shape of the Laffer curve, the ZLB forces the revenue-maximizing fiscal authority to raise the tax rate as to push inflation closer to its target and act as a substitute for the constrained monetary authority. The peak of the Laffer curve is thus associated with a higher tax rate, which shrinks the tax base and impairs revenues, and a higher interest rate, which further harms economic activity and depresses

the present value of future revenues compared to an unconstrained economy. Moreover, debt sustainability improves with monetary policy activeness, that is, with the elasticity of the interest rate to changes in inflation and the output gap. Indeed, a lower volatility of inflation improves economic activity. On this basis, the authors assess that in normal times, large public spending shocks may engender perverse debt dynamics and cause economic contractions. At the ZLB, a muted tradeoff between stabilization and sustainability instead expands the fiscal margin, especially if coupled with a commitment to a more active monetary policy during normal times. Linnemann and Schabert (2010) also study the consequences of non-neutrality of government debt for macroeconomic stabilization policy in a sticky-price model, where Ricardian equivalence fails because debt has a negative impact on its rate of return and on private savings. They find that under aggressive monetary policy regimes, macroeconomic fluctuations and inflation expectations tend to be stabilized if nominal budget deficits are low and with a smooth debt path. So, if debt is non-neutral, the central bank's output gap–inflation volatility trade-off is improved under a balanced budget policy.

In this context, the current paper aims at studying the economic stabilization–public debt sustainability trade-off for the government, with the help of a simple analytical modelling.

3. The model

In a given country, we consider a representative household, a representative firm, and a government. Obviously, as our goal is to study the dilemma between economic stabilization and public debt sustainability, we put a particular emphasis on the budgetary constraint of the government. We also introduce public expenditure in the utility function of the representative household, in order to underline the usefulness of this public expenditure; but we also make the distinction between public consumption and investment expenditure.

3.1. Households

The economy is populated by a unit measure of households. The representative household provides labor and it consumes goods. In a given period (t), it maximises an inter-temporal utility function:

$$\text{Max} \sum_{k=0}^{\infty} \beta^k E_t \left[\alpha_c \frac{\theta}{(\theta-1)} (C_{t+k})^{\frac{(\theta-1)}{\theta}} + \alpha_g \frac{\theta}{(\theta-1)} (G_{t+k})^{\frac{(\theta-1)}{\theta}} - \alpha_l \frac{1}{(1+\varphi)} L_{t+k}^{(1+\varphi)} \right] \quad (1)$$

With, in period (t): (C_t): real private consumption; (G_t): real public expenditure; (L_t): hours worked by the representative household. $E_t(\cdot)$ is the rational expectation operator conditional on information available at date (t), (β) is the time discount factor, and the indices ($0 < \alpha_c < 1$), ($0 < \alpha_g < 1$) and ($0 < \alpha_l < 1$) are the respective weights given to consumption of private goods, public goods and leisure in the utility function.

Utility is an increasing and concave function of (C_t), an index of the household's consumption of all supplied goods; (θ) is the elasticity of intertemporal substitution. Utility is also an increasing and concave function of public goods and services (G_t), which is supposed to be additively separable [this is introduced in Sims and Wolff (2018), for example]. One of the main contribution of the current paper is thus not to neglect this possibility of utility-enhancing public spending. Indeed, the well-being of households is empirically higher with public expenditure such as health, education or infrastructure. Besides, without including public expenditure in the utility function as substitute with private consumption, a fiscal policy of increase in public spending could not rationally be justified, and decreasing public expenditure and reducing the public indebtedness level would be the only rational economic policy. Utility is also a decreasing and convex function of the hours worked (L_t), where ($\varphi \geq 0$) is the inverse of the Frisch elasticity of labor supply.

This maximisation is subject to a life time and inter-temporal nominal budget constraint for each date (t), where prices of goods, interest rates, taxation rates and wages are taken as given by the representative household.

$$(1 + \tau_t^c) P_t C_t + B_t = (1 - \tau_t^l) W_t L_t + (1 + i_{t-1}) B_{t-1} \quad (2)$$

With, in period (t): (P_t): level of consumer prices; (W_t): nominal hourly wage; (τ_t^l): taxation rate on labor income; (τ_t^c): taxation rate on consumption; (i_t): nominal interest rate on the public debt; (B_t): nominal public debt at the end of the period.

In this context, the result of the maximisation of equation (1) under the constraint (2) implies the following first order Euler condition, regarding timing of expenditure decisions and inter-temporal substitution of consumption, for whatever period ($t+n$):

$$(C_{t+n})^{-\frac{1}{\theta}} = \frac{(1 + \tau_{t+n}^c)P_{t+n}}{\beta^n(1 + i_t) \dots (1 + i_{t+n-1})(1 + \tau_t^c)P_t} (C_t)^{-\frac{1}{\theta}} \text{ for } n \geq 1 \tag{3}$$

So, in percentage deviation from steady state, equation (3) implies:

$$\widehat{C}_t = E_t(\widehat{C}_{t+1}) - \theta[i_t - E_t(\pi_{t+1})] - \frac{\theta\tau^c}{(1 + \tau^c)} [\widehat{\tau}_t^c - E_t(\widehat{\tau}_{t+1}^c)] \tag{4}$$

Where $[\pi_t = \ln(P_t/P_{t-1})]$ is the inflation rate in period (t).

Therefore, private consumption increases with future consumption, because of smoothing of intertemporal consumption, and it decreases with the real interest rate. Moreover, private consumption also decreases with a temporary acceleration of the increase in the consumption taxation rate.

Besides, for the representative household, by combining equations (1) and (2), we obtain the following optimal substitution between private consumption and leisure:

$$(L_{t+n})^\varphi = \frac{\alpha_c(1 - \tau_{t+n}^l)W_{t+n}}{\alpha_l(1 + \tau_{t+n}^c)P_{t+n}} (C_{t+n})^{-\frac{1}{\theta}} \text{ for } n \geq 0 \tag{5}$$

So, in percentage deviation from steady state, equation (5) implies:

$$\widehat{L}_t = \frac{1}{\varphi} (\widehat{W}_t - \widehat{P}_t) - \frac{\tau^l}{\varphi(1 - \tau^l)} \widehat{\tau}_t^l - \frac{\tau^c}{\varphi(1 + \tau^c)} \widehat{\tau}_t^c - \frac{1}{\varphi\theta} \widehat{C}_t \text{ for } n \geq 0 \tag{6}$$

Therefore, labor supply increases with the real wage, but it decreases with higher taxation rates (τ^l and τ^c) and with the disutility of working time (φ).

3.2. Firms

The representative firm produces a differentiated good in a monopolistic competition setting. It defines the real wage in order to maximise its profit, taking other variables as given. Capital is supposed to be fixed in the short run, whereas labor is defined according to the maximization program of households in equation (6). It is the only production factor which is variable in the short run, as we abstract from capital accumulation in this paper. Besides, public expenditure is also a factor raising public input; production increases with public goods and services supplied by the government. However, we suppose that investment and public capital expenditure ($G_{inv,t}$) is more productive than public consumption and public employment ($G_{c,t}$), and more efficient in increasing the productivity of private factors, which implies: ($0 < z_2 < z_1 < 1$), whereas: ($G_{i,t} = G_{inv,t} + G_{c,t}$)¹. Indeed, the consequences of an increase of the public indebtedness level would likely be different if this public debt is only intended to finance current consumption public expenditure or if it allows public investment in capital. So, the production function has the following form:

$$Y_t = A_t L_t^{1-\nu} G_{inv,t}^{z_1} G_{c,t}^{z_2} \quad 0 < \nu < 1 \tag{7}$$

With, in period (t): (A_t): technology or productivity shock; (Y_t): real production level; (ν): decreasing returns of the production function.

Therefore, in percentage deviation from steady state, we obtain:

$$\widehat{Y}_t = \widehat{A}_t + (1 - \nu)\widehat{L}_t + z_1\widehat{G}_{inv,t} + z_2\widehat{G}_{c,t} \tag{8}$$

This firm maximizes its nominal profit, and labor is paid at its marginal product. So, profit maximization and equation (7) imply:

$$\frac{W_t L_t}{P_t Y_t} = (1 - \nu) \tag{9}$$

Therefore, in percentage deviations from steady state, we obtain:

$$(\widehat{W}_t - \widehat{P}_t) = \widehat{Y}_t - \widehat{L}_t \tag{10}$$

¹ Non growth enhancing public expenditure ($G_{c,t}$) is, for example: justice, defense or social welfare, whereas growth enhancing public expenditure ($G_{inv,t}$) is: public infrastructure, education or health.

We consider a Calvo-type framework of staggered priced, where a fraction ($0 < \alpha < 1$) of goods prices remain unchanged each period, whereas prices are adjusted for the remaining fraction ($1 - \alpha$) of goods. DSGE macroeconomic models then imply the following supply function, where the expression in parenthesis represents the variation in real marginal costs:

$$\pi_t = \beta E_t(\pi_{t+1}) + \frac{(1 - \alpha)(1 - \alpha\beta)}{\alpha} \left[\widehat{W}_t - P_t - \frac{1}{1 - \nu} (\widehat{A}_t + z_1 \widehat{G}_{inv,t} + z_2 \widehat{G}_{c,t}) + \frac{\nu}{1 - \nu} \widehat{Y}_t \right] \quad (11)$$

Inflation then depends on expected future inflation and on real marginal costs, whereas the latter increase with real wages and economic activity (decreasing returns: ν), but decrease with positive productivity shocks as well as with public expenditure.

Therefore, using equations (11), (A3) for the real wage and (A1) for public consumption expenditure in Appendix A.1, real marginal costs are constant, and: $\pi_t = \beta E_t(\pi_{t+1})$.

3.3. Budgetary constraint

The levels of public expenditure, taxation rates and public debt are fixed at the national level by the budgetary authorities. For simplicity, we suppose that all government debt consists of one-period bonds; it is held domestically, and it is risk free real debt. The budgetary constraint of the government is then the following:

$$B_t = (1 + i_{t-1})B_{t-1} + P_t(G_{inv,t} + G_{c,t}) - \tau_t^c P_t C_t - \tau_t^l W_t L_t \quad (12)$$

Besides, in most countries, fiscal revenues move approximatively as GDP, as long as non-tax revenues are relatively low. On the other side, public expenditure is quite independent from GDP, given the small share of unemployment relative expenditure. So, many studies find that the fiscal deficit varies with economic activity, but also varies empirically with the public debt level, in order to insure public debt sustainability. For example, Bohn (1998) shows that between 1916 and 1995, in the United-States, there was a corrective action of the fiscal authority to ensure debt sustainability: the primary surplus was an increasing function of the debt-GDP ratio. Martin *et al.* (2021, p.3) also mention that in the Euro Area, between 1995 and 2019, an increase (fall) by one percentage point of GDP in interest payments on the public indebtedness is associated with an improvement (deterioration) of about 0.5 percentage point in the primary balance. Therefore, we introduce the possibility of a rule constraining fiscal policy: public expenditure and the budget deficit should be reduced in case of excessive public indebtedness. Checherita-Westphal and Zdarek (2017) also find empirically that the primary balance improves if the public debt increases. So, we consider that public expenditure is as follows:

$$P_t G_{inv,t} = P_t G_{inv1,t} - \lambda_1 B_t \quad P_t G_{c,t} = P_t G_{c1,t} - \lambda_2 B_t \quad (13)$$

Therefore, equations (13) imply the following variations of public expenditure:

$$\gamma_1 \widehat{G}_{inv,t} = \frac{G_{inv1}}{Y} \widehat{G}_{inv1,t} - \lambda_1 \frac{b}{Y} \widehat{b}_t \quad \gamma_2 \widehat{G}_{c,t} = \frac{G_{c1}}{Y} \widehat{G}_{c1,t} - \lambda_2 \frac{b}{Y} \widehat{b}_t \quad (14)$$

Where ($b_t = \frac{B_t}{P_t}$) is the nominal public debt; ($\gamma_1 = \frac{G_{inv}}{Y}$) and ($\gamma_2 = \frac{G_c}{Y}$) are the long term respective shares of public investment and public consumption expenditure in GDP. Therefore, the share of global public expenditure in GDP is: ($\gamma = \frac{G}{Y} = \gamma_1 + \gamma_2$), whereas the long term share of private consumption in GDP is ($1 - \gamma = \frac{C}{Y}$).

Equations (12) and (13) then imply:

$$(1 - \lambda_1 - \lambda_2)B_t = (1 + i_{t-1})B_{t-1} + P_t(G_{inv1,t} + G_{c1,t}) - \tau_t^c P_t C_t - \tau_t^l W_t L_t \quad (15)$$

Therefore, using equations (9) and (15), the nominal public debt is:

$$b_t = \frac{(1 + i_{t-1})b_{t-1}}{(1 - \lambda_1 - \lambda_2)(1 + \pi_t)} + \frac{(G_{inv1,t} + G_{c1,t})}{(1 - \lambda_1 - \lambda_2)} - \frac{\tau_t^c C_t}{(1 - \lambda_1 - \lambda_2)} - \frac{(1 - \nu)\tau_t^l Y_t}{(1 - \lambda_1 - \lambda_2)} \quad (16)$$

Solving equation (16) forwards, using equation (3), and with $\lim_{t \rightarrow \infty} b_t = 0$ (we suppose a no-Ponzi-game, and the satisfaction of the intertemporal budgetary constraint), we can obtain:

$$b_t = \beta E_t \left\{ \sum_{n=0}^{\infty} \beta^n (1 - \lambda_1 - \lambda_2)^n \frac{(1 + \tau_t^c)(C_t)^{\frac{1}{\theta}}}{(1 + \tau_{t+n+1}^c)(C_{t+n+1})^{\frac{1}{\theta}}} \left[(G_{inv1,t+n+1} + G_{c1,t+n+1}) + \tau_{t+n+1}^c C_{t+n+1} \right] \right\} \quad (17)$$

In this context, the long term steady state nominal public debt to GDP ratio is²:

$$\frac{b}{Y} = \frac{\beta}{[1 - \beta(1 - 2\lambda_1 - 2\lambda_2)]} [(1 - \nu)\tau^l + \tau^c(1 - \gamma) - (\gamma_1 + \gamma_2)] \quad (18)$$

Therefore, we recover the traditional result that the maximal long term public debt to GDP ratio which is sustainable would be limited by the maximal budget surplus (taxation rates above the share of public expenditure in GDP) that a country can generate. Besides, log-linearizing equation (16), in percentage deviation from steady state, we obtain:

$$\begin{aligned} \frac{(1+i)}{(1+\pi)} (\widehat{b}_t + i_t - \pi_{t+1}) &= (1 - \lambda_1 - \lambda_2) \widehat{b}_{t+1} - \frac{G_{inv1}}{b} \widehat{G}_{inv1,t+1} \\ - \frac{G_{c1}}{b} \widehat{G}_{c1,t+1} + \frac{\tau^c C}{b} (\widehat{\tau}_{t+1}^c + \widehat{C}_{t+1}) &+ \frac{(1-\nu)\tau^l Y}{b} (\widehat{\tau}_{t+1}^l + \widehat{Y}_{t+1}) \end{aligned} \quad (19)$$

3.4. Equilibrium

Equilibrium of aggregate demand and clearing on the market of goods and services implies:

$$Y_t = C_t + G_t \quad (20)$$

So, in percentage deviation from steady state, equation (20) implies:

$$\widehat{Y}_t = (1 - \gamma)\widehat{C}_t + \gamma_1 \widehat{G}_{inv,t} + \gamma_2 \widehat{G}_{c,t} \quad (21)$$

In our model, productivity shocks (\widehat{A}_t) are exogenous. The government can define taxation rates ($\widehat{\tau}_t^c, \widehat{\tau}_t^l$) and public investment expenditure ($\widehat{G}_{inv,t}$), whereas the monetary authority defines the real interest rate. Afterwards, all other variables of the model are endogenous: public consumption expenditure ($\widehat{G}_{c,t}$), but also private consumption (\widehat{C}_t), labor demand and supply (\widehat{L}_t), and the real wage ($W_t - P_t$).

So, equations (4), (21) and (A1) in Appendix A.1 imply the following demand equation:

$$\begin{aligned} \widehat{Y}_t &= \frac{[z_2(1-\gamma)(1+\varphi)\theta + (1-\nu)\gamma_2]}{[\gamma_2(\nu+\varphi) - z_2(1+\varphi)]} [i_t - E_t(\pi_{t+1})] + \frac{\tau^c z_2(1-\gamma)(1+\varphi)\theta}{(1+\tau^c)[\gamma_2(\nu+\varphi) - z_2(1+\varphi)]} [\widehat{\tau}_t^c - E_t(\widehat{\tau}_{t+1}^c)] \\ &- \frac{\gamma_2(1-\nu)\tau^l}{(1-\tau^l)[\gamma_2(\nu+\varphi) - z_2(1+\varphi)]} [\widehat{\tau}_t^l - E_t(\widehat{\tau}_{t+1}^l)] + \frac{(1+\varphi)(\gamma_2 z_1 - \gamma_1 z_2)}{[\gamma_2(\nu+\varphi) - z_2(1+\varphi)]} [\widehat{G}_{inv,t} - E_t(\widehat{G}_{inv,t+1})] \\ &+ E_t(\widehat{Y}_{t+1}) + \frac{\gamma_2(1+\varphi)}{[\gamma_2(\nu+\varphi) - z_2(1+\varphi)]} [\widehat{A}_t - E_t(\widehat{A}_{t+1})] \end{aligned} \quad (22)$$

Therefore, according to equation (22), a higher future expected output increases current output and consumption, because households prefer to smooth consumption, and then higher future revenues raise their current consumption and current output. Current output also increases with the temporary increase of public investment expenditure, or with a temporary positive productivity shock³. Finally, current output slightly decreases with a temporary increase of the labor taxation rate, which is harmful to the purchasing power of households and to private consumption. That is why a conflict of goals can take place for the budgetary authority, between stabilizing economic activity (and then increasing public investment and decreasing the labor taxation rate) and preserving the sustainability of the public debt level (and then conducting the opposite fiscal policy).

Equations (19) for the variation of the public debt, (14), (A1) and (A4) in Appendix A.1 imply:

² Equation (13) implies: $\frac{G_{inv1}}{Y} = \gamma_1 + \lambda_1 \frac{b}{Y}$ and $\frac{G_{c1}}{Y} = \gamma_2 + \lambda_2 \frac{b}{Y}$.

³ $\gamma_2(\nu + \varphi) > z_2(1 + \varphi)$ according to the basic calibration in Section 3.5.

$$\begin{aligned}
 \widehat{b}_t = & \frac{(1 + \pi)(1 - 2\lambda_1 - 2\lambda_2)}{(1 + i)} E_t(\widehat{b}_{t+1}) - [i_t - E_t(\pi_{t+1})] \\
 & + \frac{(1 + \pi) Y (\gamma_2 z_1 - z_2 \gamma_1)(1 - \gamma)(1 + \varphi)\theta(1 + \tau^c)}{(1 + i) b [z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} E_t(\widehat{G}_{inv,t+1}) \\
 & - \frac{(1 + \pi) Y \left\{ \gamma_2(1 + \tau^c) \left[\frac{(v + \varphi)\theta(1 - \gamma) + (1 - \nu)}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} - (1 - \nu)\tau^l - \tau^c \right] \right\}}{(1 + i) b} E_t(\widehat{Y}_{t+1}) \\
 & + \frac{(1 + \pi) Y (1 + \tau^c)\gamma_2(1 - \gamma)(1 + \varphi)\theta}{(1 + i) b [z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} E_t(\widehat{A}_{t+1}) \\
 & + \frac{(1 + \pi) Y}{(1 + i) b} \tau^c(1 - \gamma) \left\{ 1 - \frac{\gamma_2\theta(1 - \nu)}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \right\} E_t(\widehat{\tau}_{t+1}^c) \\
 & + \frac{(1 + \pi) Y}{(1 + i) b} (1 - \nu)\tau^l \left\{ 1 - \frac{\gamma_2\theta(1 - \gamma)(1 + \tau^c)}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2](1 - \tau^l)} \right\} E_t(\widehat{\tau}_{t+1}^l) \tag{23}
 \end{aligned}$$

Therefore, according to equation (23), the public debt increases with expected future public investment, increasing the weight of public expenditure to be financed by the government. The public debt also very strongly increases with an expected future positive productivity shock, creating deflationary tensions harmful to the reimbursement of the public debt [see equation (11)]. The public debt also slightly increases with an expected increase of the consumption or labor taxation rates, harmful to the purchasing power of households and to current private consumption.

3.5 Calibration

We consider a standard calibration of the parameters of our model, in conformity with the economic literature. However, in the following Section 4 of the paper, we will mention and analyze carefully the sensitivity of our results to variations in these parameters.

In conformity with empirical data and with economic studies, we can calibrate the labor share in the production function at two thirds: ($1-\nu= 0.66$). The calibration of the inverse of the Frisch labor supply elasticity is quite heterogeneous in the economic literature, but can be calibrated around ($\varphi=2$). We suppose that consumption appears in logarithm in the utility function (consistent with log preferences), and therefore, that ($\theta=1$). We suppose that the time discount factor is ($\beta=0.99$). We consider a small long term nominal interest rate ($i=0.02$), and also a long term equilibrium inflation rate around the European Central Bank target: ($\pi=0.02$).

We consider that public consumption expenditure is quite inelastic ($\lambda_2 = 0$), as it represents a “State lifestyle” (civil servants) difficult to modify in the short run. On the contrary, public investment expenditure (infrastructure, capital) can slightly react to the public debt level. For example, Bohn (1998) shows that between 1916 and 1995, in the United-States, there was a corrective action of the fiscal authority to ensure debt sustainability: the primary surplus was an increasing function of the debt-GDP ratio ($\lambda_1=0.054$). Checherita-Westphal and Zdarek (2017) estimate a fiscal reaction function framework for 18 euro area countries for the period 1970-2013, and derive a novel approach to measure fiscal fatigue. In the Euro Area, they find that the primary balance improves by about 0.03–0.04 for every 1 percentage point increase in the debt-to-GDP ratio after controlling for other relevant factors. So, we will take ($\lambda_1 = 0.04$).

According to average data for European countries given by Eurostat, we consider that the share of government investment expenditure in GDP is ($\gamma_1 = 0.04$), the share of government consumption expenditure is ($\gamma_2 = 0.26$), and the share of private consumption is ($1 - \gamma = 0.7$)⁴. In conformity with implicit tax rates mentioned by the European Commission (2022), we will consider the following average long term taxation rates regarding: labor ($\tau^l = 0.38$) and consumption ($\tau^c = 0.17$)⁵. Finn (1998) considers that public capital investment is highly productive:

⁴ According to Eurostat, in 2022, final consumption expenditure of general government in GDP is on average $\gamma_2 = \frac{3377477.4}{15810286.6} = 21.36\%$ in EU 27 countries, $\gamma_2 = \frac{2869567.4}{13332098.1} = 21.52\%$ in Euro Area 19 countries. According to the AMECO database, in 2022, Public Gross Fixed Capital Formation in GDP is on average $\gamma_1 = 3\%$ in Southern European countries, $\gamma_1 = 3.3\%$ in Northern and Western European countries or in the whole European Union, $\gamma_1 = 5\%$ in Central and Eastern European countries.

⁵ According to the European Commission (2022, pp.272-273), in 2020, implicit tax rates on consumption were 16.5% on average in the Euro-Area 19, and 17.1% in the European Union 27. They range from only 14.1% in Spain until 24.7% in Denmark. Implicit tax rates on labor were 38.5% on average in the Euro-Area 19, and 38.1% in the

($z_1=0.16$), whereas Sims and Wolff (2018) underline that public consumption is weakly productive ($z_2=0.05$). In the Euro Area, the productivity of public consumption expenditure is supposed to be ($z_2=0.05$) and the productivity of investment expenditure ($z_1=0.2$) in Carvalho and Martins (2011), values that we will retain in the current paper. According to equation (18), the previous values are then compatible with a very small long term public debt to GDP ratio: ($b/Y=81.69\%$).

4. Dilemma between economic activity and public debt sustainability

Our model allows studying the effects of two kinds of shocks. Indeed, we suppose that a shock (\widehat{x}_t) is temporary if [$\partial E_t(\widehat{x}_{t+1}) = 0$] and is permanent if [$\partial E_t(\widehat{x}_{t+1}) = \partial \widehat{x}_t$]. We can then study the consequences of fiscal shocks, on public investment or on taxation rates, for economic activity and various other economic variables. Besides, if monetary policy is not limited by the ZLB constraint, it can be active, and according to equations (22) and (23), we obtain a demand equation which is independent from the monetary policy and from the real interest rate [$i_t - E_t(\pi_{t+1})$]. However, in our model, when monetary policy is constrained by the ZLB and when the nominal interest rate cannot decrease ($i_t = 0$), prices vary in order to imply exactly the same variation of the real interest rate and the same economic variables as when monetary policy is active. In particular, in case of recession, higher future increases in prices are anticipated, in order to provide the decrease of the real interest rate which cannot be obtained by a lower nominal interest rate, and to sustain the current economic activity level⁶.

However, in the framework of our model, we can study the conflict of goals for the fiscal authorities between stabilizing economic activity and ensuring public debt sustainability. Indeed, the public debt is non-neutral in our model, as by combining equations (22) and (23), the level of the public debt enters the demand equation.

4.1. Effects of productivity or public investment shocks

By combining equations (22) and (23), we obtain the same effect of productivity or fiscal shocks on economic activity, whatever the monetary policy. A temporary [$(\frac{\partial \widehat{Y}_t}{\partial \widehat{A}_t})^{ST} = 1.71$ with our basic calibration] negative productivity shock implies a danger of recession. Indeed, the less productive public consumption expenditure (share: γ_2) then increases (see Appendix A.1). The real wage decreases (φ), as the necessary labor force employed on the labor market to produce the same level of goods and services is higher, which decreases private consumption expenditure. When monetary policy is active, the nominal interest rate then decreases to sustain economic activity. When monetary policy is hardly constrained and in the framework of the ZLB for the interest rate, expectations of future inflationary tensions also decrease the real interest rate. In both cases, anticipations of a negative productivity shock decrease the current real interest rate, and they also decrease the current public debt level ($\frac{\partial \widehat{b}_t}{\partial E_t(\widehat{A}_{t+1})} = 2.80$). Therefore, the recession implied by a negative productivity shock is more limited in the long run [$(\frac{\partial \widehat{Y}}{\partial \widehat{A}})^{LT} = 1.10$] than its short term consequences.

In the same way, regarding the consequences of a variation of public investment expenditure, in the short run and in the long run, we obtain respectively the following values:

$$\left(\frac{\partial \widehat{Y}_t}{\partial \widehat{G}_{inv,t}}\right)^{ST} = \frac{(1 + \varphi)(\gamma_2 z_1 - z_2 \gamma_1)}{[\gamma_2(v + \varphi) - z_2(1 + \varphi)]} \tag{24}$$

$$\left(\frac{\partial \widehat{Y}}{\partial \widehat{G}_{inv}}\right)^{LT} = \frac{(1 + \varphi)(\gamma_2 z_1 - z_2 \gamma_1)}{\Delta}$$

$$with: \Delta = [\gamma_2(v + \varphi) - z_2(1 + \varphi)] + \frac{(1 - \tau^l + v\tau^l)}{(1 + \tau^c)} \left[z_2(1 + \varphi) + \frac{\gamma_2(1 - v)}{\theta(1 - \gamma)} \right] \tag{25}$$

According to equation (24), a temporary decrease in public investment expenditure implies a recession

European Union 27. They range from only 23.5% in Malta until 44.1% in Italy.

⁶ In the context of a ZLB constraint, with ($i_t = 0$), combining equations (22) and (23) imply an anticipated inflation rate according to anticipated variations of economic variables:

$$E_t(\pi_{t+1}) = f\{[\widehat{Y}_t - E_t(\widehat{Y}_{t+1})], [\widehat{G}_{inv,t} - E_t(\widehat{G}_{inv,t+1})], [\widehat{A}_t - E_t(\widehat{A}_{t+1})], [\widehat{\tau}_t^c - E_t(\widehat{\tau}_{t+1}^c)], [\widehat{\tau}_t^l - E_t(\widehat{\tau}_{t+1}^l)]\}.$$

$\left[\left(\frac{\partial \widehat{Y}_t}{\partial G_{inv,t}} \right)^{ST} = 0.33 \right]$. Indeed, it decreases the relative share of public investment which is the most productive public expenditure (z_1), whereas the share of public consumption increases in public expenditure. The real wage decreases with the smaller productivity of the labor force, as well as private consumption, whereas the necessary labor force on the labor market increases. The recession is then accentuated, in the short run in equation (24) as well as in the long run in equation (25), if the Frisch elasticity of labor supply ($1/\varphi$) is high, if the productivity of public investment (z_1) or consumption (z_2) expenditure is high, and if the labor share in the production function ($1-\nu$) is high. It is also accentuated if the share of public investment (γ_1) or consumption (γ_2) expenditure in GDP is small.

Besides, when monetary policy is active, the nominal interest rate then decreases to sustain economic activity. When monetary policy is hardly constrained by the ZLB, expectations of future inflationary tensions also decrease the real interest rate. In both cases, anticipations of a decrease of public investment expenditure decrease the current real interest rate, and they also decrease the current public debt level $\left(\frac{\partial \widehat{b}_t}{\partial E_t(G_{inv,t+1})} = 0.54 \right)$. Therefore, the recession implied by a decrease in public investment expenditure is more limited in the long run $\left[\left(\frac{\partial \widehat{Y}}{\partial G_{inv}} \right)^{LT} = 0.21 \right]$ than its short term consequences in equation (24). However, in the long run, the recession is accentuated if the labor and consumption taxation rates (τ^l and τ^c) and if the elasticity of intertemporal substitution (θ) are high.

4.2. Effects of fiscal shocks

Regarding fiscal policies, variations of taxation rates have more negligible consequences on global economic variables. Indeed, by combining equations (22) and (23), in the short run and in the long run, we obtain the following sensitivities of economic activity to a variation of the consumption or of the labor taxation rate:

$$\left(\frac{\partial \widehat{Y}_t}{\partial \tau_t^c} \right)^{ST} = \frac{\tau^c(1-\gamma)z_2(1+\varphi)\theta}{(1+\tau^c)[\gamma_2(\nu+\varphi)-z_2(1+\varphi)]} \tag{26}$$

$$\left(\frac{\partial \widehat{Y}}{\partial \tau^c} \right)^{LT} = \frac{\tau^c[z_2(1-\gamma)(1+\varphi)\theta + (1-\nu)\gamma_2(1-\theta)]}{\theta(1+\tau^c)\Delta} \tag{27}$$

$$\left(\frac{\partial \widehat{Y}_t}{\partial \tau_t^l} \right)^{ST} = -\frac{\gamma_2(1-\nu)\tau^l}{(1-\tau^l)[\gamma_2(\nu+\varphi)-z_2(1+\varphi)]} \tag{28}$$

$$\left(\frac{\partial \widehat{Y}}{\partial \tau^l} \right)^{LT} = \frac{(1-\nu)\tau^l}{(1+\tau^c)\Delta} \left[z_2(1+\varphi) + \frac{\gamma_2(1-\nu)}{(1-\gamma)\theta} - \frac{\gamma_2(1+\tau^c)}{(1-\tau^l)} \right] \tag{29}$$

According to equation (26), a temporary $\left[\left(\frac{\partial \widehat{Y}_t}{\partial \tau_t^c} \right)^{ST} = 0.03 \right]$ decrease of the consumption taxation rate implies a slight recession. Indeed, private consumption then obviously increases, but public consumption expenditure decreases in order to compensate for the slightly higher private demand. The real wage also decreases in order to compensate for the higher purchasing power of households. The recession is then accentuated, in the short run in equation (26) as well as in the long run in equation (27), if the Frisch elasticity of labor supply ($1/\varphi$) is high, if the productivity of public consumption expenditure (z_2) or if the labor share in the production function ($1-\nu$) is high, and if the consumption taxation rate (τ^c) is high. It is also accentuated if the share of public investment (γ_1) or consumption (γ_2) expenditure in GDP is small.

Besides, if the consumption taxation rate decreases, when monetary policy is active, the nominal interest rate decreases to sustain economic activity. When monetary policy is hardly constrained by the ZLB, expectations of future inflationary tensions also decrease the real interest rate. In both cases, anticipations of a smaller consumption taxation rate decrease the current real interest rate, and they also decrease the current public debt level $\left(\frac{\partial \widehat{b}_t}{\partial E_t(\tau_{t+1}^c)} = 0.05 \right)$. Therefore, according to equation (27), with plausible values of our parameters, the limited recession implied by a decrease of the consumption taxation rate are still smaller in the long run $\left[\left(\frac{\partial \widehat{Y}}{\partial \tau^c} \right)^{LT} = 0.02 \right]$ than their short term consequences in equation (26). However, in the long run, the recession is accentuated if the labor taxation rate (τ^l) is high. We can also mention that a higher elasticity of intertemporal substitution (θ) has ambiguous consequences: accentuating (limiting) the recession in the short (long) run.

On the contrary, according to equation (28), a temporary $\left[\left(\frac{\partial \hat{Y}_t}{\partial \tau^l} \right)^{ST} = -0.23 \right]$ increase of the labor taxation rate implies a slight recession. Indeed, private consumption then obviously decreases, with the weaker purchasing power of households, even if public consumption expenditure increases because of higher government revenue. The real wage also increases in order to compensate for the weaker purchasing power of households, whereas labor demand decreases. The recession is then accentuated if the Frisch elasticity of labor supply ($1/\varphi$) is high, if the productivity of public consumption expenditure (z_2) or if the labor share in the production function ($1-\nu$) is high, and if the labor taxation rate (τ^l) is high. It is also accentuated if the share of public consumption expenditure (γ_2) in GDP is small.

Besides, when monetary policy is active, the nominal interest rate then decreases in order to compensate for the slight recession. When monetary policy is hardly constrained by the ZLB, expectations of future inflationary tensions also decrease the real interest rate. In both cases, anticipations of a higher labor taxation rate decrease the current real interest rate, and they also very slightly decrease the current public debt level $\left(\frac{\partial \hat{b}_t}{\partial E_t(\tau_{t+1}^l)} = -0.07 \right)$. However, according to equation (29), the consequences of a decrease of the labor taxation rate are still smaller in the long run $\left[\left(\frac{\partial \hat{Y}}{\partial \tau^l} \right)^{LT} = -0.03 \right]$ than their short term consequences in equation (28)⁷.

So, the conflict of goals between stabilizing economic activity and public debt sustainability is obvious with the difference between short term and long term budget multipliers. In the short run, an active fiscal policy, increasing public investment or reducing the labor taxation rate, are growth enhancing. However, as these short term fiscal policies also decrease government revenue, increase the budget deficit and the public debt, they are harmful to the long term sustainability of the public debt. Therefore, budget and fiscal multipliers are much smaller in the long run.

4.3. Effect of a variation of the public debt

According to equation (30), reducing the public debt unambiguously increases economic activity in the short run $\left[\left(\frac{\partial \hat{Y}_t}{\partial \hat{b}_t} \right)^{ST} = -0.61 \right]$ with our basic calibration]. Besides, reducing the public debt is more growth enhancing if the productivity of public consumption expenditure (z_2) is high (see Figure 1). Indeed, reducing the weight of interest rates on the public debt is all the more beneficial as devoting more government revenue to public expenditure improves the productivity of the labor and capital production factors in the production function. It is also more growth enhancing if the shares of public investment (γ_1) and mainly of public consumption expenditure (γ_2) in global GDP are small (see Figure 1). Indeed, it is then easier to improve the global productivity by a small increase of public expenditure, because of its small initial level and of the smaller cost of interest rates on the public debt. Reducing the public debt is also more growth enhancing if the Frisch elasticity of labor supply ($1/\varphi$) is high, if the labor share in the production function ($1-\nu$) is high, or if the intertemporal elasticity of substitution (θ) is high. Regarding variations of these parameters, consequences are much more limited and minimal in the long run.

Indeed, by combining equations (18), (22) and (23), we obtain the following equations:

$$\left(\frac{\partial \hat{Y}_t}{\partial \hat{b}_t} \right)^{ST} = - \frac{[z_2(1 - \gamma_1 - \gamma_2)(1 + \varphi)\theta + (1 - \nu)\gamma_2]}{[\gamma_2(\nu + \varphi) - z_2(1 + \varphi)]} \tag{30}$$

$$\left(\frac{\partial \hat{Y}}{\partial \hat{b}} \right)^{LT} = - \frac{\beta[i - \pi + 2(\lambda_1 + \lambda_2)(1 + \pi)]}{(1 + \pi)[1 - \beta(1 - 2\lambda_1 - 2\lambda_2)]} \frac{[(1 - \nu)\tau^l + \tau^c - (1 + \tau^c)(\gamma_1 + \gamma_2)]}{\left\{ (1 - \tau^l + \nu\tau^l) + \frac{\theta(1 + \tau^c)(1 - \gamma_1 - \gamma_2)[\gamma_2(\nu + \varphi) - z_2(1 + \varphi)]}{[z_2(1 - \gamma_1 - \gamma_2)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \right\}} \tag{31}$$

⁷ According to our basic calibration, in the long run, the decrease of the labor taxation rate implies a recession if the equilibrium labor taxation rate is small ($\tau^l < \tau^{l*}$) but an expansion if this rate is high ($\tau^l > \tau^{l*}$). $\tau^{l*} = \frac{[(z_2 + \varphi z_2 - \gamma_2 - \gamma_2 \tau^c)(1 - \gamma_1 - \gamma_2)\theta + \gamma_2(1 - \nu)]}{[z_2(1 + \varphi)(1 - \gamma_1 - \gamma_2)\theta + \gamma_2(1 - \nu)]}$, ($\tau^{l*} = 0.24$) with our basic calibration.

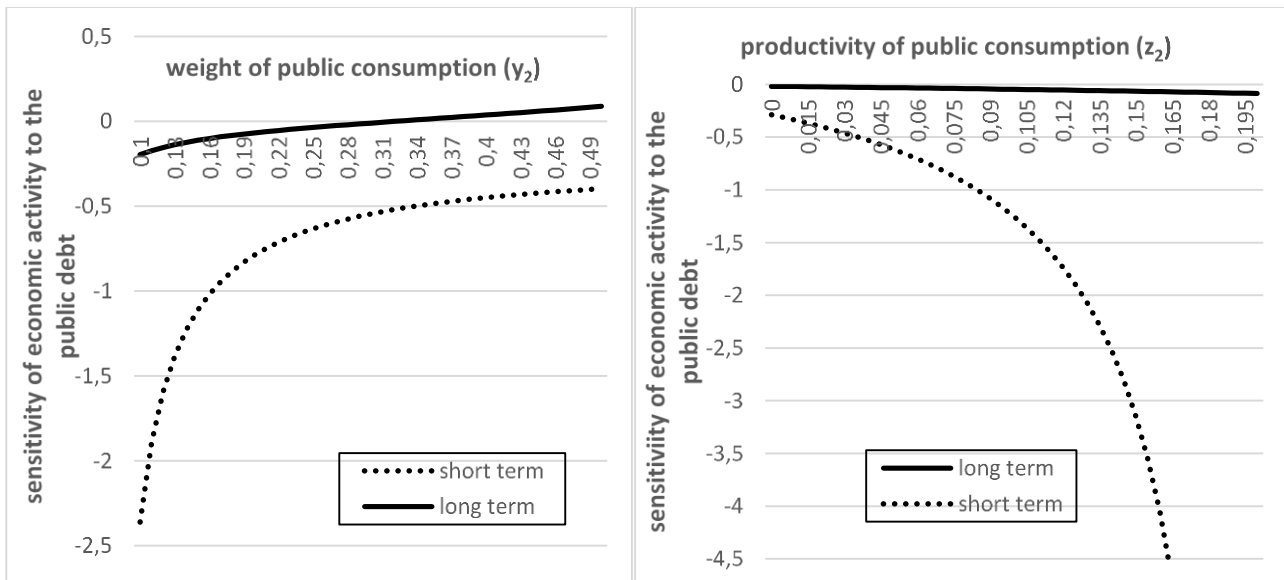


Figure 1. Sensitivity of economic activity to the public debt $(\partial \hat{Y}_t / \partial \hat{b}_t)$.

However, according to equation (31), a variation of the public debt is quite neutral for economic activity in the long run $[(\frac{\partial \hat{Y}_t}{\partial \hat{b}_t})^{LT} = -0.03]$. Indeed, a decrease of the cost of the reimbursement of the public debt is beneficial as it allows to dedicate more government revenue to higher public expenditure. It allows higher public expenditure because the interest rates on the public debt and the cost of reimbursement of the stock of long term public debt decreases. Therefore, in the long run, reducing the public debt is all the more beneficial to economic growth as the time discount factor (β) is high. It is also slightly more beneficial if the long term inflation rate (π) is small, but if the long term nominal interest rate (i) is high, as the cost of the reimbursement of the public debt is then higher.

Regarding fiscal policy, in the long run only, the decrease of the public debt is also very slightly more beneficial to economic activity as the sensitivity of government expenditure to the public debt (λ_1 and λ_2) is high. Indeed, according to equation (14), a sane fiscal situation and a decrease of the public debt can allow a higher level of public expenditure and to sustain economic activity (see Figure 2). Reducing the public debt is also very slightly growth enhancing if the consumption taxation rate (τ^c) and if the labor taxation rate (τ^l) are high, whereas it implies a slight recession in the long run if these taxation rates are small (see Figure 2). However, as mentioned in Section 4.3. below, the situation is then quite complex as more precisely, it depends on the calibration of our parameters.

4.4. Determination of the appropriate fiscal activism

Our modelling provides interesting results regarding the appropriate fiscal activism, and the dilemma between public debt sustainability and economic stabilization. In the long run, the solution of this dilemma depends on the policy-mix, on the coordination between the monetary and budgetary policies. Indeed, it depends on the respective levels of the real interest rate ($i - \pi$) and of the values of the long term labor (τ^l) and consumption (τ^c) taxation rates. More precisely, for plausible values of our parameters⁸, according to equation (31), we obtain:

$$\left(\frac{\partial \hat{Y}}{\partial \hat{b}}\right)^{LT} > 0 \text{ iff: } (i - i^*)[(1 - \nu)(\tau^l - \tau^{l*}) + (1 - \gamma_1 - \gamma_2)(\tau^c - \tau^{c*})] < 0$$

With: $[i^* = \pi - 2(\lambda_1 + \lambda_2)(1 + \pi)]$ and $[(1 - \nu)\tau^{l*} + (1 - \gamma_1 - \gamma_2)\tau^{c*} = (\gamma_1 + \gamma_2)]$ (32)

So, fiscal policy has an interest in increasing short term economic activity by higher public investment or by reducing the labor taxation rate, even if it increases the long term public debt, if:

- Monetary policy is contractionary ($i > i^*$), but long term labor and consumption taxation rates are small ($\tau^l < \tau^{l*}$, $\tau^c < \tau^{c*}$). Indeed, the contractionary monetary policy (high nominal interest rate) must then be compensated by an expansionary fiscal policy. Besides, temporary increasing fiscal levies is all the more feasible that long term taxation rates are small.

⁸ With plausible parameters, we obtain: $[\gamma_2(\nu + \varphi) - z_2(1 + \varphi)] > 0$ and: $[1 - \beta(1 - 2\lambda_1 - 2\lambda_2)] > 0$.

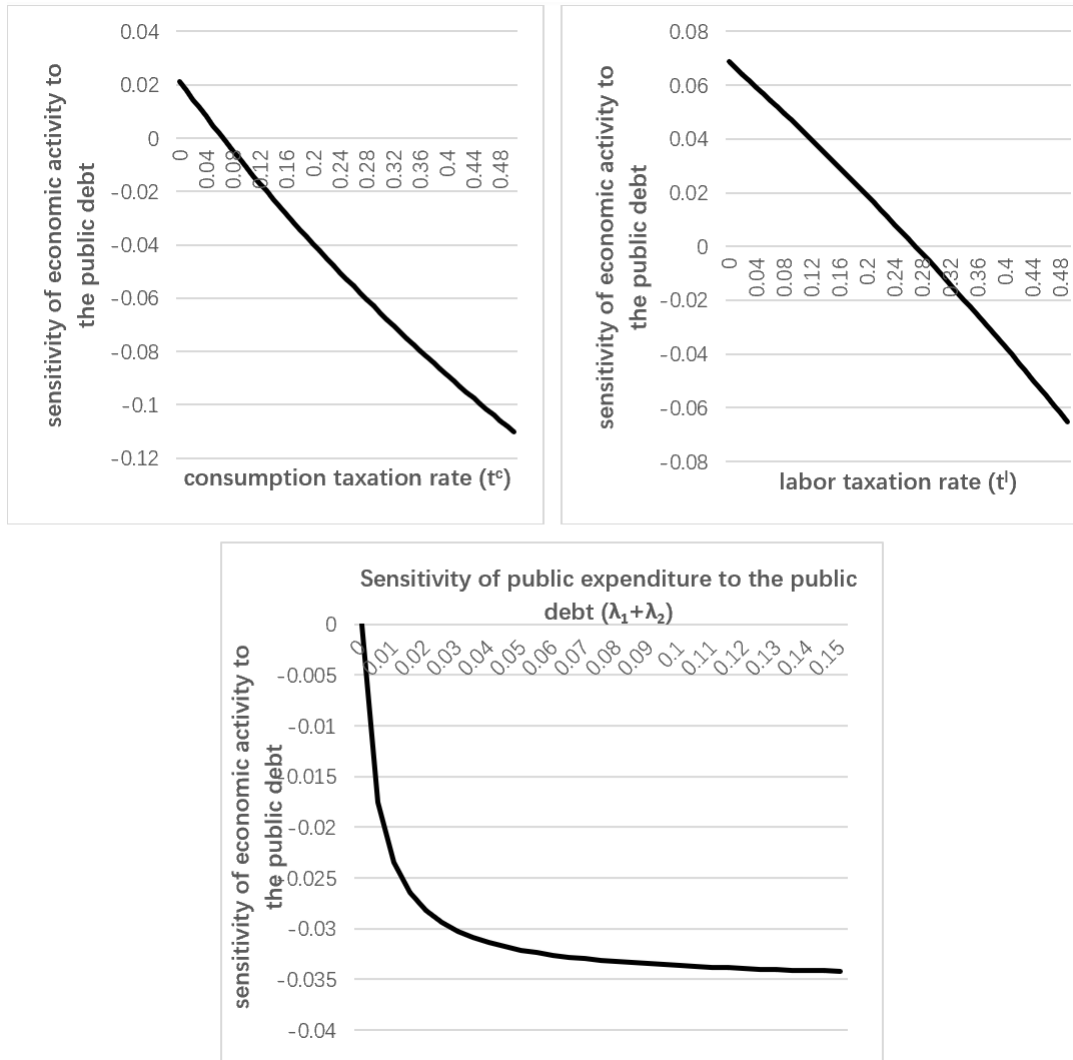


Figure 2. Long term sensitivity of economic activity to the public debt ($\partial \hat{Y} / \partial \hat{b}$).

- Monetary policy is expansionary ($i < i^*$), but long term labor and consumption taxation rates are high ($\tau^l > \tau^{l*}$, $\tau^c > \tau^{c*}$). Indeed, the expansionary monetary policy creates inflationary tensions automatically reducing the weight of the public indebtedness level, and an active fiscal policy is then feasible without putting in danger public debt sustainability. Even if long term taxation rates are high, temporary increasing fiscal levies is then feasible. However, the decrease of the nominal interest rate below the level ($i^* = -6.16\%$ with our basic calibration) risks to face empirically the ZLB constraint.

On the contrary, fiscal policy has an interest in reducing short term economic activity, by reducing public investment or by increasing labor taxation rates, in order to insure the sustainability of the long term public debt, and to be beneficial to long term economic growth, if:

- Monetary policy is contractionary ($i > i^*$), but long term labor and consumption taxation rates are high ($\tau^l > \tau^{l*}$, $\tau^c > \tau^{c*}$). Indeed, high real interest rates could dangerously increase the weight of the public indebtedness level, and fiscal policy should compensate and be contractionary. Taxation rates should then temporary increase to provide enough fiscal resources, or public investment should decrease.
- Monetary policy is expansionary ($i < i^*$) but long term labor and consumption taxation rates are small ($\tau^l < \tau^{l*}$, $\tau^c < \tau^{c*}$). Indeed, as taxation rates are small, government revenue is limited, and could be insufficient to reimburse the public debt in the long run. So, taxation rates should temporary increase, or public investment should decrease. However, the decrease of the nominal interest rate below the level (i^*) risks to face empirically the ZLB constraint.

Therefore, Figure 3 summarizes the various policy-mix situations and appropriate fiscal policies, according to the monetary policy (nominal interest rate) and to the value of the long term labor taxation rate.

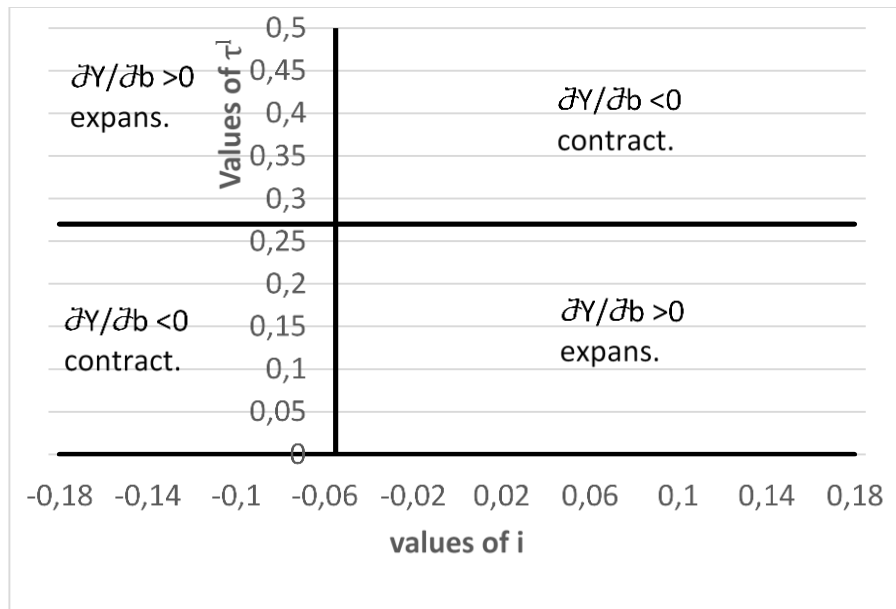


Figure 3. Appropriate fiscal policy according to the monetary policy and to the long term labor taxation rate.

Calibration: $(\pi=0.02)$, $(\lambda_1 + \lambda_2 = 0.04)$, $(v=0.33)$, $(\tau^c = 0.17)$, $(\gamma_1 + \gamma_2=0.3)$.

According to equation (32), the Zero Lower Bound constraint implies that an expansionary monetary policy $(0 < i < i^*)$ necessitates a very high inflation rate: $\left[\pi > \frac{2(\lambda_1 + \lambda_2)}{(1 - 2\lambda_1 - 2\lambda_2)} \right]$, i.e. $(\pi > 8.7\%)$ with $(\lambda_1 + \lambda_2 = 0.04)$. The ZLB constraint necessitates a very high inflation rate to have a sufficiently expansionary monetary policy to be in the left side of the space distribution of Figure 3. Nevertheless, in the framework of the very high inflation rates reached in 2022, unknown since a very long time, with the war in Ukraine and the exponential increase of energy prices, this possibility of very high inflation rates cannot fully be eliminated.

Furthermore, according to equation (32), the equilibrium labor taxation rate, for which fiscal policy should be neutral is: $\left[\tau^{l*} = \frac{(1 + \tau^c)(\gamma_1 + \gamma_2) - \tau^c}{(1 - v)} \right]$, $(\tau^{l*} = 27.01\%)$ with our basic calibration. So, in the right side of the space distribution of Figure 3, fiscal policy should be more expansionary in a country where the share of public expenditure in GDP $(\gamma_1 + \gamma_2)$ is high [the limit (τ^{l*}) is then higher]. On the contrary, fiscal policy should be more contractionary in a country where the labor share in the production function $(1 - v)$ is high, or where the consumption taxation rate (τ^c) is high [the limit (τ^{l*}) is then weaker]. These results are in conformity with those obtained in the previous Section 4.3.

5. Conclusion

Our paper studies analytically the conflict of goals between stabilizing economic activity and public debt sustainability, for the fiscal authorities. In the short run, an active and expansionary fiscal policy, increasing public investment or reducing the labor taxation rate, is growth enhancing (high budgetary multiplier). However, as these short term fiscal policies also decrease government revenue, increase the budget deficit and the public debt, they are harmful to the long term sustainability of the public debt. Therefore, budgetary and fiscal multipliers are much smaller in the long run. Indeed, a weaker public debt level unambiguously increases economic activity in the short run. Finally, in the framework of a potential ZLB constraint and of a relatively contractionary monetary policy, fiscal policy has an interest in increasing short term economic activity by higher public investment or by reducing the labor taxation rate only if long term labor and consumption taxation rates are small. Besides, fiscal policy should then be more expansionary in a country where the share of public expenditure in GDP is high.

On the contrary, in the framework of a potential ZLB constraint, fiscal policy has an interest in reducing short term economic activity, by reducing public investment or by increasing labor taxation rates, in order to insure the sustainability of the long term public debt, and to be beneficial to long term economic growth, if long term labor and consumption taxation rates are high. Indeed, the incapacity to decrease further nominal and real interest rates could dangerously increase the weight of the public indebtedness level, and fiscal policy should compensate and be contractionary. A contractionary fiscal policy is then also very slightly more appropriate if the sensitivity of government expenditure to the public debt is high. Indeed, a sane fiscal situation and a decrease of the public debt can allow a higher level of public expenditure and to sustain long term economic activity. Fiscal policy should also

be more contractionary in a country where the labor share in the production function is high.

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Conflict of interest

All the authors claim that the manuscript is completely original. The authors also declare no conflict of interest.

Auto contributions

Conceptualization, Methodology, Formal Analysis: Séverine Menguy.

Appendix

A1. Main Economic Variables.

By combining equations (6), (8), (10) and (21), we obtain:

$$\begin{aligned} \widehat{G}_{c,t} = & \frac{[(1 - \nu) + (1 - \gamma)(\nu + \varphi)\theta]}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \widehat{Y}_t + \frac{(1 - \gamma)\theta(1 - \nu)\tau^c}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2](1 + \tau^c)} \widehat{\tau}_t^c \\ & + \frac{(1 - \gamma)\theta(1 - \nu)\tau^l}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2](1 - \tau^l)} \widehat{\tau}_t^l - \frac{(1 - \gamma)(1 + \varphi)\theta}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \widehat{A}_t \\ & - \frac{[z_1(1 - \gamma)(1 + \varphi)\theta + \gamma_1(1 - \nu)]}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \widehat{G}_{inv,t} \end{aligned} \tag{A1}$$

$$\begin{aligned} \widehat{L}_t = & \frac{[\gamma_2 - z_2(1 - \theta + \gamma\theta)]}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \widehat{Y}_t - \frac{\gamma_2}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \widehat{A}_t \\ & - \frac{(z_1\gamma_2 - z_2\gamma_1)}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \widehat{G}_{inv,t} - \frac{z_2(1 - \gamma)\theta\tau^c}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2](1 + \tau^c)} \widehat{\tau}_t^c \\ & - \frac{z_2(1 - \gamma)\theta\tau^l}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2](1 - \tau^l)} \widehat{\tau}_t^l \end{aligned} \tag{A2}$$

$$\begin{aligned} (\widehat{W}_t - \widehat{P}_t) = & \frac{\gamma_2}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \widehat{A}_t + \frac{[z_2 + z_2(1 - \gamma)\varphi\theta - \nu\gamma_2]}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \widehat{Y}_t \\ & + \frac{(z_1\gamma_2 - z_2\gamma_1)}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \widehat{G}_{inv,t} + \frac{z_2(1 - \gamma)\theta\tau^c}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2](1 + \tau^c)} \widehat{\tau}_t^c \\ & + \frac{z_2(1 - \gamma)\theta\tau^l}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2](1 - \tau^l)} \widehat{\tau}_t^l \end{aligned} \tag{A3}$$

$$\begin{aligned} \widehat{C}_t = & \frac{\theta[z_2(1 + \varphi) - \gamma_2(\nu + \varphi)]}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \widehat{Y}_t + \frac{(z_1\gamma_2 - z_2\gamma_1)(1 + \varphi)\theta}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \widehat{G}_{inv,t} \\ & + \frac{\gamma_2(1 + \varphi)\theta}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2]} \widehat{A}_t - \frac{\gamma_2\theta(1 - \nu)\tau^c}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2](1 + \tau^c)} \widehat{\tau}_t^c \\ & - \frac{\gamma_2\theta(1 - \nu)\tau^l}{[z_2(1 - \gamma)(1 + \varphi)\theta + (1 - \nu)\gamma_2](1 - \tau^l)} \widehat{\tau}_t^l \end{aligned} \tag{A4}$$

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