Fiscal Policy under Alternative Fiscal Discipline Regimes in a Currency Union

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Abstract

The present paper uses a two-country overlapping generations framework in order to assess the implications of the degree of fiscal discipline on the fiscal policy effectiveness in a currency union. The results show that, initially, a fiscal stimulus implemented under the condition of returning to a balanced budget leads to a higher increase in per capita output and consumption compared to a fiscal expansion with permanently higher public debt. However, in the medium run, the strict fiscal discipline case leads to an output recession despite the increase in private per capita consumption whereas a loosening of the fiscal discipline helps avoid the recession at the cost of higher public debt. The overlapping-generations framework shows also the demographic impact on the fiscal policy effectiveness under different degrees of fiscal discipline.

Keywords: *fiscal policy, fiscal discipline, currency union*

JEL Classification: E62, F41, H62

Introduction

Following the economic stagnation in Europe due to the global financial crisis, the European Commission offered in November 2008 a fiscal stimulus strategy for the member countries. In order to facilitate the implementation of national measures, the Commission allowed countries to exceed temporarily the limits for the public debt (60% of GDP) indicated in the Stability and Growth Pact (SGP). Consequently, public debt increased rapidly during the two years of fiscal stimulus, which led the union members to carry out public spending cuts in order to reduce public debt to the level set by the SGP. This type of feedback from public debt to public spending is also observed for several countries in empirical studies

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such as Gali and Perotti (2003). However, the standard theoretical models that analyse the effect of a debt-financed public spending shock generally overlook the possibility of a procedure that allows to improve public finance following a deterioration due to the fiscal expansion. In many of the new open economy macroeconomics models inspired by Obstfeld and Rogoff (1995), the Ricardian equivalence assumption implies that the debt burden is met entirely by an increase in taxes. Similarly, dynamic stochastic general equilibrium models consider public spending path generally as an AR(1) process in which increases in public spending and taxes fade away gradually. However, as shown by Favero and Giavazzi (2007) using US data, a simple AR(1) process does not allow to estimate correctly the dynamic effects of a fiscal policy because it neglects the possible feedbacks from public debt towards public spending and taxes.

In order to reconcile theoretical analyses and the empirical observations, Corsetti, Meier and Müller (2010; 2012) introduce a fiscal rule with feedbacks from public debt to both public spending and taxes into a two-country general equilibrium model with flexible exchange rates. This leads to a two-phase transition dynamics for public spending. In the first phase public spending increases and is mostly debt-financed. In the second phase, public spending decreases in order to mitigate the negative impact on public debt observed in the first phase. Corsetti, Meier and Müller (2010) find evidence of spending reversals for fiscal transmission using US data in a VAR model.

The present setup is similar to Corsetti, Meier and Müller (2010; 2012) regarding the law of motion for public spending but differs from their analysis by the choice of its framework and aim. First, in contrast to Corsetti, Meier and Müller (2010; 2012), the present framework uses a two-country overlapping generations (OLG) framework inspired by Weil (1989). Second, in contrast to the flexible exchange rate assumption in Corsetti, Meier and Müller (2010; 2012), the present OLG setup is applied to a currency union. The OLG setup is particularly appropriate to analyse the relation between public debt and public spending since it allows to eliminate public debt neutrality. However, as indicated by Weil (1989; 2008), the finite lives assumption in two-period OLG models, such as Blanchard (1985), is not necessary to eliminate public debt neutrality. In contrast, the assumption of new generations arriving at each period is crucial. The present setup keeps the assumption of infinitely-lived households, which allows to analyse the impact of population growth on fiscal policy effectiveness. Moreover, infinite-life assumption enables to compare the results of the present setup to those of the dynamic stochastic general equilibrium (DSGE) framework which generally assumes infinitely-lived households. The discreet-time structure of the present setup also helps compare the implications of the present setup with the DSGE framework.

This setup is used to analyse the short and medium run effects of a home fiscal expansion incorporating a feedback mechanism that would mitigate the negative effects of fiscal expansion on public finance in the medium run. This can be interpreted as a fiscal expansion under strong budget discipline, as intended by the new SGP. The dynamic effects of this type of policy is compared to those of a fiscal expansion that is concerned only with the stabilization of public debt without being concerned about the level at which the public debt is stabilized. This second type of policy can be interpreted as a fiscal expansion with a weak fiscal discipline, similar to the one that is being implemented in the USA. Indeed, in contrast to Europe, the USA chose to maintain fiscal expansion in 2011 despite the worsening of public deficit, hoping that the output growth resulting from active fiscal policy will help stabilize public deficit and debt at some level in the medium run and reduce in the long-run.

The results show that a domestic fiscal expansion under strong discipline increases the short run output and consumption in both countries and allow to restore the budget balance in the medium run and then to achieve a budget surplus leading to a reduction in public debt. This improvement in public finance is accompanied by a reduction in foreign debt. However, this type of policy leads to an output recession and to deflation in the medium run. In contrast, a fiscal expansion under weak fiscal discipline avoids the recession and deflation but leads to a higher level of public and foreign debt. The results also show that increasing fiscal discipline leads to higher volatility in short run real interest rate, inflation and taxes. Finally, the OLG setup shows to what extent the impact of fiscal expansion on per capita variables under various degrees of fiscal discipline is influenced by the population growth rate which specifies the degree of deviation from the Ricardian equivalence.

The paper is organized as follows: section 1 describes the theoretical setup whereas section 2 calibrates the model and gives the dynamics of the fiscal policy impact on main variables under alternative fiscal discipline regimes. Section 3 considers alternative calibrations for various parameters. Last section concludes.

1. The Setup

There are two countries forming a currency union, called home and foreign. At any period t, population in each country consists of a combination of different generations of households: households born in previous periods and those who enter the economy in period t (new-borns). The rate of arrival of new generations is denoted by n which is also the population growth rate. Since all households within each generation live infinitely, the period t population of the home country

is defined as $N_t = N_0(1+n)^t$. Foreign country population N_t^* grows at the same constant rate. Initial union population is normalized to 1. Following Weil (1989), intergenerational bequests are excluded.

Initially *a* households reside in home country while the foreign population is equal to (1 – *a*). Home and foreign goods varieties are also indexed respectively on the arrays [0, *a*) and (*a*, 1]. Population increases in time while the number of goods varieties remains unchanged.

1.1. Households

There are two types of households in each country: the first type has access to financial markets and is called asset holders. The second type of households do not have access to financial markets, consume all their disposable income and therefore are called hand-to-mouth households. This type of consumer behaviour is empirically observed in various industrialized countries as pointed out by Campbell and Mankiw (1989). The share of the asset holders (non-asset holders) is equal to λ (1 – λ) in each country. Moreover, following Weil (1989), it is assumed that the newborns do not own financial assets. However, they own the present discounted value of their human wealth defined as the labour income and share of profits net of taxes.

Household Behaviour

In any period *t*, a representative home asset holder *j* from generation $\upsilon \in [0,\ t-1]$ maximizes the following utility function with respect to consumption C^{υ^j} and leisure $(1-L^{\upsilon^j})$ where L^{υ^j} is the labour supply. Time endowment is normalized to 1:

$$U_t^{\upsilon^j} = E_t \sum_{s=t}^{\infty} \beta^{s-t} \left[\frac{(C_s^{\upsilon^j})^{1-\rho}}{1-\rho} + \eta \log(1-L_s^{\upsilon^j}) \right] \qquad 0<\beta<1,\ \eta>0,\ \rho>1 \qquad (1)$$

where β and ρ are respectively the subjective discount factor and the coefficient of risk aversion.

The real consumption index $C_t^{\upsilon^j}$ is a CES type function defined as:

$$C^{\upsilon^j} = \left[a^{\frac{1}{\theta}} (C_H^{\upsilon^j})^{\frac{\theta-1}{\theta}} + (1-a)^{\frac{1}{\theta}} (C_F^{\upsilon^j})^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}} \qquad (2)$$

where $\theta > 1$ gives the elasticity of substitution between home (*H*) and foreign (*F*) goods.

In (2), the consumption sub-indexes over the goods produced at home (*h*) and abroad (*f*) and consumed by home household *j* from generation υ are defined as:

$$C_H^{\upsilon^j} = \left[(\tfrac{1}{a})^{\frac{1}{\sigma}} \int_0^a c^{\upsilon^j}(h)^{\frac{\sigma-1}{\sigma}} dh \right]^{\frac{\sigma}{\sigma-1}} \text{ and } C_F^{\upsilon^j} = \left[(\tfrac{1}{1-a})^{\frac{1}{\sigma}} \int_a^1 c^{\upsilon^j}(f)^{\frac{\sigma-1}{\sigma}} df \right]^{\frac{\sigma}{\sigma-1}} \quad (3)$$

where $\sigma > 1$ is the elasticity of substitution between goods produced within a country.

The home consumption price indexes corresponding to $C_H^{\upsilon^j}$ and $C_F^{\upsilon^j}$ are defined as:

$$P_{H,t} = \left[\tfrac{1}{a} \int_0^a p_t(h)^{1-\sigma} dh \right]^{\frac{1}{1-\sigma}} \text{ and } P_{F,t}^* = \left[\tfrac{1}{1-a} \int_a^1 p_t^*(f)^{1-\sigma} df \right]^{\frac{1}{1-\sigma}} \quad (4)$$

The overall price index is given as $P_t = \left[aP_{H,t}^{1-\theta} + (1-a)P_{F,t}^{1-\theta} \right]^{\frac{1}{1-\theta}}$.

The preferences of foreign households are similar with asterisks denoting foreign variables. Identical preferences and the law of one price imply that overall prices expressed in the common currency are equal across countries. In addition, the terms of trade is defined as $S_t = P_{F,t}^* / P_{H,t}$.

It is assumed that home and foreign households do not have biased preferences toward the goods produced in their country.

In period *t*, home asset-holder *j* from generation $\upsilon \in [0,\ t-1]$ holds private bonds which are traded internationally along with public bonds which are traded at the national level. These bonds are denoted by $B_{t+1}^{\upsilon^j}$ and correspond to assets purchased at the beginning of period *t*, arriving at maturity at the beginning of $t + 1$. The asset holder receives profits $\int_0^a \Pi_t^i di$ from home firms, earns wage income by supplying labour at wage rate W_t^j in the perfectly competitive labour market and pays lump sum taxes $P_t T_t^j$. Hence, the budget constraint is given as follows:

$$P_t B_{t+1}^{\upsilon^j} = P_t(1+r_t)B_t^{\upsilon^j} + W_t^j L_t^{\upsilon^j} + \int_0^a \Pi_t^i di - P_t C_t^{\upsilon^j} - P_t T_t^j \quad (5)$$

where r_t denotes the real rate of return on both bonds between periods *t* and $t - 1$. The budget constraint of a foreign asset holder is similar to (5).

The individual demand of the representative home asset holder from generation υ for a typical home and foreign good is given as follows:

$$c_t^{v^j}(h) = \left[\frac{p_t(h)}{P_{H,t}}\right]^{-\sigma}\left[\frac{P_{H,t}}{P_t}\right]^{-\theta} C_t^{v^j} \text{ and } c_t^{v^j}(f) = \left[\frac{p_t^*(f)}{P_{F,t}^*}\right]^{-\sigma}\left[\frac{P_{F,t}^*}{P_t^*}\right]^{-\theta} C_t^{v^j} \quad (6)$$

Similar equations can be defined abroad.

Maximizing utility (1) under the budget constraint (5) with respect to $C_t^{v^j}$, $B_{t+1}^{v^j}$, $L_t^{v^j}$ leads to the following first order conditions which give respectively the intertemporal consumption path, and the optimal labour supply of the asset holders:

$$(C_t^{v^j})^{-\rho} = \beta E_t\left[(1+r_{t+1})(C_{t+1}^{v^j})^{-\rho}\right] \quad (7)$$

$$L_t^{v^j} = 1 - \frac{\eta P_t (C_t^{v^j})^{\rho}}{W_t} \quad (8)$$

The utility maximization of a foreign asset holder leads to similar equations. In contrast to an asset holder, a home hand-to-mouth household born in period v consumes his/her entire disposable income at each period. Thus, the consumption of a non-asset holder is given as follows:

$$C_t^{v^j} = \frac{W_t}{P_t} L_t^{v^j} - T_t^{v^j} \quad (9)$$

Equations (2) – (4), (6), (8), (9) and their foreign analogues hold also for hand-to-mouth households.

Aggregate per capita Values

As it is traditional in OLG models, one needs to express all variables in per capita terms (indicated by the subscript *PC*). This consists in aggregating the relevant variables across all generations and then dividing by the number of households. In what follows, a variable without any reference to a specific generation will denote the aggregate level, while the subscripts *A* and *HM* refer respectively to asset holders and hand-to-mouth households.

Given that there are $a(1+n)^t$ asset holders in the home country in period *t*, the optimal per capita labour supply derived from (8) and its counterpart for non-asset holders are given as follows:

$$L_t^{A,PC} = 1 - \frac{\eta P_t (C_t^{A,PC})^{\rho}}{W_t} \text{ and } L_t^{HM,PC} = 1 - \frac{\eta P_t (C_t^{HM,PC})^{\rho}}{W_t} \quad (10)$$

The per capita consumptions are different for the two types of households. The following per capita consumption of a home hand-to-mouth household is derived from (9):

$$C_t^{HM,PC} = \frac{W_t}{P_t} L_t^{HM,PC} - T_t^{HM,PC} \tag{11}$$

For the asset holders, the per capita consumption is derived from (7). Aggregating equation (7) across all generations of asset holders alive at period t gives.[1]

$$a\left[(C_t^{A,\upsilon=0})^\rho + n(C_t^{A,\upsilon=1})^\rho + ... + n(1+n)^{t-1}(C_t^{A,\upsilon=t})^\rho \right]$$
$$= \frac{1}{\beta E_t(1+r_{t+1})} a E_t\left[(C_{t+1}^{A,\upsilon=0})^\rho + n(C_{t+1}^{A,\upsilon=1})^\rho + ... + n(1+n)^{t-1}(C_{t+1}^{A,\upsilon=t})^\rho \right]$$

The left-hand side of the expression above gives the total consumption of all asset holders alive at date t ($(C_t^A)^\rho$) while the right-hand side is different from the consumption of all households alive at $t + 1$ ($(C_{t+1}^A)^\rho$) since it does not include the period $t + 1$ consumption of individuals born in $t + 1$ ($an(1+n)^t(C_{t+1}^{A,\upsilon=t+1})^\rho$). However, this equation can be rewritten as follows so as to include this consumption:

$$(C_t^A)^\rho = \frac{1}{\beta E_t(1+r_{t+1})} E_t\left[(C_{t+1}^A)^\rho - an(1+n)^t(C_{t+1}^{A,\upsilon=t+1})^\rho \right] \tag{12}$$

Dividing both sides by the number of households alive at period t yields the per capita consumption Euler equation as follows:

$$(C_t^{A,PC})^\rho = \frac{1}{\beta E_t(1+r_{t+1})} E_t\left[(C_{t+1}^{A,PC})^\rho - an(1+n)^t(C_{t+1}^{A,PC,\upsilon=t+1})^\rho \right] \tag{13}$$

This intertemporal consumption equation includes the period $t + 1$ consumption of the new-borns $(C_{t+1}^{A,PC,\upsilon=t+1})^\rho$ which is one of the fundamental differences with the representative household models. The arrival of new generations tilts the intertemporal consumption path by increasing current consumption. Indeed, with positive population growth ($n > 0$), households anticipate that the future tax burden due to a debt-financed increase in current public spending will be shared among a greater number of households. This implies that the discounted per capita value of future taxes is lower than the current per capita public spending.

[1] If the population grows at rate n and initial population is equal to a, the generation $\upsilon = 1$ has an members, generation $\upsilon = 2$ has $a(1 + n)^2 - a(1 + n) = an(1 + n)$ members, generation 3 has $a(1 + n)^3 - a(1 + n)^2 = an(1 + n)^2$ members and so on.

The difference is perceived as a net increase in wealth. Thus, asset holders respond by increasing their current consumption.

1.2. Firms

Each monopolistically competitive home firm *i* (owned entirely by home households) produces a quantity Y_t^i of a single good according to the following production function: $Y_t^i = L_t^i$. The same is true for the foreign country.

Firms set their prices according to the price adjustment mechanism defined by Calvo (1983) who assumes that, in each period, only a randomly selected fraction 1 – α of firms gets the chance to reset their prices by maximizing their market value. The new optimal price chosen by a home firm *i* in period *t* is the same for all adjusting firms. The price index for home goods is then an average of the optimal price p_t^o charged by the adjusting firms and the average of the price charged by the remaining firms:

$$P_{H,t}^{1-\sigma} = (1-\alpha)(p_t^o)^{1-\sigma} + \alpha P_{H,t-1}^{1-\sigma} \tag{14}$$

A similar expression can be derived for the aggregate price index for foreign goods.

1.3. Fiscal Authority

In the present setup public spending is restricted to government consumption expenditures. Other types of public spending, such as spending on infrastructure or the government wage bill, are excluded for simplification purposes. It is assumed that government consumes from each available good in the same way as households so that there is no home bias for domestically produced goods. This implies that public consumption indexes are similar to equations (2).

Government expenditures *G* are financed by lump sum taxes *T* and by public debt *D*. This gives the following public budget constraint for period *t*:

$$G_t + (1+r_t)D_t = T_t + D_{t+1} \tag{15}$$

In the above equation, D_{t+1} denotes public bonds issued in period *t* arriving at maturity in period *t* + 1.

The evolution of public spending and taxes are defined similarly to Corsetti, Meier and Müller (2010; 2012) in aggregate terms. It is possible to express public spending and taxes in per capita terms as follows where a bar over any variable denotes the steady-state level of that variable:

$$G_{t+1}^{PC} = (1-\phi_{gg})\bar{G}^{PC} + \phi_{gg} G_t^{PC} + \phi_{gd}(1+n) D_{t+1}^{PC} + \varepsilon_{t+1} \tag{16}$$

$$T_t^{PC} = \bar{G}^{PC}\left(\frac{G_t^{PC}}{\bar{G}^{PC}}\right)^{\phi_{tg}} + \phi_{td} D_t^{PC} \tag{17}$$

Equation (16) gives the law of motion for public spending, where ε is the one-time stochastic i.i.d. shock. In contrast to the typical AR(1) process, the evolution of government expenditure depends also on the level of public debt. Indeed, assuming that $\phi_{gd} < 0$, following an initial increase in public spending, fiscal authority will adjust government expenditure endogenously through future public spending cuts as the outstanding public debt increases. This implies that the fiscal authority has to reduce public spending and debt sometime after the fiscal expansion when faced to an upper limit for public debt and deficit. If such an upper limit is not required ($\phi_{gd} = 0$), public spending will follow an exogenous path towards its steady-state level following the shock. Similarly, equation (17) translates the efforts of reducing public deficit through higher taxes in response to an increase in public spending and debt assuming that $\phi_{td} > 0$. The parameter ϕ_{tg} is the feedback from public spending to taxes and defines the responsiveness of taxes to public spending.

1.4. Monetary Authority

The common central bank is assumed to pursue an interest rate policy that responds to the deviations of union-wide consumer price inflation π^{CPI} and output from their steady-state levels. Following Rottemberg and Woodford (1999), the interest rule is given as:[2]

$$i_{t+1} = (1-\phi_i)\bar{i} + \phi_i i_t + \phi_p \pi_{t+1}^{CPI} + \phi_y (Y_t^u - \bar{Y}^u) \tag{18}$$

where the superscript *u* indicates union-wide levels.

The assumption that period *t* + 1 nominal interest rate i_{t+1} depends on its lagged value allows for interest rate smoothing so that sustained changes in output and inflation lead only to gradual changes in the nominal interest rate.

1.5. General Equilibrium

General equilibrium is a sequence of prices, wages, consumption and production levels as well as policy instruments and financial assets which meet the following conditions:

[2] Steady-state inflation is zero by definition.

(i) Aggregate total per capita labour demand must be equal to the sum of labour supplied by asset holders and hand-to-mouth consumers in both countries, which implies the following expression at home and a similar equation for the foreign country:

$$\int_0^a L_t^{i,PC} di = L_t^{PC} = (1-\lambda) L_t^{A,PC} + \lambda L_t^{HM,PC} \tag{19}$$

(ii) Goods market must be in equilibrium in each country where goods supply is given by the home and foreign production functions. Total demand for a single home good is given as follows:

$$y_t^{d,PC}(h) = \left[\frac{p_t(h)}{P_{H,t}} \right]^{-\sigma} \left[\frac{P_{H,t}}{P_t} \right]^{-\theta} (C_t^{u,PC} + G_t^{u,PC}) \tag{20}$$

Equation (20) is obtained by combining the per capita versions of aggregate home and foreign private demand for good *h* (derived from equation (6)) along with home and foreign public demand which are expressed similarly.

(iii) International bond market must be in equilibrium which requires that global net private assets be zero:

$$aF_{t+1}^{PC} + (1-a) F_{t+1}^{*PC} = 0 \tag{21}$$

where *F* and *F** denote the private bonds which are internationally traded between home and foreign countries such that at home $F = B - D$ and abroad $F^* = B^* - D^*$

(iv) the following transversality condition has to be met both in aggregate and per capita terms:

$$\lim_{T \to \infty} q_{t,t+T} \left(B_{t+1+T} + \frac{M_{t+T}}{P_{t+T}} \right) = 0 \tag{22}$$

where $q_{t,t+T}$ is defined as the market discount factor for date $t + T$ on date t.

To solve the model one must log-linearize the relevant equations in per capita terms around the steady-state. The steady-state is defined as the special equilibrium with zero inflation and perfectly flexible prices where international trade is in balance so that private debt is nil. Moreover, public budget is also balanced in the steady-state so that taxes are equal to public spending. The log-linearization allows to express all per capita variables in terms of their percentage deviation from the steady-state level. The log-linear model is solved numerically under the assumption of rational expectations.

2. Calibration and Results

This section compares the impact of two types of fiscal policy. First, it considers an increase in home public spending assuming that fiscal authority is not concerned about the budget deficit as long as public debt is not explosive (weak fiscal discipline). Second, the same policy exercise is reconsidered assuming that fiscal policy is designed to ensure a balanced budget in the medium run (strong fiscal discipline). Foreign public spending is assumed to remain unchanged throughout the rest.

2.1. Parameterisation

Table 1 below summarizes the values and the descriptions of various parameters used for calibration on quarterly basis.

T a b l e 1

Calibrated Parameters

Parameters		**Value**	**Parameters**		**Value**
Subjective discount factor	β	0.99	Weight of leisure in utility	η	Calib.
Substitution elasticity between home domestic goods	σ	6	Monetary rule coefficient on output	ϕ_y	0.1
Substitution elasticity between home and foreign goods	θ	6	Monetary rule coefficient on inflation	ϕ_p	1.5
Measure of price rigidity	α	0.75	Interest rate smoothing	ϕ_i	0.9
Coefficient of risk aversion	ρ	1.35	Public spending persistence	ϕ_{gg}	0.8
Growth rate of country population	n	0.0025	Tax response to public debt	ϕ_{td}	0.04
Share of public spending financed by taxes	ϕ_{tg}	0.3	Public spending response to public debt	ϕ_{gd}	–0.04
Share of hand-to-mouth consumer	λ	0.3	Home country size	a	0.3

Source: See the text below.

The discount factor β and the risk aversion coefficient ρ in equation (1) are respectively set to 0.99 for each quarter and to 1.35 according to the estimations of Smets and Wooters (2003). The value of η in the same equation is calibrated to have a steady state labour supply equal to one third of the available time.

The size of the home country a and the rate of population growth n are respectively set to 0.3 which corresponds roughly to the share of Germany in the European GDP and to 0.25% which is equal to the average population growth rate in the Economic and Monetary Union (EMU) in 2014. The share of hand-to-mouth consumers λ is set to 0.30 which is the average range estimated in the literature (Campbell and Mankiw, 1989; Gali, Lopez-Salido and Valles, 2007). Intra-temporal substitution elasticity within a country σ is set to 6. Given the high integration of the goods markets across EMU members, the goods substitution

elasticity across countries θ is assumed to be equal to the substitution elasticity within the country. The measure of price rigidity α in equation (14) is equal to 0.75 which, on a quarterly basis, implies that prices remain fixed during one year on average.

The interest rate smoothing parameter ϕ_i in equation (18) is set to 0.9 which is in line with the estimations in the recent literature (e.g. Fendel and Frenkel, 2006). The responsiveness of the interest rate to the inflation deviation ϕ_p is traditionally set to 1.5 while the coefficient on output ϕ_y is assumed to be equal to 0.1.

Regarding the fiscal policy parameters, the present paper follows Gali and Perotti (2003) who estimate a fiscal policy rule for several members of the EU. Following these estimates, the present paper assumes $\phi_{gd} = -0.04$ and sets accordingly $\phi_{td} = 0.04$ to indicate the strong fiscal discipline case. For the weak fiscal discipline case, the last two parameters are calibrated to have debt stability at an endogenously determined point in time. Following Gali and Perotti (2003), the present paper sets the persistence coefficient of fiscal policy ϕ_{gg} to 0.8. The reaction of taxes to public spending ϕ_{tg} is arbitrarily set to 0.3. It is assumed that the share of public spending in GDP is equal to 20% in the steady-state.

2.2. Fiscal Policy Effectiveness under Weak and Strong Fiscal Discipline

Figure 1 below shows the impact of a public spending increase by one per cent of the steady state real GDP on the main variables under weak fiscal discipline (solid lines) and under strong fiscal discipline (dashed lines) where the *x*-axis measures time in quarters and *y*-axis gives the percentage deviation of the relevant variable from its steady state level.[3]

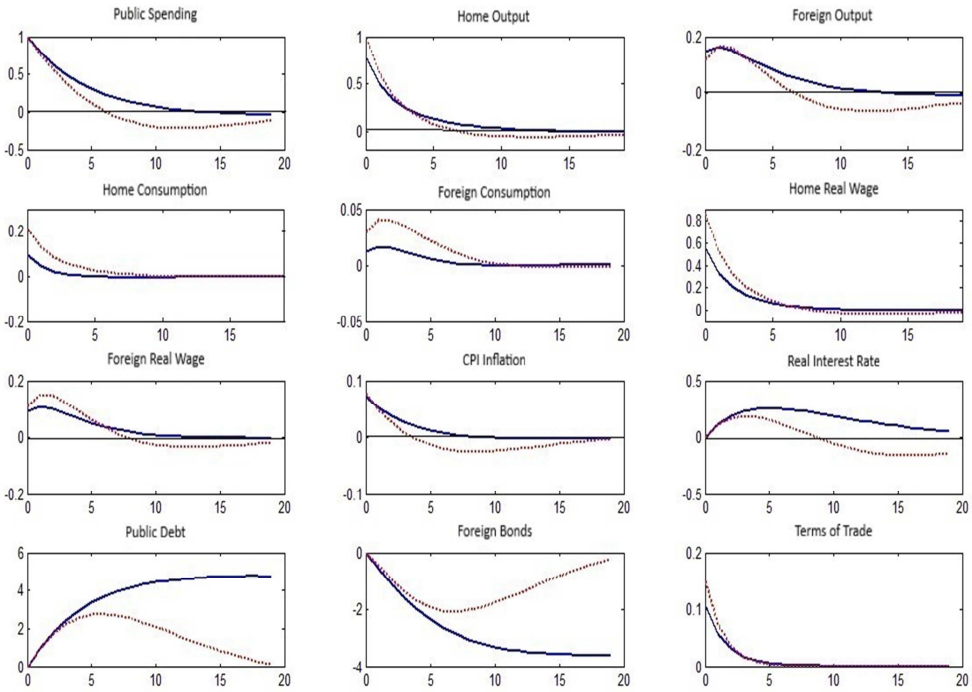
Effects on Public Finance

In the weak fiscal discipline case, home fiscal authority increases public spending without worrying about the public debt persistence as long as it is not explosive. According to (17) and (18), per capita public spending increases less at each period compared to the steady state level and returns gradually to the initial level (first panel of the first row), while per capita taxes increase less than the public spending (not shown in the figure). Government will issue new public bonds in order to finance the resulting budget deficit as well as the service of the previous debt. This will lead to an increase in per capita public debt which slows down progressively and leads to a medium run stabilization at a level higher than the steady-state (as shown in the first panel of the last row).

[3] Quantity variables are expressed in aggregate per capita terms.

F i g u r e 1

The Effect of Fiscal Policy on Main Variables



Note: Solid line corresponds to the weak discipline case while the dashed line corresponds to the strong discipline case. Horizontal axis measures time in quarters and *y*-axis measures the percentage deviation of the relevant variable from the steady-state.

Source: Author's own calculations.

In the strong fiscal discipline case, the fiscal authority seeks to restore the budget balance in the medium run and to reduce progressively the public debt. Therefore, public spending increases by a lower amount compared to the weak discipline case as a reaction to the higher public debt. It falls below the steady--state level in the medium run, before returning to its initial long-term level. As a result, after an initial increase, both aggregate and per capita public debt start a decreasing trend in the medium run and return to the steady-state level in the long-run.

Effects on Prices and Real Variables

The initial effects of a home fiscal expansion on prices and real variables are similar under both types of discipline, but the transition effects in the medium run depend on the degree of fiscal discipline.

Initially, the increase in public spending stimulates the aggregate public demand in the same way in both countries regardless of the degree of fiscal discipline since the absence of home bias implies equal expenditure-shifting effect of public spending at home and abroad. At the aggregate level, foreign aggregate demand increases more than the home aggregate demand especially due to the fact that foreign households benefit from the home fiscal stimulus without having to pay for the cost in the form of higher taxes in contrast to home households. As a result, foreign prices increase more than home prices implying an increase in the terms of trade (last panel of the last row in Figure 1), which reallocates demand towards home goods. However this expenditure-switching effect, which increases the demand for home goods, is dominated by the expenditure-shifting effect which increases the demand for foreign goods. The resulting home trade deficit causes an increase in private debt vis-à-vis the foreign country in the short run under both fiscal discipline cases (middle panel of the last row in Figure 1).

The upward pressure on prices in both countries is limited as prices are sticky in the short run. This implies that output is partly demand driven. Therefore aggregate output increases more in the home country compared to the foreign output. However, since the increase in the aggregate output is shared among a greater number of households in the foreign country, the foreign per capita output increases less than at home as shown in the middle panel of the first row in Figure 1. In order to meet the increase in the demand, firms increase their labour demand. This leads to an increase in real wages (as seen in the last panel of the second row in Figure 1) to the extent that nominal wage increases more than the prices.

Following the increase in output at the union level, the central bank reacts initially by increasing the nominal interest rate which decreases the asset holders' consumption. This mitigates the consumption increase due to the hand-to-mouth households, but the net effect is positive. However, as the reaction of the union output fades, the gap between the current and stationary interest rate falls progressively under the weak fiscal discipline. Hence the negative impact of the interest rate on asset holders' consumption is mitigated in the medium run. Under both types of fiscal discipline, consumption of asset holders and hand-to-mouth households evolve in the opposite way. Hence, total per capita private consumption returns to its initial value in the medium run (the first panel of the second row). This implies that, total demand is mainly driven by public spending especially in the medium run. Therefore, the evolution of per capita output is similar to that of per capita public spending. Thus, as can be seen in the second panel of the first row in Figure 1, per capita output increases less at each period in both countries. However, under weak fiscal discipline output remains above the initial

level in the medium run, whereas it falls below the steady-state level under strong fiscal discipline. The reduction in hours worked, due to the fall in output, brings about a decrease in real wages in both countries.

As both home and foreign demand fall below the initial level in the medium term under strong discipline, goods prices also start to fall. Because of the interest rate smoothing parameter, large jumps in the interest rate are ruled out even in the presence of deflation observed in the strong discipline case. Therefore, the real interest rate remains below the initial level even in the long-run where prices return to their steady-state level (last panel of the third row in Figure 1). In contrast, under weak discipline, the real interest rate remains above the initial level since the evolution of output excludes the possibility of a deflation.

The evolution of foreign debt is also related to that of goods demand. As the home demand for foreign goods falls below the initial level under strong discipline case in the medium run, trade deficit and foreign debt start to fall before returning to the initial zero-debt equilibrium in the long-run. In contrast, due to higher levels of foreign goods demand, foreign debt stabilizes at a higher level in the medium run under weak fiscal discipline.

Some of the results mentioned above are similar to those reported by Corsetti, Meier and Müller et al. (2010) with whom the present paper shares the design of fiscal policy. Specifically, public spending, home output and inflation responses are similar under both fiscal cases. However, home consumption response is positive in the present setup in both cases whereas Corsetti, Meier and Müller (2010) find a negative consumption response in the absence of fiscal feedback parameters. The authors explain the evolution of consumption by that of the long-run real interest rate which they define as the infinite sum of the expected short run real interest rates. Indeed, the latter falls below its steady-state level in the presence of spending reversals whereas without the feedback mechanism long-run real interest rate remains above the steady-state level. This positive response of the long-run real interest rate brings about a fall in consumption. In contrast, the present setup implies a positive consumption response even when the real interest rate remains high compared to the steady-state level. This can be explained by the fact that with positive population growth, households anticipate a fall in per capita future taxes when public spending is debt-financed (weak discipline). Expected taxes affect positively the consumption of all households whereas the negative effect of the interest rate concerns only the consumption of asset holders. Nevertheless, in the present setup consumption increases more under strong discipline as in Corsetti, Meier and Müller (2010).

Regarding the spill-over effects, the results of the present paper differs from those of Corsetti, Meier and Müller (2010) in the weak discipline case. Under weak

discipline, spill-over effects remain positive in the present setup while Corsetti, Meier and Müller (2010) find negative spill-over effects in the absence of the feedback mechanism. This is due to the fact that Corsetti, Meier and Müller (2010) assume home good bias both in private and public demand whereas the present setup abstracts from home bias. Moreover, Corsetti, Meier and Müller (2010) consider flexible exchange rate regime while the present setup is applied to a currency union.

The overlapping-generations framework gives some insight on the intergenerational effects of a fiscal expansion. In the weak fiscal discipline case, government pays only the interests by issuing new bonds in the following period. Therefore, new generations do not bear the burden of former debt in the form of higher taxes. In contrast, under high fiscal discipline, government resorts to tax increases in order to reduce public debt. Therefore newborns bear the tax burden without receiving any interest income since they do not hold assets by assumption. Moreover, under strong fiscal discipline the initial impact of fiscal expansion is higher compared to the weak discipline case but the medium run effect is a recession since output falls below the steady-state in the medium run. This implies that the strong discipline regime favours current generations at the expense of future generations.

3. Sensitivity Analysis

This section considers alternative values for the population growth rate, for the parameters that affect fiscal policy transmission and for the policy parameters in order to assess their impact on the implications of public spending under strong and weak fiscal discipline regimes.

The parameter n will be allowed to vary in this section for two reasons. First, the population growth differs across members of the euro zone, suggesting that the transition dynamics may differ from one country to another. Second, population growth may play an important role in an overlapping generations model since it is one of the factors that determine the degree of deviation from the Ricardian equivalence.

In a two country setup, the size of the policy implementing country is important since it affects the international policy transmission and thereby the effectiveness of the fiscal stimulus. As the country size differs significantly from one member to the other in the euro zone, it will be convenient to consider alternative values for this parameter. The elasticity of substitution between home and foreign goods (θ) also affects the size of the spill-over effects of a home fiscal expansion. Therefore, alternative values for θ will be considered.

Among policy parameters, the monetary rule coefficient on output (ϕ_y) plays an important role on the fiscal policy transmission both at home and in the foreign country. The tax response coefficient ϕ_{tg} is also an important policy parameter. While some of the members of the euro zone rely relatively more on taxes, others prefer spending cuts to reduce public deficit rather than increasing taxes. Therefore, alternative values of the tax response coefficient ϕ_{tg} will be considered in this section.

3.1. Population Growth and Fiscal Policy Effectiveness

In the present setup, the deviation from the Ricardian equivalence depends on the population growth. Therefore population growth will influence the impact of public spending on consumption and output in both countries. Table 2 gives the first year per capita output and consumption multipliers in the two countries for various values of the population growth.[4] A row-by-row comparison of Table 2 allows to see how multipliers vary with the population growth rate whereas a column-by-column inspection allows to compare the performances of the two fiscal regimes.

T a b l e 2

Output and Consumption per capita Multipliers and Population Growth

				Weak fiscal discipline			**Strong fiscal discipline**		
	n	Y^{PC}	Y^{*PC}	C^{PC}	C^{*PC}	Y^{PC}	Y^{*PC}	C^{PC}	C^{*PC}
$\phi_{tg} = 0$	0.0025	0.5	0.271	0.072	0.026	0.876	0.267	0.238	0.112
	0.005	0.539	0.249	0.079	0.018	0.868	0.232	0.215	0.084
$\phi_{tg} = 0.3$	0.0025	0.565	0.232	0.037	0.018	0.873	0.233	0.217	0.085
	0.005	0.529	0.231	0.027	0.018	0.868	0.232	0.215	0.084

Source: Author's own calculations.

As Table 2 shows, under weak fiscal discipline, the effect of population growth on consumption and output multipliers depends on the initial increase in taxes given by ϕ_{tg}. This suggests that population growth works through two different mechanisms with opposite effects. The first effect is on aggregate values and works through the typical OLG channel, which implies that the discounted value of per capita future taxes is lower than the discounted value of public spending financed with public debt. Indeed, the fiscal authority has to increase future taxes in order to pay the public debt contracted at any period *t*. However, with positive population growth, households anticipate that the increased future

[4] Specifically, the table gives the cumulative four-quarter response of the relevant variable with respect to the cumulative four-quarter change in public spending.

burden of taxes due to higher public debt will be shared among a greater number of home households. Hence, they perceive public spending as an increase in their net wealth and thereby raise their current consumption (as implied by equation (12) at the aggregate level and by equation (13) in per capita terms). This is the typical result in OLG models where Ricardian equivalence does not hold. In the present setup, the typical OLG result holds when fiscal discipline is low and when initially all public spending is debt-financed ($\phi_{tg} = 0$). The second effect of population growth works through its mechanical effect on per capita variables since population growth leads to a redistribution of aggregate variables among a larger number of households. For a given level of aggregate consumption, dividing by a larger population will decrease the per capita level.

As the present setup shows, when some of the initial increase in public spending is tax-financed ($\phi_{tg} > 0$) or when fiscal discipline is strong, the typical OLG result does not hold any more suggesting that the aggregate consumption does not increase enough to compensate for the higher population. This implies that the second effect of population growth mentioned above is higher than the first effect. As a result, per capita consumption and output multipliers in both countries fall as population growth increases.

Given $\phi_{tg} > 0$, under both fiscal regimes, a higher *n* leads to a higher increase in the consumption of asset holders both at the aggregate level as implied by equation (12) and in per capita terms as implied by equation (13). The increase in aggregate output stimulates the consumption of hand-to-mouth households, which amplifies the impact of *n* on the response of aggregate output and consumption following the fiscal expansion. The resulting spill-over effect on the aggregate foreign output and consumption is positive, but the effect in per capita terms on all variables is negative due to the high population increase.

Table 2 gives also the effect of ϕ_{tg} on the fiscal multipliers. Inspection of the first and third rows of Table 2 (keeping *n* constant at 0.25%) shows that under weak fiscal discipline, a fall in tax response to public spending (ϕ_{tg}), leads to a fall in the output multiplier whereas the effect on all other multipliers is positive. Indeed, the negative wealth effect of taxes on home consumption is lower when $\phi_{tg} = 0$, which increases the home consumption multiplier. Despite higher private demand, output increases less when $\phi_{tg} = 0$. This is due to the fact that the terms of trade increase less when public debt is entirely debt-financed. Therefore, world demand switches to home producers but less than when initial public spending is partially tax-financed ($\phi_{tg} = 0.3$). Hence, home output multiplier falls while the foreign output multiplier increases. In contrast, under strong

discipline, a fall in tax response to public spending (ϕ_{tg}) increases the expansionary effect of fiscal policy on all variables. Indeed, the negative effect of the terms of trade on home output is more than compensated by the increase in home private demand which is higher under strong discipline. As a result, home output multiplier slightly increases following the fall in ϕ_{tg} under strong discipline in contrast to the weak discipline case. This result suggests that in times of fiscal expansion, it is better to finance extra public spending with debt (rather than taxes) provided that fiscal discipline is high.

3.2. The Effect of a Change in Policy Parameters and Fiscal Transmission

Table 3 gives the first year per capita output and consumption multipliers in the two countries for various values of the elasticity of substitution between home and foreign goods θ, the size of the policy-implementing country *a* and the monetary policy response to output gap ϕ_y.[5] A row-by-row comparison of Table 3 allows to see how multipliers vary with the relevant parameter whereas a column-by-column inspection allows to compare the performances of the two fiscal regimes. The first row of each panel gives the multipliers of the benchmark calibration.

T a b l e 3

Sensitivity Analysis for Various Parameters

		Weak fiscal discipline				**Strong fiscal discipline**			
		Y^{PC}	Y^{*PC}	C^{PC}	C^{*PC}	Y^{PC}	Y^{*PC}	C^{PC}	C^{*PC}
(a)	θ = 6	0.565	0.232	0.037	0.018	0.873	0.233	0.217	0.085
	θ = 4	0.588	0.205	0.034	0.014	0.923	0.201	0.215	0.075
	θ = 2	0.712	0.133	0.023	0.001	1.193	0.05	0.212	0.04
(b)	a = 0.30	0.565	0.232	0.037	0.018	0.873	0.233	0.217	0.085
	a = 0.50	0.712	0.367	0.049	0.03	1.028	0.388	0.274	0.141
	a = 0.65	0.822	0.477	0.058	0.039	1.144	0.504	0.316	0.185
(c)	$\phi_y = 0.1$	0.565	0.232	0.037	0.018	0.873	0.233	0.217	0.085
	$\phi_y = 0.2$	0.557	0.212	0.028	0.009	0.861	0.221	0.205	0.074
	$\phi_y = 0.3$	0.548	0.203	0.02	0.001	0.85	0.21	0.194	0.062

Source: Author's own calculations.

As θ decreases, home and foreign goods become poor substitutes and demand switches less easily from one country to the other following relative price movements. Therefore, the terms of trade increase more following the fiscal expansion with a low elasticity of substitution. When θ decreases, the advantage of the terms of trade lasts longer which implies higher output at home under both fiscal

[5] Specifically, the table gives the cumulative four-quarter response of the relevant variable with respect to the cumulative four-quarter change in public spending.

regimes. Accordingly, foreign output falls with θ. Lower income in the foreign country brings about a fall in foreign consumption. Panel (a) in Table 3 shows that home and foreign variables react similarly to a fall in θ regardless of the degree of fiscal discipline.

Table 3 shows that country size is important for the fiscal multipliers (panel b). As country size increases, output and consumption multipliers in both countries increase regardless of the fiscal regime. Indeed, a bigger country size leads to a higher expansion of world demand following the fiscal shock which, then, stimulates foreign variables through spillover effects. This result suggests that the effectiveness of fiscal stimulus plans is likely to be increased when those plans are generalized in a currency union. Moreover, the positive spillover effects across the countries suggest that there may be gains from fiscal policy cooperation among the implementing countries.

Panel (c) in Table 3 shows that a higher reaction coefficient of output in the monetary policy causes a fall in consumption and output multipliers in both countries regardless of the fiscal regime. When monetary authority reacts more aggressively to output deviations, any expansionary effect of public spending is counter balanced by a higher increase in the nominal interest rate. This implies that, some kind of cooperation between fiscal and monetary authorities, inducing a less active monetary behaviour, may increase the effectiveness of fiscal stimulus plans.

Conclusion

The present paper compares the dynamic effects of two types of fiscal policies based on different degrees of fiscal discipline. Short run consumption and output multipliers of fiscal policy are lower under weak discipline compared to the strong discipline case. However, in the medium run fiscal policy under weak discipline stimulates output better than the strong discipline case since it helps avoid output recession and deflation as long as a minimum of budget discipline is respected so that neither public debt nor foreign private debt are explosive.

The European fiscal stimulus plan implemented after the 2009 crisis in order to stimulate economic growth while avoiding the undesired effects on public finance seems similar to the fiscal stimulus plan under strong fiscal discipline presented in the previous section. Although the European stimulus plan does not imply the endogenous feedback mechanism, there seems to be an exogenous feedback from public debt to public spending. Indeed, in 2011, the European Commission asked the member countries to end the fiscal stimulus plans after two years of implementation and to take restrictive precautions in order to reduce public deficit. This fiscal consolidation policy implemented in 2011 allowed the

members to reduce average euro zone fiscal deficit from 4.1% in 2011 to 2.1% in 2015 and to slow down the increase in public debt albeit at a higher level than the upper limit indicated by the SGP. At the same time, economic recession increased unemployment beyond 11% in 2012 and 2013 and the economic growth in 2015 remained below the pre-crisis level (2.6% in 2007). Moreover, inflation is around 0% in 2015 which remains well below the ECB's target of 2%, implying a risk of deflation.

In contrast to the European reaction to the crisis, the American fiscal stimulus plan implemented in 2009 was subject to a lower fiscal discipline and hence continued in 2011. The US GDP growth rates in 2012 and 2013 were above 2% and well above those of the euro zone in 2014 and 2015 with an unemployment rate equal to the half of the European unemployment. Public debt in the US as a percentage of GDP tends to stabilize with a lower growth rate between 2012 and 2014 compared to the previous period.

The OLG structure of the present setup allows to see how the contribution of the future generations to the financing of the fiscal stimulus affects the consumption of current generations. It also shows that, regarding output growth, strong fiscal discipline favours current generation against the future generations since the strong fiscal discipline case causes a slight output recession in the medium run. Finally, this OLG structure shows the effect of population growth on the fiscal multipliers under various degrees of fiscal discipline.

The present setup neglects the possibility of multiple equilibria and therefore does not account for government solvency and sovereign debt issues. Indeed, in a multiple equilibrium setup, households may refuse to lend government even when the permanent public debt is stable, which may cause government insolvency and thereby render undesirable a high level of public debt. Incorporating a risk premium on the public bond of the country with the highest outstanding public debt would work similarly. The risk premium would induce the public authorities to refrain from excessive debt even under weak discipline case and thereby reduce the gap between the results of the two fiscal regimes. Introducing these issues into the present setup may be interesting for future research.

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