

Fiscal policy, the current account and the twin deficits hypothesis

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Abstract

The relationship between the fiscal policy and the current account balance is an open question for open economies analysis. Traditional view leads to the so-called “twin deficits hypothesis”, which establishes a direct relationship between the government budget deficit and the current account deficit. However, intertemporal approach of the current account doubts on the existence of such a relationship. In this paper, we study this twin deficits hypothesis using a dynamic general equilibrium model in a monetary union context, in which it is considered the role of international investors in financing government deficit. We find that the proportion of government debt purchased by foreign investment is a key factor in explaining the relationship between fiscal policy and the current account. In general, we obtain that the effects of different shocks on the current account dynamics are magnified as the proportion of government debt held by foreign investors increases.

Keywords: fiscal policy, government budget deficit, trade balance, twin deficits.

JEL classification: E62, F32, F41.

Resumen

La relación entre la política fiscal y el saldo de la cuenta corriente es una cuestión que tiene gran interés para el análisis de economías abiertas. La visión tradicional establece una relación directa entre los déficits públicos y los déficits en la cuenta corriente, lo que la literatura ha denominado como la hipótesis de los déficits gemelos (twin deficits hypothesis). Sin embargo, el enfoque intertemporal de la cuenta corriente pone en duda la existencia sistemática de dicha relación. En este artículo estudiamos la hipótesis de los déficits gemelos en un contexto de equilibrio general en el cual consideramos la existencia de financiación del gobierno en los mercados internacionales. Los resultados obtenidos muestran que la proporción de deuda pública en manos de inversores extranjeros es un factor fundamental a la hora de explicar la relación entre la política fiscal y la cuenta corriente. En general, encontramos que la respuesta de la cuenta corriente ante las diferentes perturbaciones estudiadas se magnifica a medida que aumenta la proporción de deuda pública en manos de inversores internacionales.

Palabras clave: política fiscal, déficit público, cuenta corriente, déficits gemelos.

Códigos JEL: E62, F32, F41.

1. Introduction

There is an ongoing controversy, both theoretically and empirically, whether government deficits and fiscal policy are linked to the current account. Traditional view suggests that a fiscal expansion should lead to an appreciation of the real exchange

rate and a worsening in the current account, contrary to the Ricardian view, in which there is no systematic relationship between budget and current account deficits. The supposed relationship between the budget deficit and the current account deficit established by the traditional absorption approach is known as the “twin deficits” hypothesis, indicating that both balances moves in the same direction, and that an expansionary fiscal policy deteriorating the public balance will also translate into a deterioration of the current account. The twin deficits hypothesis gained popularity because of the experience of the U.S., during the 1980s. The reduction of taxes by the Residence of Reagan lead to a worsening of the fiscal balance, jointly with an appreciation of the real exchange rate and a deterioration of the current account. This observed causality relationship between fiscal position and the current account was broken in the late 1990s, as indicated by Mann (2002). However, in the early 2000s during the Bush administration was also observed a worsening of the fiscal balance associated to an increase in the current account deficit, emerging again the interest on the “twin deficits” hypothesis.

A government budget deficit can influence the trade balance through several channels. In the traditional Mundell-Fleming approach, a fiscal contraction leads to a reduction in the interest rate, causing a capital outflow, and a depreciation in the nominal exchange rate. This leads to a depreciation of the real exchange rate, increasing the level of competitiveness, making imports less attractive and making exports more attractive and, therefore, provoking an improvement in the current account deficit. This systematic link has been criticized by the intertemporal approach of the current account. Under this approach, the relationship between the current account and the government budget only exists in the case of a transitory shock to public expenditures, whereas in the case of a permanent shock, the adjustment is done via private consumption, leaving the current account unaffected. However, notice that the transmission mechanism highlighted by the traditional view is absent in the case of a fixed exchange rate regime or in the context of a monetary union. If the nominal exchange rate is a constant or there is a common currency, then the relationship between the fiscal policy and the current account via changes in the nominal exchange rate is broken. Furthermore, in the case of a monetary union, monetary policy is common, and hence, the interest rate is the same for all countries in the monetary union. Corsetti and Müller (2006) highlight an alternative transmission channel via the change in the terms of trade. Again, this channel is arguably very limited in the case of a monetary union.

Nevertheless, the relationship between budget deficits and the current account is not direct, depending on the excess of investment over private saving. Indeed, all three components, the budget deficit, the trade deficit, and the excess of investment over private saving, are simultaneously determined. Furthermore, if we assume that the Ricardian Equivalence holds (Barro, 1974; 1989), there is no systematic relationship between budget and current account deficits. The Ricardian Equivalence hypothesis implies that just changing taxes without changing government spending will not affect private spending and hence, will not affect the current account. In

this context, a change in taxes will affect the budget deficit but keeping the current account unaltered, just by changing the excess of investment over private saving. On the other hand, private savings will typically increase in response to a rise in public deficit, breaking down the supposed direct relationship between the budget and the current account balances. Roubini (1988) shows that optimal tax smoothing implies a one-to-one relationship between the current account and the fiscal deficit. Therefore, testing the Ricardian Equivalence hypothesis is equivalent to testing the twin deficits hypothesis.

A large body of empirical literature has focused in solving that theoretical controversy, arriving also to contradictory results. On the one hand, there is a collection of papers that found empirical support of the twin deficit hypothesis, including Baxter (1985) who shows that a transitory tax rate cut may improve the current account but worsen the government budget. He estimated that a 1 percentage point rise in government spending over GDP caused a trade balance deterioration of about 0.5 percentage point of GDP. Enders and Lee (1990) developed a Dynamic Stochastic General Equilibrium (DSGE) model consistent with the Ricardian equivalence hypothesis. They obtained that tax increases used to reduce government debts will not affect private spending or the current account balance, but a rise in government spending will induce a current account deficit. Abell (1990) obtained a closed link between budget and current account deficits. Chinn and Prasad (2003) found that current account balances are positively correlated with government budget balances and with the initial stock of net foreign assets. Corsetti and Müller (2006) show the magnitude of the twin deficits depends on the degree of openness of an economy and on the persistence of fiscal shocks. Piersanti (2000) studies the link between current account deficits and expected future budget deficits. Using a dynamic general equilibrium model, he considers the forward-looking expectations by the agents for studying the effects of future budget deficits and found a close relationship between the current account and the budget deficit. More recently, Bluedorn and Leig (2011) found support of the twin deficits hypothesis by using changes in fiscal policy that are uncorrelated with other factors affecting the current account and are associated to periods of fiscal consolidation. They estimate that a 1 per cent of GDP fiscal consolidation raises the current account balance to GDP by about 0.6 percentage points. Finally, Kumhof and Laxton (2013) shows that the relationship between both deficits depends on the size of the country in the case of a permanent fiscal shock.

On the other hand, there is a number of empirical works that do not find a stable link between government deficits and the current account, including Ahmed (1987), Evans, 1988, Erceg, Guierrieri and Gust (2005), Kim and Roubini (2008), and Bussière, Fratzscher and Müller (2010), among others. Evans (1988) studied the relation between budget and current account deficits for the major industrialized countries (the United States, Canada, France, Germany and the U.K.) and found no relationship consistent with the Ricardian hypothesis that the budget deficit is not related to the current account deficit. Erceg *et al.* (2005) found that fiscal deficits have

a small effect on the US trade balance, irrespective of whether the source is a spending increase or a tax cut. Kim and Roubini (2008) pointed out that output shocks, more than fiscal shocks, appear to drive the co-movements of the current account and the fiscal balance, and suggesting the existence of a “twin divergence” rather than “twin deficits”. They estimated a Vector Autoregression (VAR) model and found that a government deficit shock improves the current account and depreciates the real exchange rate in the short run. This improvement in the current account is explained by an increase in private saving and a fall in investment. Bussière et al. (2010), studied the effect of productivity shocks and budget deficits on the current account, introducing non-Ricardian agents. They obtain that a deterioration in public savings by 1 percentage point of GDP will lower the current account by 0.14 percentage points of GDP.

In this paper, we develop a DSGE model for a small open economy with forward looking agents. Domestic households can save in the form of physical capital investment, domestic bonds, or foreign bonds. Exports are determined exogenously. Government spending is assumed exogenously determined. Difference between total government expenditures including interest payments and fiscal income is financed by issuing domestic debts. We consider three shocks: an aggregate productivity shock, a government spending shock, and a tax cut. The key aspect of the model is that government debt can be purchased by both domestic and foreign agents. This introduces an important aspect of the analysis, as budget imbalances can be financed using foreign saving and not domestic saving. In fact, public debt is included in the definition of the current account in the case they are held by foreign agents. The main result that we found is that the response of the current account to the different shocks is greatly affected by the proportion of public debt purchased by foreign agents.

The structure of the rest of the paper is as follows. In Section 2 we present the relationship between government deficit and current account deficit using simple national accounts identities. Section 3 presents the open economy model. Section 4 calibrated the model for the Spanish economy. Section 5 studies the effect of different shocks on the current account dynamics. Finally, Section 6 summarizes the main conclusions.

2. Government budget deficits and the current account

In the literature we found a large numbers of factors explaining the dynamics of the current account, including the monetary policy, productivity growth, openness, decisions on private saving, fiscal policy, improvement in international financial markets, etc. However, there is no consensus about the relative importance of these factors. Here, we will focus our attention to the relationship between fiscal policy and the current account imbalances.

The relationship between budget deficits and the international trade can be easily observed from simple national accounts identities. First, we study such relationship in a static environment using a simple accounting approach just to highlight the

relationship among the main macroeconomic aggregates. Final output in an open economy, Y can be defined as the sum of total consumption of goods and services, C total investment, I exports, X , and less imports, M . The difference of exports and imports represent the net sale of goods and services to foreign agents (i.e., the trade balance):

$$Y_t = C_t + I_t + X_t - M_t \quad [1]$$

Notice that government spending is not included in the above identity in order to avoid double accounting in the definition of output and for model consistency, that is, just to define government spending as total government expenditures, G_t^1 . Therefore, consumption refers to total consumption, including goods and services provided by the government (government intermediate consumption plus social benefits provided in kind), and investment refers to total investment including both private and public investment.

On the other hand, (disposable) income, which have to be equal to GDP, is the sum of total consumption, private saving, S , taxes, T , less government spending, these last two components reflecting public saving:

$$Y_t = C_t + S_t + T_t - G_t \quad [2]$$

that is, income is equal to total consumption plus total saving, where total saving is the sum of private plus public saving. Combining equations [1] and [2], we obtain that²:

$$C_t + I_t + X_t - M_t = C_t + S_t + T_t - G_t \quad [3]$$

Expression [3], after some simple manipulation can be used to address the relationship between three elements: budget deficits, the trade balance and the difference between investment and saving. Indeed, we can write:

$$(I_t - S_t) + (G_t - T_t) + (X_t - M_t) = 0 \quad [4]$$

¹ Traditionally, output (or aggregate demand) is defined as the sum of of private consumption, investment, government spending, exports, less imports:

$$Y_t = C_t + I_t + G_t - X_t - M_t$$

However, this definition implies that G_t is only a fraction of total government spending, representing government consumption of goods and services. Notice that other components of total government expenditures, such as social benefits and transfers other than in kind, or public compensation to employees, are not included in this definition of government spending and, instead, they must be included either in the definition of private consumption or in investment. Moreover, if investment is defined as total investment in the economy, and not only private investment, then public investment is also not included in the definition of government spending. As the budget constraint of the government includes total government spending, this definition of output introduces an inconsistency in the model economy that need to be addressed.

² Notice that the combination of [1] with [2] leads to the same expression as with the traditional definitions of output and disposable income.

The above expression indicates that the budget deficit is equal to the trade balance surplus plus the excess of investment over private saving. With equilibrium in the public accounts, the excess of investment over private saving is just equal to the trade balance. This implies that excess of investment should be financed by a surplus in the trade balance, that is, by foreign savings. Furthermore, in the case in which investment is equal to private saving, we obtain that the government deficit is just equal to the trade balance. A budget deficit must then be financed by a surplus in the trade balance. This is the basic of the so-called twin deficits (see, for instance, Salvatore, 2006). A change in fiscal policy, for example, increasing public spending or reducing taxes, will provoke either a deterioration of the trade balance or a reduction in the excess of investment over private saving. That is, the rise in the budget deficit (the reduction in the public saving) needs to be financed either by domestic private saving or by foreign saving. If the change in the excess of investment over private saving does not completely offset the fiscal policy change, then we will observe a relationship between both the budget and the current account deficits.

The twin deficits hypothesis has been extensively studied empirically by a large number of papers. Initial works investigating this topic are Ahmed (1987), Bernheim (1988), and Abell (1990). However, empirical results are far to be conclusive about the relationship between the trade balance and the budget deficits, and when a positive relationship between both deficits is found the causality direction is not clear. Whereas some empirical works found support of the “twin deficits” hypothesis (Abell, 1990; Enders and Lee, 1990; Chinn and Prasad, 2003; among others), there is other set of empirical works which cast doubt about the validity of the “twin deficits” hypothesis and the existence of a direct relationship between budget and current account imbalances (Ahmed, 1987; Evans, 1988; Erceg, Guierrieri and Gust, 2005; Kim and Roubini, 2008; and Bussière, Fratzscher and Müller, 2010; among others).

The key question is how the effects of a particular fiscal policy affects to both the excess investment over private saving, and the current account. These effects will depend, on the one hand, on how domestic agents change their decisions regarding investment and saving and, on the other hand, whether domestic investment have to be financed domestically or not. Under the assumption of no access to the international financial markets, private investment must finance both investment and government deficit, making the balance of trade independent on the fiscal policy. With access to the international financial markets, both private investment and budget deficits can be financed using foreign saving. This introduces a new dimension into the problem, as the current account is a combination of foreign bonds hold by the private sector plus the government debt hold by international investors.

Opposite to the traditional view, a second interpretation arises from the Ricardian equivalence principle (Barro, 1974; 1989). The Ricardian equivalence implies that a deficit today has to be financed by future taxes, and therefore a change in the budget deficit is accompanied by a change in the consumption-saving decision. In this framework, government debts are not part of the net wealth of the private sector, and the total present value of future taxes must be equal to the total present value of

spending today. According to this principle, no relationship between the current account and the budget deficit exists. When Ricardian equivalence holds (agents are forward-looking, financial markets are perfect, and there is no distortionary taxes), a rise in the government deficit leads to an equal instantaneous increase in private savings, as a higher debt generates expectations of higher taxes in the future, implying that there will be no link between fiscal deficits and the current account. Only in the case in which the Ricardian equivalence is not fully satisfied, then the response of private saving to the fiscal shock is not complete and then the fiscal policy will affect the current account.

2.1. Government debt and the current account

Next, we consider the intertemporal dimension of the problem. In this context, the current account is equivalent to the change in the net external debt, including the trade deficit and the payments to abroad. We assume that government debt, B_t , can be purchased either by domestic agents, B_t^H , or foreign agents, B_t^F :

$$B_t = B_t^H + B_t^F \quad [5]$$

Trade balance is financed by the purchasing of foreign bonds, F_t . In our notation, $F_t > 0$ implies an accumulated trade balance surplus, whereas $F_t < 0$ represents an accumulated trade balance deficit. This will be clear when defining the household budget constraint. Under the assumption that all government bonds are held by the domestic sector, the current account, CA_t , is defined as:

$$CA_t = F_t - F_{t-1} = Y_t - C_t - I_t + R_{t-1}^F F_{t-1} \quad [6]$$

where R_t^F is the interest rate of foreign bonds. The above expressions are obtained under the assumption that all public debt is maintained by domestic agents ($B_t^F = 0$). In the case in which public debt is also held by international investors, then expression [1] must be defined as:

$$Y_t = C_t + I_t + X_t - M_t - R_{t-1}^F F_{t-1} - B_t^F + (1 + R_{t-1}^B) B_{t-1}^F \quad [7]$$

where B_t^B is the interest rate of public debt, and the current account would be defined as the sum of private and public foreign financing:

$$CA_t = (F_t - F_{t-1}) - (B_t^F - B_{t-1}^F) = Y_t - C_t - I_t + R_{t-1}^F F_{t-1} - R_{t-1}^B B_{t-1}^H \quad [8]$$

Importantly, notice that the amount of public debt purchased by foreign investors enters now in the definition of the current account. In this context, the relationship between the variables can be written, by combining [8] with [2], as follows:

$$(I_t - S_t) + (G_t - T_t) + CA_t - R_{t-1}^F F_{t-1} + R_{t-1}^B B_{t-1}^F = 0 \quad [9]$$

3. The model

In this paper, we develop a small open economy general equilibrium model to study the interactions between fiscal policy and the current account. We first describe the behavior of households, then the firms, and finally the government. Households are modeled in a standard way, but including public goods in the utility function, and they can finance the difference between saving and investment by the purchasing of foreign bonds. Firms are represented by a CES production function nested within a standard Cobb-Douglas. The production of the final output requires three factors: labor services, private capital and public capital. The model economy assumes that exports are determined exogenously. Finally, we consider the role of the government. The model includes three taxes, public consumption of goods and services, public investment in public capital, and public debt. Differences between fiscal revenues and government spending are financed by the issue of government bonds that can be purchased by international investors.

3.1. Households

In our model economy, the decisions made by households are represented by a stand-in consumer with a period utility as a function of consumption and leisure:

$$U(C_t, L_t) = U(C_t, L_t) \quad [10]$$

where C_t is total consumption defined as:

$$C_t = C_{p,t}^\theta C_{g,t}^{1-\theta} \quad [11]$$

where $C_{p,t}$ denotes private consumption and $C_{g,t}$ denotes consumption of goods provided by the government, and L_t is working time. The parameter θ ($0 < \theta < 1$) captures the degree to which private consumption contributes to the individual's utility, and assuming that the elasticity of substitution between private goods and goods provided by the government is unitary. In this economy, households consume three types of goods; a private domestically produced good, $C_{H,t}$, a private foreign or imported good, $C_{F,t}$, and the goods provided by the government. We assume that total private consumption is a composite of domestic goods consumption and foreign good consumption:

$$C_{p,t} = \left[\mu^{1/\eta} C_{H,t}^{1-1/\eta} + (1-\mu)^{1/\eta} C_{F,t}^{1-1/\eta} \right]^{\eta/(\eta-1)} \quad [12]$$

where μ is the share of domestic produced good in total consumption representing the degree of home bias in preferences and $\eta > 0$ measures the intra-temporal elasticity of substitution between home and foreign goods. Given the CES aggregator, the demand for domestically produced goods and imports is:

$$C_{H,t} = \mu \left(\frac{P_{H,t}}{P_t} \right)^{-\eta} C_{p,t} \quad [13]$$

and

$$C_{F,t} = (1 - \mu) \left(\frac{S_t P_{F,t}}{P_t} \right)^{-\eta} C_{p,t} \quad [14]$$

where

$$P_t = [\mu P_{H,t}^{1-\eta} + (1 - \mu) S_t P_{F,t}^{1-\eta}]^{1/(1-\eta)} \quad [15]$$

where S_t is the nominal exchange rate, defined as the domestic currency per unit of foreign currency.

Households' preferences are given by the following instantaneous utility function:

$$U(C_t, N_t, \bar{H} - L_t) = \gamma \frac{(C_{p,t}^\theta C_{g,t}^{1-\theta})^\sigma}{\sigma} + (1 - \gamma) \log(1 - L_t) \quad [16]$$

where σ is a parameter measuring the degree of relative risk aversion. Leisure is defined as $1 - L_t$, where total time endowment has been normalized to one. The parameter γ ($0 < \gamma < 1$) is the fraction of total consumption on total private income.

The budget constraint faced by the stand-in consumer is:

$$\begin{aligned} & (1 + \tau_t^c) C_{p,t} + I_{p,t} + B_t^H + S_t F_t \\ &= (1 - \tau_t^l) W_t L_t + (1 - \tau_t^k) (R_t - \delta_{K_p}) K_{p,t-1} \\ & \quad + (1 + R_{t-1}^B) B + (1 + R_{t-1}^F) S_{t-1} F_{t-1} + Z_t + (1 - \tau_t^k) \pi_t \end{aligned} \quad [17]$$

where $I_{p,t}$ is private investment, B_t^H are (public) domestic bonds, F_t are foreign bonds, $K_{p,t}$ is private physical capital stock, W_t is compensation per employee, R_t is the rental rate of capital, δ_{K_p} is the capital depreciation rate which is modeled as tax deductible, R_t^B is the interest rate on domestic bonds, R_t^F is the interest rate on foreign bonds, Z_t denotes lump-sum transfers from the government, and π_t are profits. The budget constraint includes three taxes: a consumption tax, τ_t^c , a labor income tax, τ_t^l , and a capital and profits tax, τ_t^k .

To close the model we assume the existence of a foreign debt-elastic premia. Following Schmitt-Grohé and Uribe (2003), we use the following functional form for the risk premium:

$$\Phi_t(F_t) = \phi(\exp(F_t - \bar{F}) - 1) \quad [18]$$

where $\phi > 0$, and \bar{F} is the steady state value for foreign bonds. This implies that

domestic households are charged a premium over the exogenous foreign interest rate, R_t^F , if the domestic economy is net borrower ($F_t < 0$), and receive a lower remuneration on their saving if the domestic economy is a net lender ($F_t > 0$). Therefore:

$$R_t^F = R_t^* + \phi(\exp(F_t - \bar{F}) - 1) \quad [19]$$

where R_t^* is the world interest rate. We set the subjective discount factor equal to the world interest rate, such as:

$$\beta = \frac{1}{1 + R_t^*} \quad [20]$$

Nominal exchange rate is the key variable in the transmission mechanism from fiscal policy to the current account in the traditional view. However, here we will focus on that relationship in the context of a monetary union, where the nominal exchange rate just does not exist (it is a constant). We will also assume that in this monetary union environment that domestic and foreign prices are equal. Note that under the assumption that $P_t = P_{H,t} = P_{F,t}$, then:

$$C_{H,t} = \mu C_{p,t} \quad [21]$$

$$C_{F,t} = M_t = (1 - \mu)C_{p,t} \quad [22]$$

and therefore, total private consumption is just the sum of domestically produced private consumption plus imports:

$$C_{p,t} = C_{H,t} + C_{F,t} \quad [23]$$

Finally, private physical capital holdings evolve according to:

$$K_{p,t} = (1 - \delta_K)K_{p,t-1} + I_{p,t} \quad [24]$$

where $I_{p,t}$ is household's gross investment.

Households' maximization problem

The consumer maximizes the value of her lifetime utility given by:

$$\text{Max}_{\{C_t, L_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \left[\gamma \frac{(C_{p,t}^\theta C_{g,t}^{1-\theta})^\sigma}{\sigma} + (1 - \gamma) \log(1 - L_t) \right] \quad [25]$$

subject to the budget constraint, where (K_0) and taxes are given, and where $\beta \in (0, 1)$, is the consumer's discount factor. The first order conditions for the consumer maximization problem are:

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial C_{p,t}} &= \gamma \theta \beta^t C_{p,t}^{\theta\sigma-1} C_{g,t}^{(1-\theta)\sigma} - \lambda_t(1 + \tau_t^c) = 0 \\
\frac{\partial \mathcal{L}}{\partial L_t} &= -(1 - \gamma) \frac{\beta^t}{1 - L_t} + \lambda_t(1 - \tau_t^l) W_t = 0 \\
\frac{\partial \mathcal{L}}{\partial K_t} &= \left[\lambda_{t+1} \left(1 + (1 - \tau_{t+1}^k)(R_{t+1} - \delta_{Kp}) \right) \right] - \lambda_t = 0 \\
\frac{\partial \mathcal{L}}{\partial B_t^H} &= \left[\lambda_{t+1} (1 + R_t^B) \right] - \lambda_t = 0 \\
\frac{\partial \mathcal{L}}{\partial F_t} &= \left[\lambda_{t+1} (1 + R_t^F) \right] - \lambda_t = 0
\end{aligned} \tag{26}$$

plus the budget constraint and a transversality condition stating that the today-value of long distant future values of assets are zero. From the first first order condition we obtain that the Lagrangian multiplier (the shadow price of consumption) is:

$$\lambda_t = \frac{\gamma \theta \beta^t}{(1 + \tau_t^c)} C_{p,t}^{\theta\sigma-1} C_{g,t}^{(1-\theta)\sigma} \tag{27}$$

By substituting in the second first order condition, we obtain the labor supply function, given by:

$$\frac{\gamma \theta}{(1 + \tau_t^c)} C_{p,t}^{\theta\sigma-1} C_{g,t}^{(1-\theta)\sigma} = \frac{(1 - \gamma)}{(1 - \tau_t^l) W_t (1 - L_t)} \tag{28}$$

Optimal consumption path (investment decision), is obtained from substituting the Lagrangian multiplier in the third first order condition:

$$\frac{\beta}{(1 + \tau_{t+1}^c)} C_{p,t+1}^{\theta\sigma-1} C_{g,t+1}^{(1-\theta)\sigma} \left(1 + (1 - \tau_{t+1}^k)(R_{t+1} - \delta_{Kp}) \right) = \frac{1}{(1 + \tau_t^c)} C_{p,t}^{\theta\sigma-1} C_{g,t}^{(1-\theta)\sigma} \tag{29}$$

Finally, equilibrium conditions for investment decision in foreign bonds and public debt are given by:

$$\frac{\beta}{(1 + \tau_{t+1}^c)} C_{p,t+1}^{\theta\sigma-1} C_{g,t+1}^{(1-\theta)\sigma} (1 + R_t^B) = \frac{1}{(1 + \tau_t^c)} C_{p,t}^{\theta\sigma-1} C_{g,t}^{(1-\theta)\sigma} \tag{30}$$

$$\frac{\beta}{(1 + \tau_{t+1}^c)} C_{p,t+1}^{\theta\sigma-1} C_{g,t+1}^{(1-\theta)\sigma} \left(1 + R_t^* + \phi(\exp(F_t - \bar{F}) - 1) \right) = \frac{1}{(1 + \tau_t^c)} C_{p,t}^{\theta\sigma-1} C_{g,t}^{(1-\theta)\sigma} \tag{31}$$

The feasibility condition of the economy is given by (as defined by expression [7]):

$$Y_t = C_t + I_t + F_t - (1 + R_{t-1}^F)F_{t-1} - B_t^F + (1 + R_{t-1}^B)B_{t-1}^F \quad [32]$$

To close the household sector of the model economy, we assume that exports are determined exogenously, $X_t = \bar{X}$. We assume that they follow an AR(1) process:

$$\log(X_t) = (1 - \rho_X)\bar{X} + \rho_X \log(X_{t-1}) + \varepsilon_t^X \quad \varepsilon_t^X \sim N(0, \sigma_X^2) \quad [33]$$

3.2. Firms

The problem of the firm is to find optimal values for the utilization of labor and capital given the presence of public inputs. The stand-in firm is represented by a nested CES with a standard Cobb-Douglas production function. The production of final output, Y , requires labor services, L , and two types of capital: private capital, $K_{p,t}$, and public capital (public infrastructures), $K_{g,t}$. Goods and factors markets are assumed to be perfectly competitive. The firm rents capital and hires labor to maximize period profits, taking public inputs and factor prices as given. The technology exhibits a constant return to private factors. However, the firms earn an economic profit equal to the difference between the value of output and the payments made to the private inputs. We assume that these profits are distributed to households as we assume that they are the owner of the firms. The technology is given by:

$$Y_t = A_t \left[\varphi K_{g,t-1}^\rho + (1 - \varphi) (K_{p,t-1}^\alpha L_t^{1-\alpha})^\rho \right]^{1/\rho} \quad [34]$$

where A_t is a measure of total-factor productivity, α is the private capital share of output, φ measures the weight on public capital relative to private factors and $1/(1 - \rho)$ is a measure of the elasticity of substitution between public inputs and private inputs.

Based on the firm profit maximization problem, the first-order conditions are:

$$\begin{aligned} R_t &= \alpha(1 - \varphi) A_t X_t^{1/\rho-1} (K_{t-1}^\alpha L_t^{1-\alpha})^{\rho-1} K_{t-1}^{\alpha-1} L_t^{1-\alpha} \\ W_t &= (1 - \alpha)(1 - \varphi) A_t X_t^{1/\rho-1} (K_{t-1}^\alpha L_t^{1-\alpha})^{\rho-1} K_{t-1}^\alpha L_t^{-\alpha} \end{aligned} \quad [35]$$

where $X_t = \varphi G_{t-1}^\rho + (1 - \varphi) (K_{t-1}^\alpha L_t^{1-\alpha})^\rho$. The firm will produce extraordinary profits of the magnitude $\frac{\partial Y_t}{\partial G_{t-1}} G_{t-1} = \varphi A_t X_t^{1/\rho-1} G_{t-1}^\rho$, since this amount is not charged to the owner of the factor. The government usually does not charge a price that covers the full cost of the services provided with the contribution of public inputs. Therefore, a rent is generated in the form of positive profits. We assume that profits are received by households.

Finally, we consider a TFP shock and assume that TFP follows an AR(1) process:

$$\log(A_t) = (1 - \rho_A)\bar{A} + \rho_A \log(A_{t-1}) + \varepsilon_t^A \quad \varepsilon_t^A \sim N(0, \sigma_A^2) \quad [36]$$

3.3. The Government

First, we describe the elements present in the government budget constraint:

$$G_t = T_t + B_{t+1}^H + B_{t+1}^F - B_t^H - B_t^F \quad [37]$$

where B_t^H are the holdings of government bonds by domestic agents and B_t^F are the holdings of government bonds by foreign agents. Equation (GI) says that total government spending including interest payments of total government debt (G_t), must be funded by some combination of tax receipts (T_t), and new debt issuance (ΔB_t). Total government spending can be divided between primary government spending, $G_{p,t}$, plus interest payments of total government debt, $R_t^B(B_t^H + B_t^F)$, and hence,

$$G_{p,t} + R_t^B(B_t^H + B_t^F) = T_t + B_{t+1}^H + B_{t+1}^F - B_t^H - B_t^F \quad [38]$$

Government spending

Primary government spending is assumed to be exogenously determined. We assume that government spending follows an AR(1) process:

$$\log(G_{p,t}) = (1 - \rho_G)\bar{G}_p + \rho_G \log(G_{p,t-1}) + \varepsilon_t^G \quad \varepsilon_t^G \sim N(0, \sigma_{Gp}^2) \quad [39]$$

Non-interest total government spending is defined as:

$$G_{p,t} = C_{g,t} + I_{g,t} + Z_t \quad [40]$$

where $C_{g,t}$ is public consumption of goods and services, $I_{g,t}$ is public investment, and Z_t are transfer payments to households, such as welfare, social security or unemployment benefit payments. We assume an exogenous distribution of primary government spending such as:

$$\begin{aligned} C_{g,t} &= \omega_1 G_{p,t} \\ I_{g,t} &= \omega_2 G_{p,t} \\ Z_t &= (1 - \omega_1 - \omega_2) G_{p,t} \end{aligned} \quad [41]$$

Public investments accrue into the public structures stock, $K_{g,t}$. We assume the following accumulation process for the public capital:

$$K_{g,t} = (1 - \delta_{K_g})K_{g,t-1} + I_{g,t} \quad [42]$$

which is analogous to the private capital accumulation process, and where δ_{K_g} is the public physical capital depreciation rate.

Tax revenues

The government obtains resources from the economy by taxing consumption and income from labor, capital and profits, whose effective average tax rates are denoted by τ_t^c , τ_t^l , τ_t^k , respectively. The government budget from fiscal revenues in each period is given by:

$$T_t = \tau_t^c C_t + \tau_t^l W_t L_t + \tau_t^k (R_t - \delta_K) K_{t-1} + \tau_t^k \pi_t \quad [43]$$

where $C_{p,t}$ is private consumption, W_t is wages, L_t is labor, R_t is the rental rate of private capital, δ_{K_p} is the depreciation rate of private capital, $K_{p,t}$ is private capital stock, and π_t are profits.

3.4. International investors

The last agent populating our model economy represents the foreign sector. The rest of the world for this economy is modeled as a single international banker whose objective is to maximize the discounted dividend x_t obtained from the asset holdings of government bonds. The discount factor is β , identical to the consumer's discounting parameter. Purchases of government bonds, in equilibrium, are denoted by B_t^F . The maximization problem for international investors can be defined as:

$$\max_{x_t} \sum_{t=0}^{\infty} \beta^t x_t \quad [44]$$

subject to the budget constraint given by:

$$B_{t+1}^F - B_t^F + x_t = w^l + R_t^B B_t^F \quad [45]$$

where w^l is a constant endowment. From the above problem we obtain the following steady state condition:

$$\beta(1 + R_t^B) = 1 \quad [46]$$

from which we obtain that the interest rate of government bonds is equal to the world interest rate.

4. Calibration of the model

Our model economy is calibrated for the Spanish economy. In the model, the nominal exchange rate has been normalized to one, and hence, it is assumed to be fixed. Therefore, movements in the nominal exchange rate are excluded as a variable affecting the current account dynamics. Furthermore, also domestic and foreign prices are normalized to one and therefore, also real exchange rate movements are excluded as a factor affecting the current account. These assumptions are justified in the context of a monetary union, as it is the case for the Spanish economy, where a large proportion of the current account reflects international transactions with other countries in the euro zone. Furthermore, in the monetary union the monetary policy is common, which implies that the transmission path for the interest rates is very limited.

The parameters of the model are the following:

$$(\alpha, \varphi, \rho, \sigma, \mu, \theta, \gamma, \delta_{kp}, \delta_{kg}, \phi, \tau_c, \tau_l, \tau_k, \omega_1, \omega_2, \bar{F}, \bar{G}, R^*)$$

In calibrating the model presented in the previous section we need four different sets of information: preference parameters, technological parameters, fiscal policy parameters, and the world economy. In the calibration of the parameter we use information taken from the OECD National Accounts Database and EU-Klems.

Preference parameters ($\theta, \mu, \eta, \sigma, \gamma, \phi$): The parameter measuring the degree to which government spending in providing goods contribute to the individual's utility is approximate by the proportion of public spending in transfers in kind and public intermediate consumption with respect to total private consumption, and has been set to be equal to 0.20, i.e. ($1 - \theta = 0.20$), and hence, $\theta = 0.80$. The share of domestic produced goods in total consumption, representing the degree of home bias in preferences, has been set equal to 0.7. Notice that the parameter measuring the intra-temporal elasticity of substitution between domestic and foreign goods, η , is not needed for the calibration of the model, given our assumption that domestic and foreign prices are equal. The parameter governing the relative risk aversion, σ , has been set equal to 0.90. The parameter representing the relative weight of consumption in the individual's utility function has be set equal to 0.40. Finally, the risk premium parameter ϕ has been set equal to 0.01.

Technological parameters ($\varphi, \alpha, \rho, \delta_{kp}, \delta_{kg}$): Next, we calibrate the parameters of the technology function. We use data from EU-Klems for investment and capital stock and data from BBVA-IVIE for public capital. The parameter measuring the weight of public capital relative to private factors, φ , has been set equal to 0.10, which approximately implies that about of 10 percent of total income is generated

by the public capital stock. The capital income share parameter, α , has been set equal to 0.35, indicating that about 65 percent of total private income corresponds compensation to labor. Notice that this calibration implies the existence of increasing returns to scale due to the presence of the public input. The parameter measuring the elasticity of substitution between public and private inputs has been fixed to be -0.50 , which implies an elasticity of substitution of 0.66 between the public capital and the private inputs. Depreciation rates have been fixed to be 0.06 for the case of private capital and 0.04 for public capital.

Fiscal policy parameters ($\tau_c, \tau_l, \tau_k, \bar{G}, \omega_1, \omega_2$): Computational macroeconomic models of fiscal policy crucially depend on realistic measures of tax rates and a correct definition of public spending. Agents' decisions depend on marginal tax and therefore effective marginal taxes should be used in the calibration. However, marginal tax rates are hard to estimate and it is often impractical to do so given the limitations due to data availability and difficulties in dealing with the complexity of tax systems. We compute effective average taxes using data on fiscal income and consumption, labor income and capital income. Resulting values are 0.1562 for the consumption tax rate, 0.3458 for the labor income tax and 0.2480 for the

TABLE 1
CALIBRATED PARAMETER VALUES

Parameter	Definition	Value
θ	Substitution parameter between private and public goods	0.80
μ	Share of domestic produced goods	0.70
γ	Weight of total consumption over income	0.40
σ	Relative risk aversion parameter	0.90
ϕ	Risk premium parameter	0.01
τ^c	Consumption income tax	0.16
τ^l	Labor income tax	0.35
τ^k	Kapital income tax	0.25
R	World interest rate	0.01
\bar{F}	Steady state foreign bonds	0.70
\bar{G}	Steady state total government spending	0.45
δ_{K_p}	Private capital depreciation rate	0.06
φ	Weight of public capital over private factors	0.10
ρ	Substitution parameter between public and private inputs	-0.50
α	Private capital share of output	0.30
ω_1	Proportion of public consumption of goods over primary spending	0.54
ω_2	Proportion of public investment over primary government spending	0.08
δ_{K_g}	Public capital depreciation rate	0.04

capital income tax. The steady state value for government spending has been fixed to be 45 per cent of total GDP. Non-interest payment government spending (primary government spending) is distributed among goods provided by the government, public investment and social benefits and transfers other than in kind, which also include public labor compensation. We found that public spending in gross spending is 8 per cent of primary government spending and that goods provided by the government plus intermediate consumption is around 54 percent of primary government spending, thus $\omega_1 = 0.54$ and $\omega_2 = 0.08$.

Finally, the world economy is represented by the steady state value for foreign bonds, \bar{F} , and the world interest rate, R^* . We consider a steady state value for foreign bonds of -0.5 , and a world interest rate of 0.01 . Parameters for the stochastic shock have been fixed to be 0.90 for the autorregressive parameter and 0.01 for the standard deviation. Table 1 summarizes the calibrated parameter values for the Spanish economy to be used in the simulations.

5. Shocks analysis

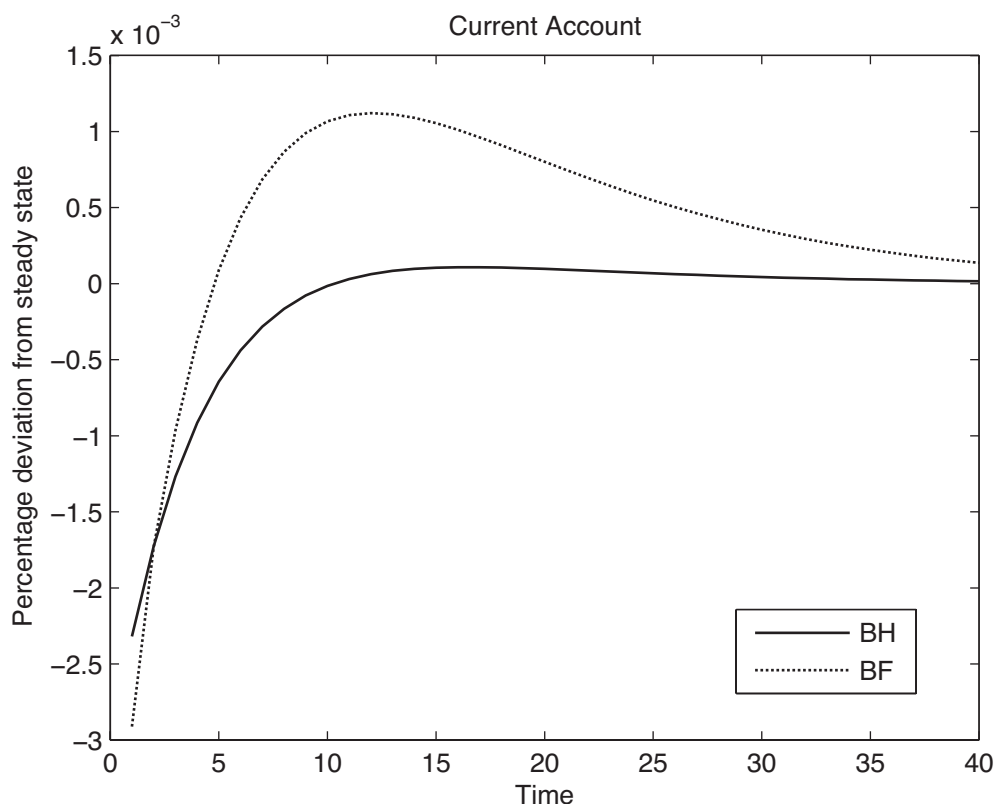
The calibrated model presented in previous sections enables us to carry out simulations to study the response of the current account to different shocks. In this section, we present some simulations to show the dynamics of the model via impulse-response functions. We consider the effects on the current account of three shocks: A total factor productivity shock, a government spending shock and a tax shock.

5.1. Total Factor Productivity shock

First, we study the properties of our model economy by simulating a positive aggregate productivity shock. In the literature, productivity shocks are considered as one of the factors driving the current account dynamics (Bussière *et al.*, 2010). As we will observe, the magnitude and the persistence of the effects of this shock are different depending on the proportion of domestic versus foreign agents purchasing government debt. We study the two extreme cases: all debts are held by domestic agents and all debt are held by foreign agents. As it is standard in the literature, the positive aggregate productivity shock provokes a rise in output, increasing both consumption and investment. Inputs factors also increase as a consequence of the higher productivity. In the context of our model, this shock also provokes a rise in imports and, given the assumption about constant exports, a deterioration in the trade balance. Nevertheless, this positive productivity shock also produces into a rise in fiscal revenues. Given that public spending is assumed to be constant, this improvement in the government balance reduces the stock of public debts. Importantly, this additional transmission channel will affect the current account only in the case in which the public debts are held by foreign investors.

Figure 1 plots the response of the current account to a positive productivity shock. In the case in which all public debts are held by domestic agents, we observe an instantaneous deterioration in the current account, explained by the worsening of the trade balance as imports increase. Importantly, this effect is obtained subject to the assumption that exports are exogenously given. If exports would react positively to the productivity shock, then trade balance deficit would be much lower, reducing the effect of this shocks over the current account dynamics. After this initial deterioration of the current account, we observe a progressive reduction of the imbalances, until the economy returns to the steady state. In fact, several authors argue that the rise in the labor productivity in the U.S. since the mid-1990s, is one of the factors explaining the rise in the trade deficit (see Gruber and Kamin, 2007).

FIGURE 1
IMPULSE-RESPONSE OF THE CURRENT ACCOUNT TO A POSITIVE TOTAL
FACTOR PRODUCTIVITY SHOCK



NOTE. BH: All government debts are held by domestic agents. BF: All government debts are held by foreign agents.

A slightly different response is observed when all public debts are held by international investors. Again, we observe a deterioration of the current account in impact of similar magnitude, explained by the increase in imports and the worsening in the trade balance. However, the current account recovers rapidly and after some periods the response is positive, turning out the initial deficit into a surplus. This positive behavior of the current account is provoked by the change in the stock of public debt. The positive aggregate productivity shock increases fiscal revenues, and given that primary public spending is a constant, this implies a reduction in the stock of public debt. That is, we are assuming that all additional gains in fiscal revenues generated by the productivity shock are expended in reducing the stock of government debt and not used for any other type of public spending. In the case in which public debt are held by foreign agents, its change enters in the definition of the current account. This reduction in the stock of public debt held by foreign agents induces a surplus in the current account, compensating the initial deficit in the trade balance. Therefore, we obtain that, with the exception of the first periods where we found a deterioration in the current account, the effect is, on average, positive, inducing a surplus in the current account through the consolidation process of the public debt held by international investors.

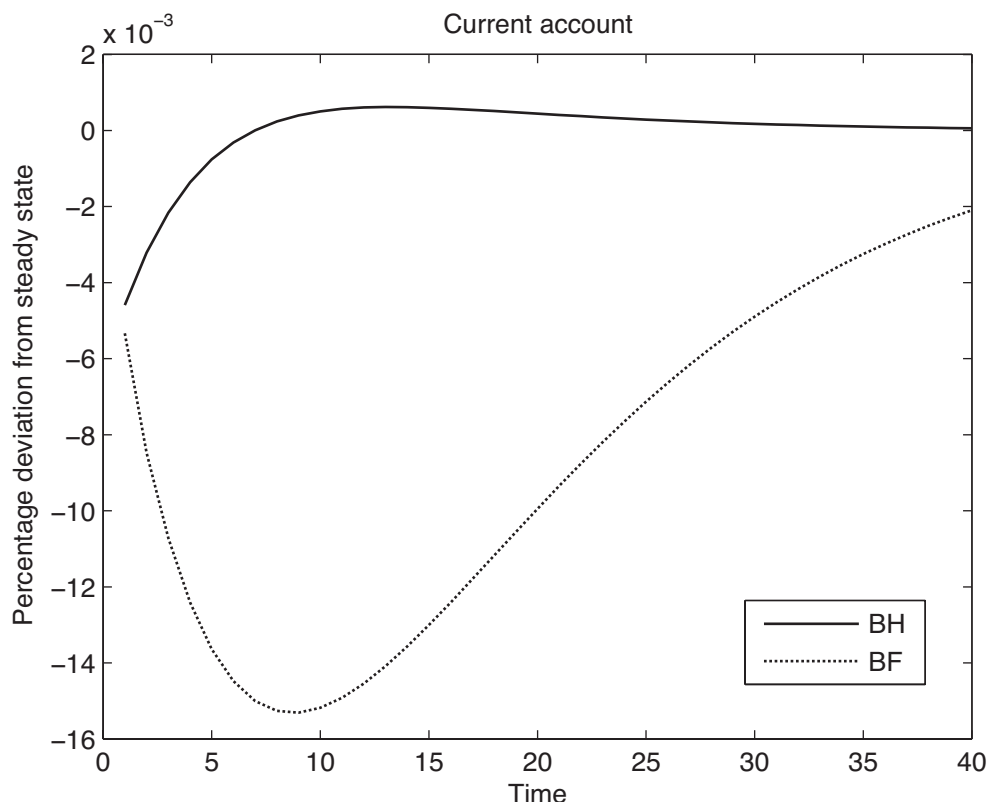
In summary, the main result we obtain is the observed different response of the current account to this productivity shock depending on the ownership of public debt. Whereas the effect is negative in the case in which public debt are held by domestic agents, the effect turns out to be positive in the case the public debt are held by foreign agents. The key idea behind this different result is how the government deficit is financed: whether through domestic savings or resorting to foreign savings.

5.2. *Government spending shock*

In this section, we will study the relationship between the budget deficit and the current account deficit given a variety of government spending shocks. In particular, we study the effects of a rise in primary government spending. This rise in primary government spending is distributed among all types of government expenditures according to the initial distribution. Again, we study the response of the current account to this shock depending on the proportion of public debts purchased by domestic versus foreign agents.

Figure 2 plots the response of the current account to a transitory government spending shock. We observe that if government debts are held by domestic agents, there is an instantaneous deterioration in the current account. The explanation is similar to that of a positive productivity shock: the rise in government spending induces a rise in consumption and a rise in imports, moving the trade balance into a deficit. The difference is that we observe a rise in domestic saving, as expected, given that agents anticipate a future budget surplus i.e., higher taxes or lower government spending. After this initial response, the effect on imports is decreasing, reducing the

FIGURE 2
IMPULSE-RESPONSE OF THE CURRENT ACCOUNT TO A TRANSITORY
INCREASE IN GOVERNMENT SPENDING



NOTE. BH: All government debts are held by domestic agents. BF: All government debts are held by foreign agents.

imbalances in both the trade balance and the current account until the steady state is reached.

When government debts are held by foreign agents the observed response of the current account to this shock is very different. The impact is a deterioration of the current account explained by the induced deficit in the trade balance. However, after this initial negative response, the current account starts a deep deterioration during some periods. This is a direct consequence of the new debt issued by the government to finance the budget deficit generates by the rise in government spending. As this budget deficit is financed by foreign saving, this provokes a further deterioration in the current account.

This result clearly indicates that the relationship between fiscal policy and the current account is conditioned by the proportion of government debt purchased by

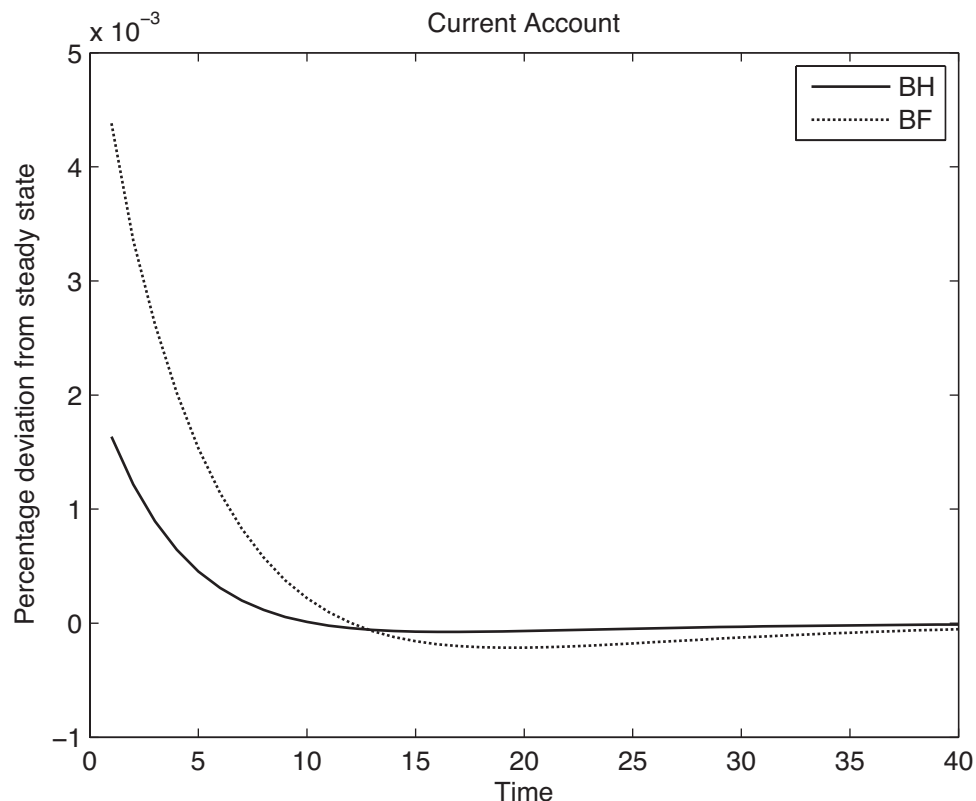
domestic versus foreign agents, or more exactly, how the budget deficit is financed. We find that the persistence of the shock is very different depending on the holding of the public debt. If debts are purchased by domestic agent, the persistence of the shock is limited to a very few periods. However, when the debts are held by foreign agents, we found that the effects of the shock on the current account is larger and long lasting. As a conclusion, the twin deficits hypothesis seems to be confirmed when foreign saving is financing government deficit. However, we found that the relationship between the current account and the budget deficit is much weaker as we increase the proportion of government debt held by domestic agents. In this context, the excess of investment over private saving reacts to the fiscal policy depending on how the budget deficit is financed. If the budget deficit is financed by foreign saving, then the excess of investment over private saving is very insensitive to changes in the budget deficit and hence, we observe a direct relationship between the budget deficit and the current account deficit. When the budget deficit is financed by domestic saving, then the fiscal policy affects to a great extent to the excess of investment over private saving, cancelling out the link with the current account.

5.3. *Tax shock*

Finally, we study the relationship between the current account and an improvement in the budget deficit by increasing taxes. In particular, we consider the effects of a transitory rise in the labor income tax rate. Government spending is assumed to be a constant, so the rise in fiscal revenues implies a budget surplus which it is used for government debt reduction. Again, we study the differences in the response of the model economy depending on the ownership of the government bonds. This rise in the labor income tax provokes a reduction in private consumption and in imports. Given that exports are assumed to be a constant, the effects on the trade balance is positive. Therefore, starting from an initial equilibrium in both the government budget and the current account, we observe simultaneously a budget surplus and a trade balance surplus. Consequently, there is a reduction in the amount of foreign bonds held by domestic agents. In the case in which government bonds are held by international investors, we observe a similar pattern for the current account dynamics, but with a larger initial response in quantitative terms. The tax shock does not only affect the trade balance through the behavior of the domestic agents, reducing imports and improving the trade balance, but it also affects the current account by the change in the government debt in the hands of foreign agents.

Figure 3 plots the impulse-response for the current account. As can be observed, the response of the current account, in impact, is positive in both scenarios. The reduction in consumption and imports induces a surplus of the trade balance. Simultaneously, the rise in taxes induces a surplus in the government budget. As expected, the positive response of the current account is larger when government debts are held by foreign agents as the budget surplus is devoted to reduce the stock

FIGURE 3
IMPULSE-RESPONSE OF THE CURRENT ACCOUNT TO A TRANSITORY RISE
IN THE LABOR INCOME TAX



NOTE. BH: All government debts are held by domestic agents. BF: All government debts are held by foreign agents.

of debts. This response of the current account confirms previous results and depends on the response of domestic saving and on the excess of investment over private saving. First, if the optimal response of domestic agents consists in increasing (reducing) saving, this will translate to an improvement (deterioration) in the current account. Second, how budget deficit is financed, using domestic saving or through foreign saving, is a key factor in determining the relationship between the current account and the fiscal policy.

6. Conclusions

The relationship between budget deficit and the current account deficit is an open question, both theoretically and empirically. Traditional absorption approach establishes a direct link between both deficits (the so-called twin deficits hypothesis). By contrast, the Ricardian equivalence hypothesis states that changes in fiscal policy are offset by changes in the consumption-saving decision and therefore no relationship between the current account and the budget deficit exists. Empirical literature has not solved this controversy, arriving to contradictory results.

This paper studied the relationship between the fiscal policy and the current account imbalances, in the context of a monetary union, where changes in both nominal and real exchange rates are absent. We show that the proportion of public debt purchased by foreign investors plays a key role in determining the relationship between fiscal policy and the current account. The paper develops a small open economy Dynamic Stochastic General Equilibrium model with three types of non-interest payment government spending. The model economy is then used to study the relationship between government budget and the current account to different shocks: a total factor productivity shock, a government spending shock and a tax shock. We found that the response of the current account to the different shocks is greatly affected by the proportion of public debt purchased by foreign agents. We obtain that the effects of different shocks on the current account dynamics are magnified as the proportion of government debt held by foreign investors increases. This means that the way how budget deficits are financed, either by using domestic savings or foreign savings, is a key element in assessing the relationship between the fiscal policy and the current account. Therefore, the twin deficits hypothesis is more likely to be confirmed when a large proportion of government debt are purchased by foreign agents.

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