Fiscal policy transmission in a non-Ricardian model of a monetary union

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We present an analytically tractable two-country New Open Economy Macroeconomics model of a currency union featuring an overlapping generations structure of the Blanchard (1985)-Yaari (1965) type. It enables us to study the transmission and spillover effects of a wider range of fiscal shocks in comparison to the standard model.

We show that, depending on the financing decision of the government, fiscal policy measures can have very different effects on key macroeconomic variables such as consumption and output. Moreover, the spillovers of national fiscal policy depend on the composition of government spending, the type of the fiscal measure and the cross-country substitutability between goods.

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1 Introduction

The formation of the European Monetary Union (EMU) has raised a notable debate on the role of fiscal policy within a currency union. The EMU membership comes at the cost of loosing monetary autonomy and flexible exchange rates between the member countries. The European Central Bank (ECB) decides on monetary policy on a supranational level, targeting an average of the inflation rates of the member countries. Thus, the ECB is ill-equipped to respond to asymmetric inflation rate developments or structural differences among the member countries which imply differences in the propagation of common shocks as well as shocks to individual member countries.

The EMU features neither a common fiscal authority with the ability to enact fiscal law on its own nor a substantial union-budget. It is well-known that the intertemporal budget constraint of the government requires that either monetary policy or the fiscal authorities have to sufficiently respond to the stock of public liabilities as to guarantee the uniqueness and existence of equlibria.

According to Leeper (1991), this type of policy authority is characterized as being passive while the remaining declared as being active and free to pursue policy objectives beyond the stabilization of the public debt stock. Awareness of this constraint has led to the introduction of the Stability and Growth Pact (SGP) which aims at limiting the member country's annual new indebtedness and thus restricting the accumulated stock of government debt.

In any case, fiscal policy remains as the only flexible tool to conduct short run stabilization policies on a national level. But national fiscal policies do not leave the remaining members of the monetary union unaffected as there are spillover effects of fiscal measures. Directly related to such considerations is the idea that fiscal policy can serve as a substitute for national monetary policy and flexible exchange rates.

The European Commission (2008) based itself on strong stabilizing effects of fiscal policy when proposing the European Economic Recovery Plan (EERP) as a response to the economic crisis of 2007. The EERP strongly encouraged the implementation of expansive fiscal measures in all member countries simultaneously to amplify the benefits of

fiscal stabilization by mutual spillovers within the EMU. Expecting that expansive fiscal measures would not only hold but reverse an upcoming recession, the OECD (2009) demonstrated a similar degree of confidence in the effectiveness of fiscal policy.

Another example for the confidence that policymakers display when it comes to the effectiveness of fiscal policy as a tool to gauge macroeconomic variables is the Macroeconomic Imbalance Procedure (MIP) of the European Commission (2012). The MIP was introduced in response to the Great Recession and monitors the development of macroeconomic variables such as the national current accounts in order to prevent the development of imbalances between member countries early on. One example for a potential source for macroeconomic risk under the MIP are prolonged current account imbalances. In case of Germany, a prolonged current account surplus. The European Commission (2014) provided an in-depth analysis along with detailed policy recommendations, such as increased public spending, to mitigate the surplus.

The national effects of fiscal policy on macroeconomic variables, such as consumption and output, are a prominent area of empirical research. The work of Ramey and Shapiro (1998), Blanchard and Perotti (2002), Mountford and Uhlig (2005, 2009) are the seminal contributions in this field with numerous studies following up. This literature is strongly focused on identifying fiscal shocks from data on the spending side of public budgets. A notable exception of this common practice is Mountford and Uhlig (2005, 2009) who identify fiscal shocks by looking at both the revenue and spending side of the government budget.

Blanchard and Perotti (2002) estimate the effects of shocks to taxes and government spending on household consumption and output. They find that fiscal expansions have positive effects on output and consumption while an increase in taxation has opposite effects.

Mountford and Uhlig (2005) identify three different fiscal policy shocks: Balanced budget changes in public spending, deficit spending and debt-financed tax cuts. They find that the responses of consumption and output depend on the type of the fiscal shock. In the aftermath of a balanced budget increase in public spending, output and consump-

tion fall. The depressing effect of the tax increase dominates the fiscal stimulus. Deficit spending stimulates output and consumption only weakly. A debt-financed tax cut has a significant positive effect on consumption and output. Mountford and Uhlig (2005) conclude the best fiscal stimulus is a debt-financed tax cut. Both of the above mentioned studies apply VAR estimation techniques to quarterly US data.

Ramey and Shapiro (1998) and Ramey (2009) identify fiscal measures by studying contemporaneous press reports and focus on war expenses in so-called Ramey-Shapiro episodes. Using annual US data, Ramey (2009) finds that increases in public demand are partially offset by a negative response of consumption. Overall, they observe a small positive response of output. This is not necessarily a contradiction to the empirical evidence from the VAR approach. Blanchard and Perotti (2002) and Mountford and Uhlig (2005) emphasize that it is the financing decision of the government that matters. The estimates of Ramey (2009) which are based on a small number of observations with different underlying financing decisions of the government support this notion. For a extensive discussion, see Perotti (2007). Overall, the empirical evidence suggests that the response of consumption and output to fiscal expansions depends on the financing decisions of the government.

In the aftermath of the Great Recession a number of studies estimated the impact of fiscal stabilization policies suggested by the EERP. Cwik and Wieland (2010) focus on the impact of an exogenous increase in public consumption which is financed by future taxation and find no support for the use of public consumption as an instrument to boost aggregate demand in standard new Keynesian models.

Coenen et al. (2012, 2013) expand the European Central Bank's New Area-Wide Model by allowing for a complex public sector. They find that increases in public spending have the potential for Keynesian multipliers on output and private consumption, provided that public and private consumption complement each other. As the EERP did not exclusively focus on such measures, its overall impact on output is not estimated to be more than one-to-one. The results of Coenen et al. (2012, 2013) provide further evidence that distinct fiscal measures lead to different multiplier effects.

Regarding spillovers of fiscal expansions among EU member states, Beetsma et al. (2006) find that fiscal expansions boost economic activity in the implementing country and have positive spillover effects on its trading partners. Thus, one should expect substantial spillovers among the members of the EMU as they are highly integrated by both, the single European market and a common currency.

Corsetti et al. (2010) evaluate fiscal expansions followed by spending reversals in a two-country model, while in 't Veld (2013) evaluate fiscal consolidations applying the QUEST-model of the European Commission. Both find evidence for positive spillovers. However, Cwik and Wieland (2011) estimate the impact of fiscal stabilization policies suggested by the EERP. They focus on the impact of an exogenous increase in public consumption which is financed by future taxation and report negligible or even negative spillover effects.

Finally, Gadatsch et al. (2015) provide a Bayesian estimation of a three-region-model where two countries form a monetary union and the remaining region represents the rest of the world. Their focus is on spending- and revenue-side measures implemented by the German government and their implied spillovers on the remaining members of the EMU as well as the rest of the world. Gadatsch et al. (2015) find that, in general, these spillovers are small and depend on the fiscal instrument chosen.

These results indicate that the precise composition of fiscal policy, i.e. the spending as well as the financing decision matter for the size and sign of the spillovers.

Beetsma and Jensen (2005), Gali and Monacelli (2008) and Ferrero (2009) are prominent examples for theoretical work on fiscal policy in a currency union. Beetsma and Jensen (2005) explore the interaction between fiscal and monetary policy in a two-country DSGE model of a monetary union. Gali and Monacelli (2008) study optimal monetary and fiscal policy in a DSGE model of a monetary union that consists of a continuum of infinitesimally small open economies. There is also Ferrero (2009)'s model which is similar to Beetsma and Jensen (2005). He studies the optimal financing decision for a given level of public spending where the choice is between distortionary taxation and public debt.

Beetsma and Jensen (2005) find considerable gains from fiscal stabilization and the co-ordination of fiscal policy, while these are small in Gali and Monacelli (2008). Both models feature infinitely-lived representative agents. Thus, the Ricardian equivalence holds which implies that debt and taxation are equivalent financing decisions of the government. Consequently, an increase of government spending financed by taxes, increases the demand for output and decreases private consumption. The overall response of output is positive.

Ferrero (2009) allows for distortionary taxation. He explores the optimal choice between debt and distortionary taxation to finance a given level of public spending. His result is that changes in the level of the public debt stock induce less disutility than variations in distortionary taxation.

Debt-financed increases in public consumption and debt-financed tax cuts are among the measures frequently taken to stimulate the economy. In particular, these policy measures were included in the EERP and suggested by the OECD (2009).

The characterizing properties of fiscal policy in standard models, which are the restriction to dissipative public consumption, fiscal policy enters as an exogenous process, the Ricardian equivalence property and, implied by that, a high variance of tax rates, are difficult to reconcile with empirical evidence. Moreover, real world policy making routinely applies not only a wider variety of fiscal measures but also assumes that the response of key macroeconomic variables depends on the chosen fiscal measure.

Taking these shortcomings into account, a lively theoretical literature has emerged that tries to move the predictions of DGE models closer to the empirical evidence. This literature mainly focuses on the failure of theoretical models to predict expansions of public consumption to crowd-in private demand and thus deliver Keynesian output multipliers. Here, the predominant theoretical approach was popularized by Gali et al. (2007), who attempts to diminish the difference between the Keynesian model and its modern successors by distorting the intertemporal optimization behavior of households. In Gali et al. (2007), a fraction of households, so-called rule-of-thumb consumers, cannot participate in intertemporal consumption-savings decisions as they have no access to capital

markets. To obtain crowding-in effects, models need to assume a large share of rule-of-thumb consumers which can hardly be confirmed by empirical evidence.

A priori it is not obvious that DGE models fail to predict crowding-in effects because of the intertemporal optimizing behavior of households. Among the model characteristics at odds with the empirical findings, there are the assumptions that public spending is restricted to purely dissipative consumption of goods and that fiscal policy is exogenous. Linnemann and Schabert (2006) show that the introduction of productive government spending in an otherwise standard new Keynesian model enables fiscal expansions to crowd-in private demand.

Corsetti et al. (2009) model an endogenous response of public consumption to the state of public finances. They find that increases in public consumption will potentially crowd-in household consumption, if they are subsequently financed, at least partially, by future decreases in public spending below trend, so-called spending reversals.

Overall, the theoretical literature related to the conduct of fiscal policy is focused on the effects of exogenous changes in public consumption. The main route taken to reconcile theory and empirical evidence is to extend standard DGE models to allow for failures of the Ricardian equivalence. However, researchers typically need to assume deviations from the paradigm of intertemporally optimizing agents, which cannot be confirmed empirically either. Thus, the predominant approach to move the predictions of standard DGE models closer to empirical findings, conflicts with another strand of empirical research.

We propose a two-country NOEM model of a currency union featuring overlapping generations (OLG) of the Blanchard (1985)-Yaari (1965) type. This enables us to study a wider range of fiscal measures including different ways of financing a given level of public spending. Our model features failures of the Ricardian equivalence. Debt and taxation are not equivalent policy instruments.

We assume that the government chooses a certain level of public spending and decides on how to finance it. Depending on the financing decision, we are interested in the effects of fiscal policy on national consumption and output as well as in the spillovers.

We abstract from distortions other than failures of the Ricardian equivalence.

Our main objective is to explore the transmission of various fiscal measures in a two-country model of a monetary union. We show that using debt as a policy instrument can be welfare improving and consumption as well as output stimulating at the same time, even if alternative financing decisions are non-distortionary.

Moreover, Gali and Monacelli (2008) emphasize the empirical evidence for home bias in public spending. In fact, the assumption of complete home bias in public spending is common to all theoretical models mentioned above. We address the issue by allowing for government spending with and without home bias and explore the transmission of four different fiscal measures. These are temporary as well as permanent balanced budget changes in public spending, deficit spending and a debt-financed tax cut in the domestic country.

We find that the response of household consumption and output in the domestic country and the spillovers on the foreign country depend on the precise type of the fiscal shock and the composition of government spending.

A balanced budget increase in public consumption always leads to a decrease in domestic consumption and an increase in home production, in the short and long run. If the government spends exclusively on domestic goods, the spillover will be negative for all time horizons. If there is no home bias in public spending, the spillover is reversed.

Deficit spending has similar effects. However, these are weaker and depend on the assumptions we make regarding the financing decision of the implementing government. In particular, the intertemporal dispersion of the spending and financing decision determine the effects of deficit-spending on household consumption and utility. This is true for all debt-financed fiscal measures.

Finally, a debt-financed tax cut implies an increase in consumption at home and abroad in the short run. Output increases in both countries. In the long run, domestic households have to repay the accumulated public debt and suffer from a decrease in net foreign assets. Foreign households benefit from the increased real income while the opposite is true for the home country in the long run.

The welfare effects of fiscal policy can also be very different. While balanced budget changes in government spending always imply welfare losses, which is not necessarily true for debt-financed fiscal expansions. Thus, we conclude that the proposed modelling strategy allows us to bring theoretical models closer to empirical evidence.

The paper is organized as follows. Section 2 sets out a two-country Blanchard (1985)-Yaari (1965) OLG of a currency union. In section 3 we analyze the positive aspects of various fiscal policy measures including policy transmission and spillover effects. We discuss the normative aspects of fiscal actions in section 4. Finally, section 5 presents the conclusions.

2 The Model

We develop a dynamic, two-country, general equilibrium model of a monetary union with sticky prices and monopolistic competition in the goods market. Households are introduced in the form of overlapping generations following the discrete-time version of the Blanchard (1985)-Yaari (1965) OLG by Frenkel et al. (1996).

We identify one country as the domestic country H, while the other country is referred to as the foreign country F. In the domestic country, a cohort of $n \in [0, 1]$ households is born in each period whereas $(1 - n)$ agents are born abroad. All agents face a constant probability of death $(1 - \gamma)$ in each period. Therefore, the population in the domestic country is $\sum_{a=0}^{\infty} \gamma^a n = \frac{n}{1-\gamma}$ while $\frac{1-n}{1-\gamma}$ is the population abroad. This implies a constant world population that is normalized to one.

Households have no bequest motive. Finite lifespans imply that an intertemporal redistribution of wealth potentially changes the expected permanent income in the remaining lifespan of an individual and thus, leads to failures of the Ricardian equivalence.

2.1 Households

Domestic households share identical preferences and maximize their utility over consumption C, real balances $\frac{M}{P}$ and leisure $(1 - L)$. We restrict our attention to the

domestic country with the notion that similar expressions hold for the foreign country. The certainty equivalent utility function of an individual domestic household reads

$$U_t = \sum_{s=t}^{\infty} (\gamma\beta)^{s-t} \left[\ln C_{a+s-t,s} + \chi \ln \left(\frac{M_{a+s-t,s}}{P_s} \right) + \psi \ln \left(1 - L_{a+s-t,s} \right) \right] \tag{1}$$

where $\beta, \chi, \psi > 0$ and $\gamma \in [0,1]$ is the probability to survive until the next period. Preferences are homothetic and additively separable over consumption, real balances and leisure. The household's endowment of time in each period is normalized to one, therefore $(1-L), L \in [0,1]$ denotes leisure. The parameter $\psi > 0$ measures the utility of time spent out of work.

The individual real flow budget constraint of a domestic household of age a reads

$$F_{a,t+1} + \frac{M_{a,t}}{P_t} + C_{a,t} = \frac{1}{\gamma} \left[\frac{M_{a-1,t-1}}{P_t} + (1+r_t) F_{a-1,t} \right] + \frac{W_{a,t}}{P_t} L_{a,t} + \frac{\Pi_t}{P_t} - T_t \tag{2}$$

where W is the nominal wage, F denotes the agents total asset holdings, T is a lump-sum tax and r_t the real interest rate known at $t-1$ and paid on bond holdings between $t-1$ and t. Households owe a portfolio of bonds denominated in units of the composite consumption good and issued either by the national government or households abroad. $\frac{\Pi_t}{P_t} = \pi_t(h)(1-\gamma)$ is the per-capita share of the profit of domestic producers received by an domestic individual. We assume that households receive an equal share of national profits independent of age[1].

Productivity and consumption preferences are assumed to be independent of age. This allows us to calculate per-capita variables by aggregating across ages and then dividing by population size. Individual and per-capita variables coincide in the model. Variables without age a index denote per-capita values. The domestic households' optimizing behavior yields the consumption function

$$C_t = \frac{1 - \gamma\beta}{1 + \chi + \psi} TW_t \tag{3}$$

where the coefficient $\frac{1-\gamma\beta}{1+\chi+\psi}$ is the agent's marginal propensity to consume out of total wealth. Domestic per-capita demand for real balances is given by

$$\frac{M_t}{P_t} = \chi \frac{1 + i_{t+1}}{i_{t+1}} C_t \tag{4}$$

where i denotes the nominal interest rate which is symmetric across countries and equal to the real interest rate, plus expected inflation,

$$L_t = 1 - \kappa \frac{P_t}{W_t} C_t \tag{5}$$

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[1]A representative domestic producer earns $\pi_t(h)$. Aggregating across domestic producers we obtain $n\pi_t(h)$, dividing by the population size $\frac{n}{1-\gamma}$ yields $\pi_t(h)(1-\gamma)$ the share of domestic profits received by any domestic agent independently of age.

is the labor-leisure trade-off equation and

$$C_{t+1} = \left(\frac{1-\gamma\beta}{1+\chi+\psi}\right)(1-\gamma)H_{t+1} + (1+r_{t+1})\gamma\beta C_t \tag{6}$$

the *Euler equation* for the optimal intertemporal allocation of consumption. We define

$$H_t = \sum_{s=t}^{\infty} \alpha_{s,t}\gamma^{s-t}\left[\frac{W_s}{P_s} + \frac{\Pi_s}{P_s} - \tau_s\right] \quad \text{with} \quad \alpha_{s,t} = \begin{cases} \alpha_{s,t} = 1 & \text{if} \quad s = t \\ \alpha_{s,t} = \frac{1}{(1+r_{t+1})\cdot\ldots\cdot(1+r_{t+s})} & \text{if} \quad s > t \end{cases} \tag{7}$$

as the human wealth, α is the present value factor and

$$TW_t = \frac{1}{\gamma}\left(\frac{1}{1+i_t}\frac{M_{t-1}}{P_{t-1}} + F_t\right)(1+r_t) + H_t \tag{8}$$

the total wealth in per-capita terms. Human wealth is the present discounted value of gross earnings net of taxes over the expected lifespan of households. Total wealth is the sum of combined financial and human wealth.

We assume that each country in the world economy specializes in the production of one type of good. For each type there exists a continuum of brands. The consumption basket of an domestic individual of age a reads

$$C_{a,t} = \left[n^{\frac{1}{\theta}}C_{H,a,t}^{\frac{\theta-1}{\theta}} + (1-n)^{\frac{1}{\theta}}C_{F,a,t}^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}} \tag{9}$$

where

$$C_{H,a,t} = \left(n^{-\frac{1}{\phi}}\int_0^n c_{a,t}(h)^{\frac{\phi-1}{\phi}}dh\right)^{\frac{\phi}{\phi-1}} \qquad C_{F,a,t} = \left((1-n)^{-\frac{1}{\phi}}\int_n^1 c_{a,t}(f)^{\frac{\phi-1}{\phi}}df\right)^{\frac{\phi}{\phi-1}} \tag{10}$$

Following Tille (2001), we refer to θ as the cross-country substitutability. $\phi > 1, \theta < \phi$ is the within-country substitutability which is assumed to be symmetric across countries. The corresponding consumer price index is defined as the minimum expenditure required to buy one unit of the composite consumption good which is given by

$$P_t = P_t^* = \left[nP_{H,t}^{1-\theta} + (1-n)P_{F,t}^{1-\theta}\right]^{\frac{1}{1-\theta}} \tag{11}$$

where

$$P_{H,t} \equiv \left(\frac{1}{n}\int_0^n p_t(h)^{1-\phi}dh\right)^{\frac{1}{1-\phi}} \qquad P_{F,t} \equiv \left(\frac{1}{1-n}\int_n^1 p_t(f)^{1-\phi}df\right)^{\frac{1}{1-\phi}} \tag{12}$$

We assume no impediments to trade. Hence, the law of one price $p(h) = p^*(h)$ holds for every single good. Home and foreign agents are assumed to have symmetric preferences which are invariant across ages. Throughout, we assume that $n = 0.5$. Thus, the law of one price, together with the consumption-based CPI implies that $P = P^*$ holds in every

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period because the two countries in the world economy share a common currency. An asterisk denotes a foreign country's variable.

The terms of trade (TOT) are defined as the ratio of the price of a domestically produced consumption bundle and a bundle of goods produced abroad.

$$TOT = \frac{P_H}{P_F} \tag{13}$$

From the domestic household's point of view, an increase in the TOT is an improvement. Each individual domestic household maximizes its utility from consumption given its budget in any period of time. This optimizing behavior results in the following individual demand functions for brands h, f

$$c_{a,t}(h) = \left(\frac{p_t(h)}{P_{H,t}}\right)^{-\phi} \left(\frac{P_{H,t}}{P_t}\right)^{-\theta} C_{a,t} \qquad c_{a,t}(f) = \left(\frac{p_t(f)}{P_{F,t}}\right)^{-\phi} \left(\frac{P_{F,t}}{P_t}\right)^{-\theta} C_{a,t} \tag{14}$$

2.2 The monetary and fiscal authorities

Our focus is on fiscal policy. To facilitate the analysis, we assume that monetary policy is delegated to a common monetary authority. We abstract from monetary policy and assume that the common central bank is only obliged to keep the world's money stock constant.

National governments act as individual entities. They decide on the level of public spending and how to finance it. Due to failures of the Ricardian equivalence in the model, debt and taxation are not equivalent instruments. Government spending on goods and debt services can be financed either by lump-sum taxation or by issuing new debt according to the period budget identity

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

and the usual no-Ponzi game condition. D denotes the real stock of public debt. We assume that the government's real consumption index takes the same form as that of households

$$G_t = \left[n^{\frac{1}{\theta}} G_{H,t}^{\frac{\theta-1}{\theta}} + (1-n)^{\frac{1}{\theta}} G_{F,t}^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}} \tag{16}$$

where

$$G_{H,t} = \left(n^{-\frac{1}{\phi}} \int_0^n g_t(h)^{\frac{\phi-1}{\phi}} dh \right)^{\frac{\phi}{\phi-1}} \qquad G_{F,t} = \left((1-n)^{-\frac{1}{\phi}} \int_n^1 g_t(f)^{\frac{\phi-1}{\phi}} df \right)^{\frac{\phi}{\phi-1}} \tag{17}$$

The latter assumption implies that there is no home bias in government spending on goods. However, Gali and Monacelli (2008) emphasize the empirical evidence for the home bias in public spending. In fact, the assumption of complete home bias in government consumption is predominant in the literature. Beetsma and Jensen (2005), Gali and Monacelli (2008) and Ferrero (2009) offer examples for such a practice. This modeling decision mirrors the validity of the Ricardian equivalence. When it comes to affecting the aggregate demand at national level, fiscal policy will be a less powerful tool, if it falls equally on all goods produced in the world economy. Moreover, if there is no home bias in Ricardian models, there will be no scope for fiscal policy interaction between the members of a monetary union.

Thus, to facilitate a comparison of our results with the existing literature, we modify our model to allow for complete home bias in government spending. All assumptions are maintained except the real consumption indices of the home and foreign governments which take the following form

$$G_{hb,H,t} = \left(n^{-\frac{1}{\phi}} \int_0^n g_{hb,t}(h)^{\frac{\phi-1}{\phi}} dh \right)^{\frac{\phi}{\phi-1}} \qquad G^*_{hb,F,t} = \left((1-n)^{-\frac{1}{\phi}} \int_n^1 g^*_{hb,t}(f)^{\frac{\phi-1}{\phi}} df \right)^{\frac{\phi}{\phi-1}} \qquad (18)$$

consequently the domestic period budget identity becomes

$$\frac{P_{H,t}}{P_t} G_{hb,H,t} + (1 + r_t) D_t = T_t + D_{t+1} \qquad (19)$$

2.3 The current account

The current account equation is derived from the government's budget constraint together with the budget constraint of the private sector. The resulting current account equation in the basic model reads

$$V_{t+1} - V_t = \frac{\phi - 1}{\phi} \frac{p_t(h)}{P_t} L_t - C_t - G_t + \frac{\Pi_t}{P_t} + r_t V_t \qquad (20)$$

where $V = F - D$ denotes the net foreign assets' position in a given period. If we assume complete home bias in government consumption, the domestic current account becomes

$$V_{t+1} - V_t = \frac{\phi - 1}{\phi} \frac{p_t(h)}{P_t} L_t - C_t - \frac{P_{H,t}}{P_t} G_{hb,H,t} + \frac{\Pi_t}{P_t} + r_t V_t \qquad (21)$$

In the aggregate, we assume that $nV + (1 - n) V^* = 0$ holds for both cases in any period of time.

2.4 Technology and production

There is a measure one of infinitely lived firms in the world economy of which $h \in [0, n]$ reside in the home country and $f \in (n, 1]$ abroad. A representative domestic producer h takes the demand for his production as given. We assume a linear production technology $Y_t(h) = L_t$. Firms operate under monopolistic competition in the goods' market while there is perfect competition in the labor market. The demand curve facing each domestic producer is

$$y_t^d(h) = \left(\frac{p_t(h)}{P_{H,t}}\right)^{-\theta} \left(\frac{P_{H,t}}{P_t}\right)^{-\rho} [C_t^w + G_t^w] \tag{22}$$

where $C_t^w = nC_t + (1-n)C_t^*$ and $G_t^w = nG_t + (1-n)G_t^*$ are the global private and public demand for consumption goods. If the government spends exclusively on national goods the demand curve facing the typical domestic producer will become

$$y_t^d(h) = \left(\frac{p_t(h)}{P_{H,t}}\right)^{-\phi} \left[\left(\frac{P_{H,t}}{P_t}\right)^{-\theta} C_t^w + nG_{hb,H,t}\right] \tag{23}$$

A typical domestic producer sets its price $p_t(h)$ to maximize the stream of revenues at any t which yields the following mark-up pricing rule

$$p_t(h) = \frac{\theta}{\theta - 1} W_t \tag{24}$$

In a symmetric equilibrium all national producers choose the same price to maximize the stream of revenues at any t.

2.5 The initial steady state

The model has no closed-form solution. The solution technique is to log-linearize around an initial steady state and then solve the resulting system of equations in relative terms. For a detailed discussion of this approach, see Obstfeld and Rogoff (1995, 1996). We assume a fully symmetric initial steady state where the net foreign assets $V_0 = V_0^* = 0$, government spending $G_0 = G_0^* = 0$ and the stock of government debt $D_0 = D_0^* = 0$. Prices are set symmetricly in each country and across borders $P_{H,0} = P_{F,0}$, supply equals demand on the world's goods market.

Fiscal policy enters the model as an exogenous shock. The variety of fiscal measures includes changes in the level of government spending, debt and the levied lump-sum

taxation.

We follow the timing assumptions of Obstfeld and Rogoff (1995, 1996). Prices are pre-set and fixed for one period. The model's response to an exogenous shock spans over three periods. In the initial steady state (period 0), no shock has occurred and prices are set for the subsequent period. In the short run (period 1), prices are fixed and a shock hits the economy, whereby all other variables are allowed to adjust. From period 2 onwards, in the model's long run, prices adjust and a new steady state is reached. The model will remain in equilibrium, provided that no additional shocks occur.

2.6 The log-linearized model equations

The steady state of the model is fully characterized by the log linearized consumption-based CPI, the demand schedules for domestic/foreign products, the labor-leisure trade-off, Euler equations, human wealth, demand for real balances, government budget constraints and the current account equations for the home and foreign country. Throughout, lower case letters denote the log-linear approximation of a variable. $R_0 = 1 + r_0$ is the real interest rate in the initial steady state.

$$p_t = p_t^* = np_{H,t} + (1-n)p_{F,t} \tag{25}$$

$$l_t = -\psi\frac{\phi}{\phi-1}\left(c_t + p_t - p_{H,t}\right) \qquad l_t^* = -\psi\frac{\phi}{\phi-1}\left(c_t^* + p_t - p_{F,t}\right) \tag{26}$$

$$
\begin{aligned}
c_{t+1} &= \frac{1-\gamma\beta}{1+\chi+\psi}(1-\gamma)(1+\psi)\left(\frac{R_0}{R_0-\gamma}\right)h_{t+1} + \gamma\beta R_0 c_t + \gamma\beta(R_0-1)r_{t+1} \\
c_{t+1}^* &= \frac{1-\gamma\beta}{1+\chi+\psi}(1-\gamma)(1+\psi)\left(\frac{R_0}{R_0-\gamma}\right)h_{t+1}^* + \gamma\beta R_0 c_t^* + \gamma\beta(R_0-1)r_{t+1}
\end{aligned} \tag{27}
$$

$$
\begin{aligned}
h_{t+1} &= -(p_{t+1} - p_{H,t+1}) + \frac{1}{\phi(1+\psi)}y_{t+1} - \frac{\gamma}{R_0-\gamma}R_{t+1} - \frac{1}{1+\psi}t_{t+1} \\
h_{t+1}^* &= -(p_{t+1} - p_{F,t+1}) + \frac{1}{\phi(1+\psi)}y_{t+1}^* - \frac{\gamma}{R_0-\gamma}R_{t+1} - \frac{1}{1+\psi}t_{t+1}^*
\end{aligned} \tag{28}
$$

$$m_t - p_t = c_t - \frac{r_{t+1}}{R_0} - \frac{p_{t+1} - p_t}{R_0 - 1} \qquad m_t^* - p_t^* = c_t^* - \frac{r_{t+1}}{R_0} - \frac{p_{t+1} - p_t}{R_0 - 1} \tag{29}$$

$$g_t = t_t + d_{t+1} - R_0 d_t \qquad g_t^* = t_t^* + d_{t+1}^* - R_0 d_t^* \tag{30}$$

$$y_t = \theta\left(p_t - p_{H,t}\right) + c_t^w + g_t^w \qquad y_t^* = \theta\left(p_t - p_{F,t}\right) + c_t^w + g_t^w \tag{31}$$

15

$$v_{t+1} - v_t = (R_0 - 1)v_t - g_t + y_t + p_{H,t} - p_t - c_t$$

$$v_{t+1}^* - v_t^* = (R_0 - 1)v_t^* - g_t^* + y_t^* + p_{H,t} - p_t - c_t^* \tag{32}$$

where $nv + (1-n)v^* = 0$. To analyze the transmission of fiscal policy under complete home bias, here again we use the system (25)-(30). However, the log linearized demand schedules and the current account equations are altered by the assumption of complete home bias in government spending and presented below.

$$y_t = \theta(p_t - p_{H,t}) + c_t^w + n g_{hb,H,t} \qquad\qquad y_t^* = \theta(p_t - p_{F,t}) + c_t^w + (1-n)g_{hb,F,t}^* \tag{33}$$

$$v_{t+1} - v_t = (R_0 - 1)v_t - g_{hb,H,t} + y_t + p_{H,t} - p_t - c_t$$

$$v_{t+1}^* - v_t^* = (R_0 - 1)v_t^* - g_{hb,F,t}^* + y_t^* + p_{H,t} - p_t - c_t^* \tag{34}$$

3 Positive analysis

The log-linearized system of equations (25)-(34) given above fully characterizes the steady state of the basic model, respectively the extension of the model to the case of complete home bias in government spending. We solve the model in relative terms following Obstfeld and Rogoff (1995, 1996). Applying the timing assumptions x_0 denotes a variable in the initial steady state while the short run value of a variable carries no index and $\bar{x}$ refers to the long run value of a variable. The solution of the model provides the endogenous variables as functions of exogenous variables in relative terms. We solve for the levels of home and foreign variables by utilizing Aoki (1981)'s formula.

Aoki (1981)'s formulas decompose the effect of a policy shock in the effect on the global variable and a relative effect whose weight depends on the size of the countries. This allows us to consider changes in the levels of endogenous variables as consumption or output without solving explicitly for the reduced forms. And thus, a discussion of the effects of national fiscal policy changes on the levels of domestic variables and the spillover on foreign variables.

Finally, we can show that the long run levels of world consumption and output are not affected by the accumulated stocks of public debt

$$\bar{c}^w = -\frac{\phi - 1}{(\psi + 1)\phi - 1}\bar{g}^w \qquad\qquad \bar{y}^w = \frac{\psi\phi}{(\psi + 1)\phi - 1}\bar{g}^w \tag{35}$$

but are functions of public spending decisions in both, the home country and abroad. This is also true under the assumption of complete home bias in government spending

$$\bar{c}^w = -\frac{\phi - 1}{(\psi + 1)\phi - 1}\left(n^2\bar{g}_H + (1-n)^2\bar{g}_F^*\right) \qquad \bar{y}^w = \frac{\psi\phi}{(\psi + 1)\phi - 1}\left(n^2\bar{g}_H + (1-n)^2\bar{g}_F^*\right) \tag{36}$$

We explore the international transmission of fiscal policy shocks by conducting a number of policy experiments that involve different ways of financing a given level of government expenditures. Furthermore, we undertake a comparison of temporary versus permanent changes in public spending. We analyze a debt-financed tax cut, deficit spending and a temporary or permanent balanced budget increase in domestic government spending. Moreover, we explore the spillover effects of fiscal measures within a monetary union.

3.1 Balanced-budget changes in government spending

Consider a permanent increase in domestic public consumption $g_0 < g = \bar{g}$ by one percent measured in terms of domestic output in the initial steady state. The fiscal expansion is financed by an equal increase in taxation $t = \bar{t} > t_0$. Following the literature for now, we assume complete home bias in government spending.

Domestic households react by decreasing their demand for consumption goods. Private consumption demand (3) is a function of current and future total wealth. A permanent increase in taxation reduces the household's disposable income over all time horizons. We label this the *direct wealth effects* of fiscal policy.

In the short run, the labor-leisure trade off does not bind and output is demand determined. Domestic households benefit from the fiscal expansion by increased dividend payments and labor income. We refer to this as the *indirect wealth effect* of fiscal policy. Overall, the direct wealth effect dominates. Domestic households reduce their demand for home and foreign goods.

Domestic output is increased one-to-one by public spending. Consumption demand by domestic households is decreased, but less than the increase in taxation. This is partly explained by household consumption smoothing behavior and partly because the increase in taxation is offset by the indirect wealth effects in the short run.

The assumption of complete home bias in government spending redistributes demand in favor of domestic producers. The demand for foreign output is decreased as compared to the initial steady state. Foreign households receive lower dividend payments and labor income and reduce their demand for consumption goods.

The relative solutions for consumption, output and the current account in the short run are given by

$$
\begin{aligned}
c - c^* = {} & \frac{\gamma_{EU}}{\gamma\beta\omega + \gamma_{cc}}(\bar{d} - \bar{d}^*) - \frac{\gamma_{cc}}{\gamma\beta\omega - \gamma_{cc}}\left[(1-n)g_H - ng_F^*\right] \\
& - \frac{\gamma_{cc}}{\gamma\beta R_0 + \gamma_{cc}(R_0 - 1)}\left[(1 - n\gamma_{gg})\,\bar{g}_{hb,H} - (1 - (1-n)\gamma_{gg})\,\bar{g}_{hb,F}^*\right]
\end{aligned}
\tag{37}
$$

$$y - y^* = n g_{hb,H} - (1-n) g^*_{hb,F} \tag{38}$$

$$\bar{v} = -(1-n) \left[\begin{array}{l} \dfrac{\gamma_{EU}}{\gamma_{cc} + \gamma\beta\omega}(\bar{d} - \bar{d}^*) - \left[\dfrac{\gamma_{cc}}{\gamma\beta\omega + \gamma_{cc}} - 1 \right] \left[(1-n)g_H - n g^*_F \right] \\ + \dfrac{\gamma_{cc}}{\gamma\beta R_0 + \gamma_{cc}(R_0 - 1)} \left[(1 - n\gamma_{gg})\bar{g}_H - (1 - (1-n)\gamma_{gg})\bar{g}^*_F \right] \end{array} \right] \tag{39}$$

where $\gamma_{EU} = \frac{1-\gamma\beta}{1+\chi+\kappa}(1-\gamma)\frac{R_0}{R_0-1}$, $\omega = \frac{R_0}{R_0-1}$, $\gamma_{gg} = \left[\frac{1+\psi\Phi}{\theta+\psi\Phi} - \frac{\gamma_{EU}}{\gamma_{cc}}\left(\frac{\Psi}{\theta+\psi\Phi} + \frac{1}{\phi} \right) \right]$, $\gamma_{cc} = \frac{\rho + \kappa\frac{\theta}{\theta-1}\left(1 - \gamma_{EU}\left(\kappa + 1 - \frac{\rho}{\theta}\right)\right)}{\rho\left(1 + \kappa\frac{\theta}{\theta-1}\right)}$ and $\bar{d} = \frac{1}{R_0-1}\bar{t}$.

The marginal response of a relative variable to exogenous shocks is derived by taking the first order conditions and adding the partial effects. To provide some intuition, we illustrate our policy experiments with numerical examples[2]. Fig. 1 shows the marginal response of short run relative consumption, the current account as well as relative consumption, output and the terms of trade in the long run to a permanent balanced-budget increase in public spending as functions of the cross-country substitutability.

If government spending is biased towards national products, a permanent balanced-budget increase will induce two asymmetries: Firstly, the composition of public spending differs from that of household demand and determines the indirect wealth effects. Secondly, the direct wealth effects due to changes in taxation. The tax burden falls exclusively on domestic households. The response of relative consumption is negative in the short run. As public spending falls exclusively on domestic production, the response of relative output is strictly positive. The current account effect of fiscal policy depends on the household income in the long run. Households smooth consumption over time.

A well-known feature of two-country general equilibrium models is the so-called *expenditure switching*. It reflects the intratemporal optimizing behavior of households in demand for home and foreign output. Households maximize their consumption in each period of time. The allocation of demand between home and foreign products depends on their relative prices. Domestic households will substitute foreign for domestic goods, if the TOT improve. However, in a MU under the given timing assumptions, the TOT are fixed in the short run.

Households anticipate the long run effects of fiscal measures and adjust their behavior. The response of relative consumption and the current account are functions of the survival probability γ and the cross-country substitutability. We follow Tille (2001) and assume $\theta < \phi$. The elasticity of substitution between home and foreign goods is smaller

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[2]The numerical examples given in figure 1-4 are based on the following parametrization: $\beta = 0.99$, $\psi = 1$, $\chi = 0.1$, $\phi = 6$, $\gamma = 0.7$ and $n = 0.5$. We vary the cross-country substitutability $\theta \in [0.1, 6]$.

than within groups of national brands. A wide range of assumptions to the cross- and within-country elasticity of substitution can be found in the literature. Empirically, the estimates of the cross-country substitutability vary between $\theta \in [0.2, 6]$, for a recent discussion, see Corsetti et al. (2008).

In a series of papers, Corsetti and Pesenti (2001, 2005) as well as Corsetti (2006) show that in a Ricardian two-country model with flexible exchange rates, the assumption of $\theta = 1 < \phi$ implies that all adjustments to exogenous shocks is determined by changes in the TOT. This finding is very robust. It holds under monetary and fiscal shocks and is also true in our model for $\gamma = 1$.

A permanent increase of domestic government spending implies that the domestic government absorbs a larger fraction of domestic output as compared to the initial steady state. The supply of domestic goods at the world market is decreased and the overall production in the home country as well as on the global level is increased. Thus, the price of domestic output at the world market is increased in the long run and the TOT improve.

By exploiting the relative price improvement in the long run, domestic households have the opportunity to obtain more foreign output per unit of domestic production. However, the permanent direct wealth effect diminishes the level of real income of domestic households. They have to work more and consume less to pay the higher tax rate.

In the long run, the labor-leisure trade off binds. Households maximize their consumption of goods and leisure. They substitute foreign for domestic goods as to enjoy more leisure. The described mechanism implies that foreign goods are substitutes for domestic output in the consumption basket of the domestic household. Thus, the cross-country substitutability determines the scope for expenditure switching.

In general, households will exploit improvements in the TOT until they have reached the point where the utility loss induced by deviations from the initial steady state consumption basket equals the utility gains from the corresponding increase in leisure.

Following Tille (2001), we differentiate two cases. Home and foreign goods are poor substitutes ($\theta < 1$ if $\gamma = 1$) and home and foreign goods are close substitutes ($\theta > 1$ if $\gamma = 1$). For the Corsetti-Pesenti threshold, $\theta = 1, \gamma = 1$, the current account is balanced and all adjustment is done by changes in the TOT.

If home and foreign goods are poor substitutes, domestic households cannot exploit improvements of the TOT. The disutility induced by deviations from the preferred consumption basket exceeds the utility derived from additional leisure. Thus, fixed TOT imply that domestic households are wealthier in the short run than in the long run. As

households adjust their behavior to the new steady state, the domestic country runs a current account surplus.

If home and foreign goods are close substitutes, households will exploit the improved TOT in the long run. Expenditure switching in the long run implies a rising demand for foreign goods. In such cases, fixed TOT in the short run imply that the income of domestic households is lower than in the new steady state. The overall result is that the home country runs a current account deficit. We conclude that the response of relative consumption in the short run depends quantitatively, but not qualitatively on the value of the cross-country substitutability.

The domestic country runs a current account deficit, if home and foreign goods are close substitutes, and a surplus, if home and foreign output are poor substitutes. Magnitude and sign of the current account response are a function of the cross-country substitutability. The threshold for a balanced current account is a function of the probability to survive which governs the rate of time preference.

In the long run, domestic households always work more and consume less in order to finance the increased tax burden which has to be paid exclusively by them. Furthermore, they have to settle imbalances of the current account.

We begin the discussion of the long run effects with the solutions for relative consumption, output and the TOT in the long run

$$\bar{c} - \bar{c}^* = \frac{\psi\Phi + \theta}{\theta(1 + \psi\Phi)} \left[\frac{R_0 - 1}{1 - n} \bar{v} + [[n\gamma_{cchb} - 1] \bar{g}_H - [(1 - n)\gamma_{cchb} - 1] \bar{g}_F^*] \right] \tag{40}$$

$$\bar{y} - \bar{y}^* = -\frac{\psi\Phi}{\psi\Phi - 1} \left[\left(\frac{R_0 - 1}{1 - n} \right) \bar{v} - (\bar{g}_H - \bar{g}_F^*) \right] \tag{41}$$

$$\bar{tot} = \frac{\psi\Phi}{\theta(1 + \psi\Phi)} \left[\left(\frac{R_0 - 1}{1 - n} \right) \bar{v} + ([1 - n\gamma_{totlr}] \bar{g}_H - [1 - (1 - n)\gamma_{totlr}] \bar{g}_F^*) \right] \tag{42}$$

Because of the direct wealth effect, the response of relative consumption is negative and that of relative output positive. Both are functions of the cross-country substitutability and the short run current account response. However, the direct wealth effect dominates all other effects and determines the outcome of the model in the long run. In the standard model with Ricardian consumers, there is no strategic interaction of fiscal policy, if there is not at least some home bias in government spending. This is no longer true, if we assume failures of the Ricardian equivalence.

Suppose a permanent balanced-budget increase in domestic government spending under the assumption that public demand aggregates in the same way as household demand

does. The government levies taxes to finance the permanent increase in public spending. The tax burden falls exclusively on domestic households and induces a permanent negative direct wealth effect.

A permanent fiscal expansion translates in an increased demand for home and foreign goods. In the short run, output is demand-determined, thus world production increases. Home and foreign households benefit from a positive indirect wealth effect. Thus, domestic households are worse off than in the case of complete home bias in government spending. While the increased tax burden falls exclusively on them, they have to share the benefits with households abroad. The decrease in domestic household income over all time horizons is more pronounced. Consumption demand of domestic households is lower as compared to the initial steady state. Foreign household increase their demand for consumption goods and leisure because their disposable income increases in the short run.

Public and private demand aggregate in the same way. Thus, there is no response of relative output in the short run. The relative solutions for consumption, output and the current account in the short run are given by

$$c - c^* = \frac{\gamma_{EU}}{\gamma_{cc} + \gamma\beta\omega} \left(\bar{d} - \bar{d}^*\right) - \frac{\gamma_{cc}}{\gamma_{cc}(R_0 - 1) + \gamma\beta R_0} \left[(R_0 - 1)(g - g^*) + (\bar{g} - \bar{g}^*)\right] \tag{43}$$

$$y - y^* = 0 \tag{44}$$

$$\bar{v} = -(1-n) \left[\frac{\gamma_{EU}}{\gamma_{cc} + \gamma\beta\omega}(\bar{d} - \bar{d}^*) + \frac{\gamma\beta\omega}{\gamma_{cc} + \gamma\beta\omega}(g - g^*) - \frac{\gamma_{cc}}{\gamma_{cc}(R_0 - 1) + \gamma\beta R_0}(\bar{g} - \bar{g}^*) \right] \tag{45}$$

Fig. 1 gives the marginal response of short run relative consumption, the current account as well as the relative consumption, output and the TOT in the long run.

If government spending falls on domestic and foreign goods, a balanced-budget increase withdraws resources from domestic households. Domestic households share the benefits of this policy with foreign households. The responses of relative consumption and the current account have the same sign as under the assumption of complete home bias, but are more pronounced. This is true in the short as well as in the long run.

We conclude the discussion of a permanent balanced budget increase with the presentation of the relative solutions for consumption, output and the terms of trade in the long run

$$\bar{c} - \bar{c}^* = \frac{\psi\Phi + \theta}{\theta(1 + \psi\Phi)} \left(\frac{R_0 - 1}{1 - n}\right) \bar{v} - \frac{\psi\Phi + \theta}{\theta(1 + \psi\Phi)}(\bar{g} - \bar{g}^*) \tag{46}$$
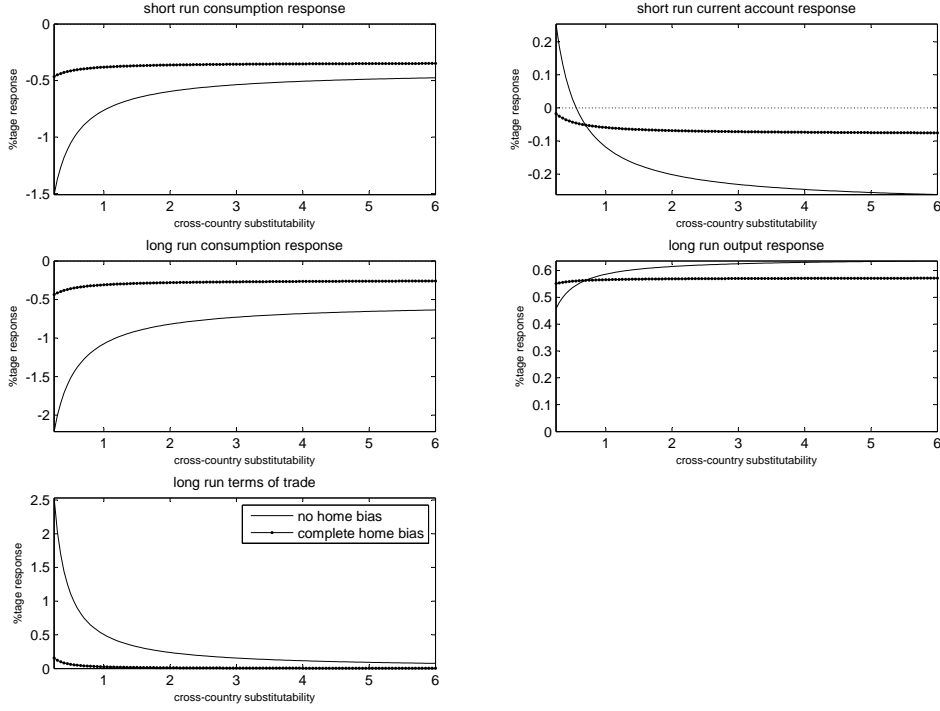
Figure 1: A permanent balanced-budget increase of government spending.

$$\bar{y} - \bar{y}^* = -\frac{\psi\Phi}{1 + \psi\Phi}\left[\left(\frac{R_0 - 1}{1 - n}\right)\bar{v} - (\bar{g} - \bar{g}^*)\right] \tag{47}$$

$$\bar{tot} = \frac{\psi\Phi}{\theta(1 + \psi\Phi)}\left[\left(\frac{R_0 - 1}{1 - n}\right)\bar{v} - (\bar{g} - \bar{g}^*)\right] \tag{48}$$

We focus on fiscal shocks that have no effects in a Ricardian model, e.g. temporary deficit-financed fiscal policy measures. As a reference point, we discuss a temporary balanced budget increase in domestic government spending. The domestic government decides to expand its demand for goods for one period $g_0 = \bar{g} < g$. The fiscal expansion is financed by an equal temporary increase in taxation $t_0 = \bar{t} < t = g$.

Again, we start with the assumption of complete home bias in public consumption. Numerical examples are given in Fig. 2. There is a fundamental difference between temporary and permanent balanced-budget changes in public spending. Permanent changes
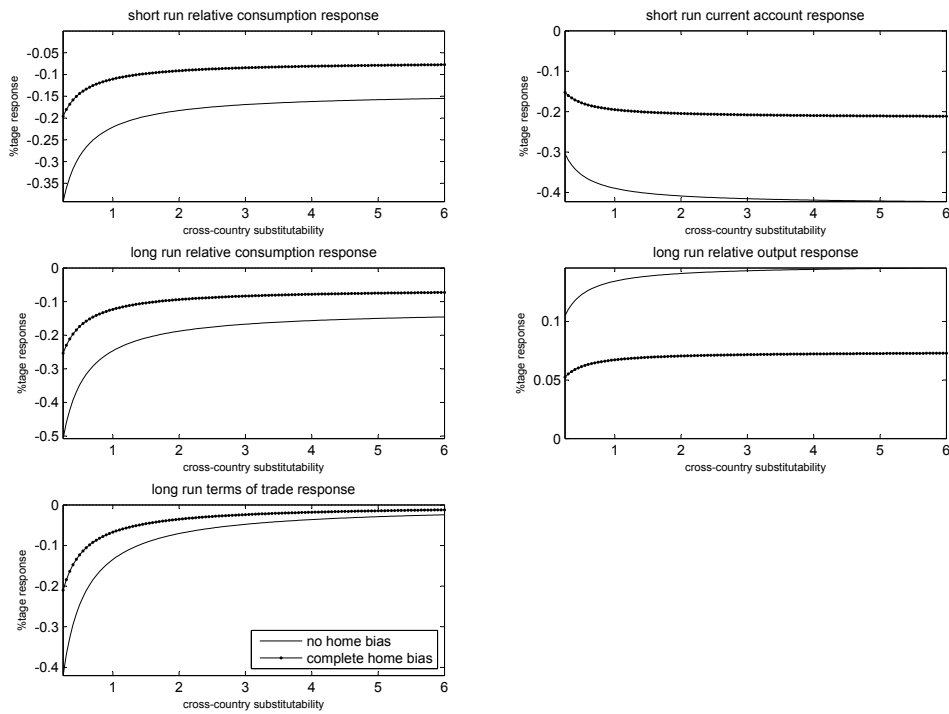
Figure 2: A temporary balanced-budget increase of government spending.

in fiscal policy imply changes in household income in the long run. If the fiscal measure is temporary, direct wealth effects are restricted to the short run.

Domestic consumption demand is a function of total income over average life expectancy. A temporary tax increase to finance public spending implies a reduction of current income, while future total wealth is not directly affected. We have shown that temporary fiscal measures do not alter the equilibrium level of neither world output nor consumption.

However, the distribution of consumption goods and labor effort between home and foreign households in the long run depends on the distribution of global wealth. Thus, the long run effect of a temporary change in fiscal policy depends on its current account effect. This is the crucial difference between temporary and permanent changes in government spending.

In the scenario of complete home bias in government spending, the increase in government spending induces certain asymmetries. The tax burden falls exclusively on domestic households and the government spends exclusively on home production. The cost and benefits of the assumed policy measure occur exclusively to domestic households. Households recognize the temporary nature of the fiscal measure. Because of the direct wealth effect, domestic income in the short run is below its long run level. Households use the international capital market to smooth consumption. For the complete range of the assumed values of the cross-country substitutability, the domestic country runs a current account deficit in the short run. This has to be settled by domestic households in the long run: They work more and consume less. The TOT adjust and the labor-leisure trade-off binds.

The supply of domestic output on the world market increases compared to the initial steady state. Thus, the TOT of the home country worsen.

The response of foreign consumption demand clearly mirrors this phenomenon. There is a redistribution of world wealth in favor of foreign households in the long run. They benefit from both, improved TOT and their improved net foreign asset position. Because of the asymmetric distribution of world wealth, foreign households consume a larger fraction of world output and enjoy more leisure than in the initial equilibrium. All long run responses depend in magnitude, but not in sign on the cross-country substitutability, which determines the short run current account response.

To complete the discussion of balanced budget changes in domestic fiscal policy, we discuss a temporary balanced budget increase in public spending under the assumption that public demand aggregates in the same way as household demand does. For a numerical example, see Fig. 2. The important difference to the case of complete home bias is again an asymmetric tax burden which is combined with symmetric indirect wealth effects. Domestic household income is reduced more than under the assumption of complete home bias in public spending. As government demand falls both, on home and foreign goods, there is no short run response of relative output. The benefits of the domestic fiscal expansion, increased wage and dividend payments are shared with foreign

households. The transmission mechanism is similar to that of the case of complete home bias. However, if the domestic government spends on home as well as on foreign goods, the current account response and thus the long run effects will be amplified.

We conclude the analysis with the discussion of the effects on the level of domestic consumption and output as well as the spillovers to the foreign country. A balanced-budget increase in domestic public spending increases domestic production in both, the short and long run, no matter, whether it is temporary or permanent and independently of the composition of domestic public demand. The domestic household's consumption of goods and leisure is decreased over all time horizons.

The effects on the levels of domestic variables are qualitatively independent of the assumed duration and the composition of public spending. But in general, the effects on domestic output are more pronounced, if we assume complete home bias. Intuitively, this is clear as in cases of complete home bias, the government redistributes demand in favor of domestic producers and thus stimulates domestic production. This implies that the benefits of this policy exclusively occur to domestic households.

If we assume that government spending aggregates in the same way as private demand does, the effect on output is much smaller and domestic consumption is decreased. Again, this is intuitively evident as domestic households do not only have to bear the complete cost of this policy in form of increased taxation but also have to share the benefits with households abroad.

The spillover effects on output and consumption abroad are much richer. In case of a permanent balanced-budget increase in domestic spending under the assumption of complete home bias, the spillover on output as well as on consumption over all time horizons are negative. The domestic government takes away resources from domestic consumers and spends these exclusively on domestic products. Thus, the demand as well as the wage and dividend payments for foreign households decrease over all time horizons. Output and consumption abroad are decreased.

If we assume that domestic spending aggregates in the same way as private demand does, a permanent balanced-budget increase in domestic public spending will enable a higher

consumption abroad, in the short as well as the long run. Foreign output is increased in the short run. In the long run, foreign households are enabled to consume more goods and leisure.

A temporary balanced-budget increase has similar short run effects. In the long run, foreign households will always benefit from the possibility of expanded consumption and a reduced workload. Foreign output is always lower than domestic production. This is explained by the fact that temporary balanced-budget changes do not alter the world equilibrium output and consumption in the long run. The long run effects of a temporary fiscal measure are determined by the current account effects. As the domestic country runs a current account deficit in the short run for all cases to smooth consumption, a temporary balanced-budget increase in domestic public spending always implies a redistribution of world wealth in favor of foreign households.

We conclude that a balanced budget increase in domestic government spending always has an expansionary effect on domestic output. Like in the basic representative agent model, the response of domestic household consumption is always negative. The spillovers depend on the precise assumptions to the composition of public spending and the persistence of a fiscal shock.

3.2 Deficit spending of the domestic government

Suppose a temporary increase in government spending which is financed by debt. The domestic government issues bonds $d_0 < d = \bar{d}$ to finance a temporary increase of public spending on goods $g_0 = \bar{g} < g = d$. Taxes remain fixed in the short run $t = t_0$. In the long run, the domestic government levies taxes $\bar{t} = (R_0 - 1)\bar{d}$ to finance the interest payments on the accumulated stock of public liabilities. A key characteristic of our model are failures of the Ricardian equivalence. In general, Ricardian equivalence describes models in which there are no real effects of the financing decision on aggregate demand. Thus, a temporary balanced-budget increase in government spending and deficit spending are equivalent.

We start the comparison of a deficit-spending and a temporary balanced-budget increase
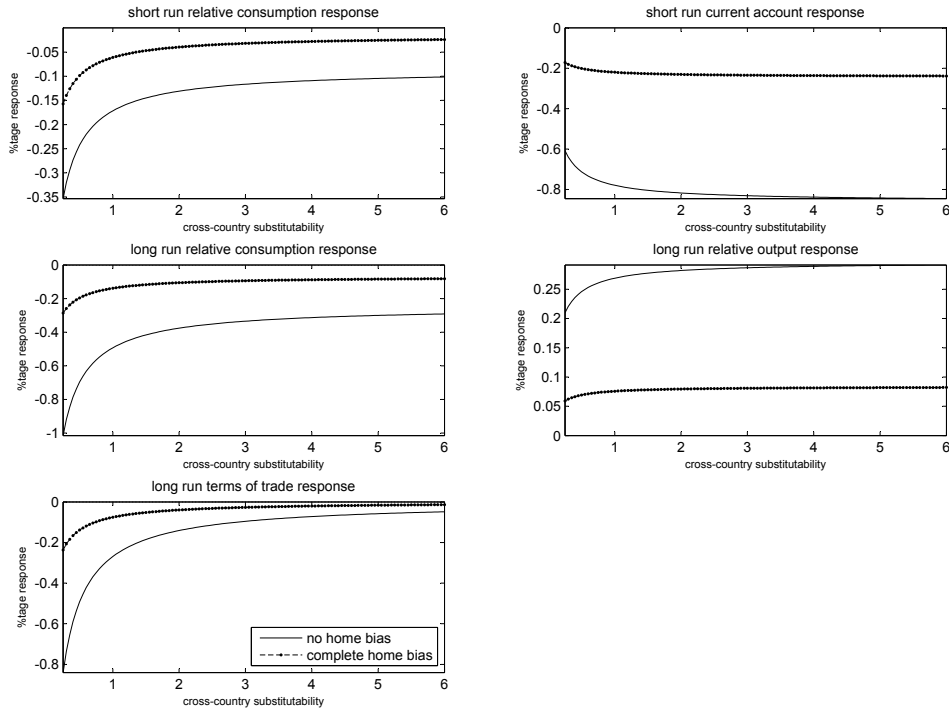
Figure 3: Deficit-spending of the domestic government.

in government spending under the assumption of complete home bias in public spending. By the numerical examples in Figs. 2, 3, we see that the responses of the relative variables are qualitatively the same but quantitatively different.

According to the consumption function (3), consumption is a function of current and future wealth. Future wealth enters the consumption decision with a weight $\frac{\gamma}{R_0-1}$ which depends on the average life expectancy.

Households base their consumption decision on the permanent income over the average life expectancy. A debt-financed fiscal expansion differs from a temporary balanced-budget increase in domestic public spending. This is because of the intertemporal allocation of the cost and benefits implied by this policy measure. Balanced-budget changes in public spending imply that the costs and benefits of fiscal measures come into effect during the same period of time. Deficit-spending has a temporary effect in the short run

and a permanent effect in the long run. The benefits of a positive indirect wealth effect occur in the short run, while the increase in taxation to finance this policy is deferred to the long run. The permanent income over the average life expectancy is increased compared to the case of a temporary balanced-budget change in public spending.

The transmission mechanism of the fiscal shock remains unaffected by the financing decision. The intertemporal allocation of the financing decision alters the effect on the domestic household's consumption decision in the short run.

Domestic households reduce their consumption to a lesser account as compared to the balanced budget case. To enable this, households borrow abroad which in turn implies an increased current account deficit as compared to the case of a temporary balanced budget increase in domestic public spending.

The long run responses of relative output, consumption and the TOT, all depend on the current account response. Thus, all responses are amplified. We conclude that by manipulating the intertemporal allocation of disposable income, fiscal authorities have an additional policy instrument at hand. It allows the government to mitigate the effects of fiscal expansion on current consumption. However, in case of deficit spending, it also implies that the tax increase required to finance current government spending falls entirely on the shoulders of future generations.

The effects on the level of domestic consumption are negative, but smaller than in case of a temporary balanced-budget increase in domestic public spending. Domestic output is increased in the short as well as in the long run.

Again, the sign of the spillover effects depends on the precise assumption we make with regard to the composition of public spending. If the home government spends exclusively on national goods, foreign consumption and output will be decreased in the short run. However, if domestic public spending aggregates in the same way as household demand does, the foreign consumption and output are increased in the short run.

This implies that the domestic country always runs a current account deficit. Domestic households borrow abroad to smooth consumption in the short run. The world distribution of wealth determines the long run responses at home and abroad. Thus, foreign
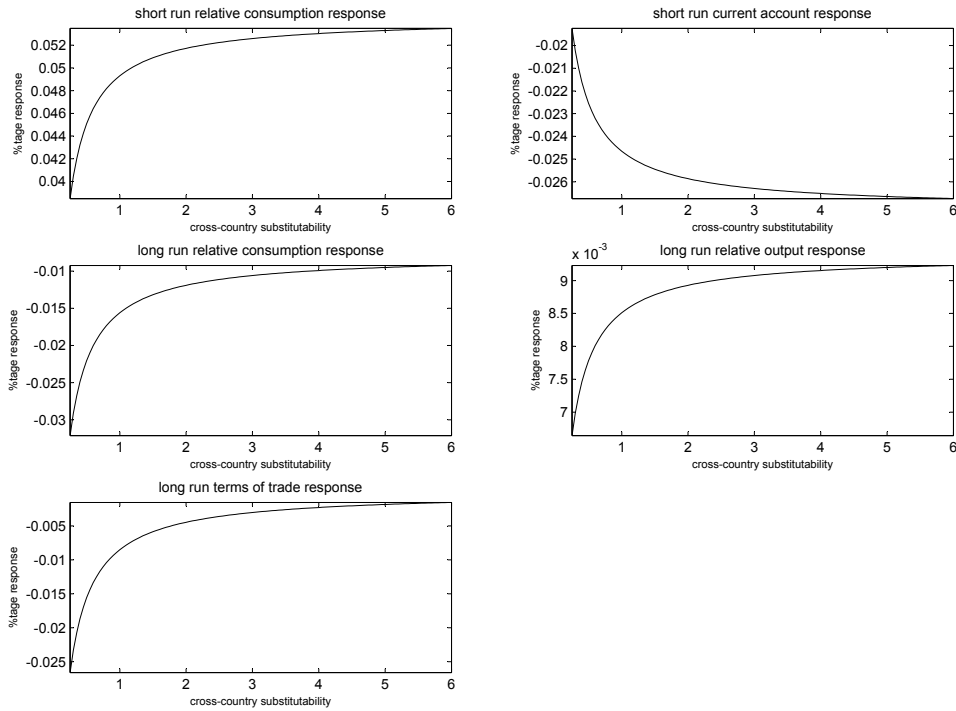
Figure 4: A debt-financed tax cut by the domestic government.

households are enabled to consume more and work less in the long run.

We conclude that deficit-spending always stimulates domestic production and triggers a decline in domestic consumption of goods and leisure over all time horizons. Foreign households benefit from a redistribution of world wealth to their favor in the long run.

3.3 A debt financed tax cut in the domestic country

We conclude the evaluation of fiscal policy measures with a debt-financed tax cut in the domestic country. The home government issues bonds $d_0 < d = \bar{d}$ to finance a temporary tax cut $\bar{t} > t_0 > t$. In the long run, taxes are levied to finance the interest payments on the accumulated stock of public liabilities $\bar{t} = (R_0 - 1)\bar{d}$.

In a model featuring Ricardian agents, debt and taxation are equivalent financing decisions. Thus, Ricardian consumers do not respond to this policy measure at all.

The key to the real effects of this policy is the finite horizon. Households in the Blanchard (1985)-Yaari (1965) OLG maximize utility over their average life expectancy. Individuals are aware that part of the stream of future taxation, which is levied to finance the interest payments on debt issued in the short run, falls in the periods of time after their death. They expect to repay only a fraction of public liabilities, depending on their probability to survive $\gamma < 1$. Thus, part of the issued government debt is perceived as net wealth. In the Blanchard (1985)-Yaari (1965) OLG a debt-financed tax cut is an intertemporal redistribution of real income in favor of the current generation. The resources obtained by the government by issuing debt, in the short run, are completely redistributed to households. Public spending is fixed at the initial steady state level.

We illustrate this policy experiment with a numerical example in, Fig. 4. Domestic households benefit from the direct wealth effect of a tax cut in the short run. In the long run, the direct wealth effect is reversed as taxes are levied to cover the interest payment on public debt. If γ is sufficiently small, the positive direct wealth effect prevails in the short run.

As a result, domestic households increase their demand for consumption goods. Output at home and abroad are increased as compared to the initial steady state. This is explained by the fact that short run movements in output are determined by demand and not by the supply-side labor-leisure decisions. An increase in domestic consumption drives up demand for world production. However, as only part of government debt is perceived as net wealth, the effects on output and consumption are positive, but small. Households at home and abroad benefit from an indirect wealth effect. Labor and dividend income are increased in the home country and abroad. As private consumption demand falls on both, home and foreign goods, there is no response of relative output in the short run. A change in relative consumption implies that domestic households consume a larger fraction of world production than in the initial steady state which implies that they have to borrow abroad.

Again, the magnitude of the relative consumption response as well the current account response depend on the assumed cross-country elasticity. If home and foreign goods

are poor substitutes, there is only little scope for international lending. Thus, a low cross-country elasticity nearly shuts down the current account channel.

We conclude that the cross-country substitutability determines the international distribution of gains that are deriving from of a debt-financed tax cut. If home and foreign goods are poor substitutes, the benefits of a debt-financed tax cut are shared between home and foreign households in the short run. The response of relative consumption and the current account effects are only small.

In the long run, the model response is driven by the current account effect. A debt-financed tax cut always worsens the domestic country's net foreign asset position. In addition, the long run tax burden has to be carried exclusively by domestic households. Hence, the response of relative consumption in the long run is always negative. Domestic households have to work more to finance tax payments to the home government and interest payments to households abroad. The response of relative output in the long run is positive, whereas the TOT worsen.

The spillovers are positive, in the short as well as in the long run. The levels of domestic and foreign output as well as consumption are always increased in the short run. In the long run, households abroad profit from a redistribution of world wealth in their favor. We conclude that failures of the Ricardian equivalence allow for fiscal measures that increase short run consumption as well as output in the world economy by the intertemporal redistribution of income.

4 Normative analysis

The Blanchard (1985)-Yaari (1965) OLG poses a problem for normative policy analysis. Namely, the choice of an adequate welfare criterion. Blanchard and Fischer (1989) argue that an appropriate welfare criterion must be as such so that households agree to it, independently of the period of their birth. They suggest a weighted average of the welfare of current and future generations

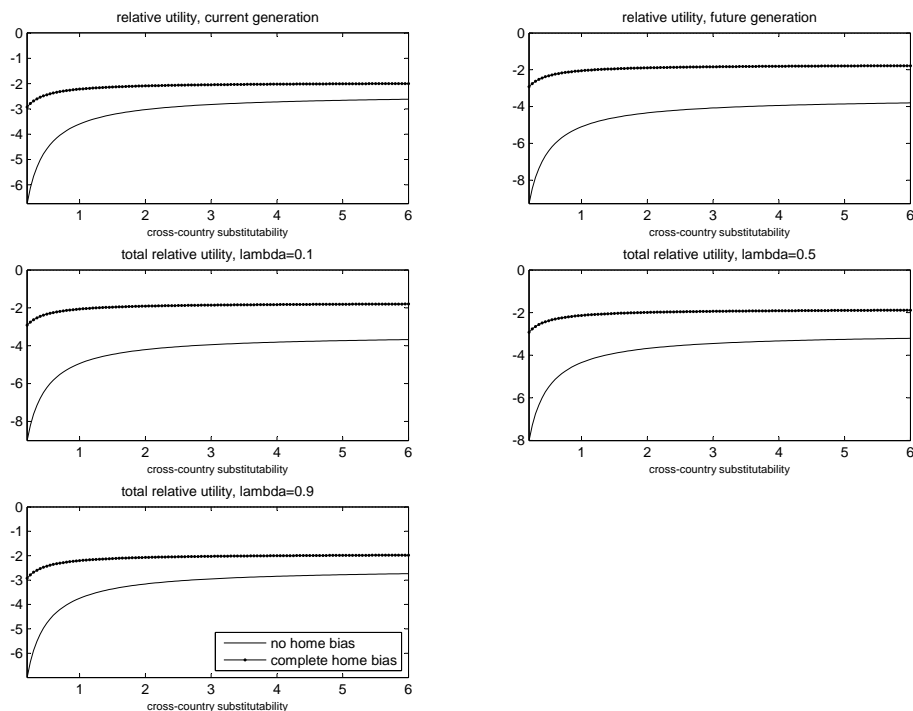$$(U - U^*)_{total} = \lambda (U - U^*)_{current} + (1 - \lambda) (U - U^*)_{future} \tag{49}$$

Figure 5: Welfare. A permanent balanced budget increase in public spending.

where $0 < \lambda < 1$, $(U - U^*)_{current} = (c - c^*) - \frac{\phi-1}{\phi}(y - y^*) + \frac{\gamma\beta}{1-\gamma\beta}\left[(\bar{c} - \bar{c}^*) - \frac{\phi-1}{\phi}(\bar{y} - \bar{y}^*)\right]$
and $(U - U^*)_{future} = \frac{1}{1-\gamma\beta}\left[(\bar{c} - \bar{c}^*) - \frac{\phi-1}{\phi}(\bar{y} - \bar{y}^*)\right]$.

The welfare criterion is derived by log-linearizing the utility function in per-capita terms. We measure utility in relative terms[3], where λ assigns weights to the utility of current and future generations. We abstract from utility that is derived from real balances.

To illustrate the welfare effects of the various fiscal measures, we provide numerical examples[4]. Fig. 5 displays the welfare effects of a balanced budget increase in domestic public spending by one percent of the domestic output in the initial steady state. A

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[3]We follow Ganelli (2005) and measure utility in the two-country Blanchard (1985)-Yaari (1965) OLG in relative terms.

[4]The numerical examples given in figures 5-8 are based on the following parametrization: $\beta = 0.99$, $\psi = 1$, $\chi = 0.1$, $\phi = 6$, $\gamma = 0.7$ and $n = 0.5$. We vary the cross-country substitutability $\theta \in [0.1, 6]$ and calculate total welfare for different values of λ, $\lambda = 0.1, 0.5, 0.9$.
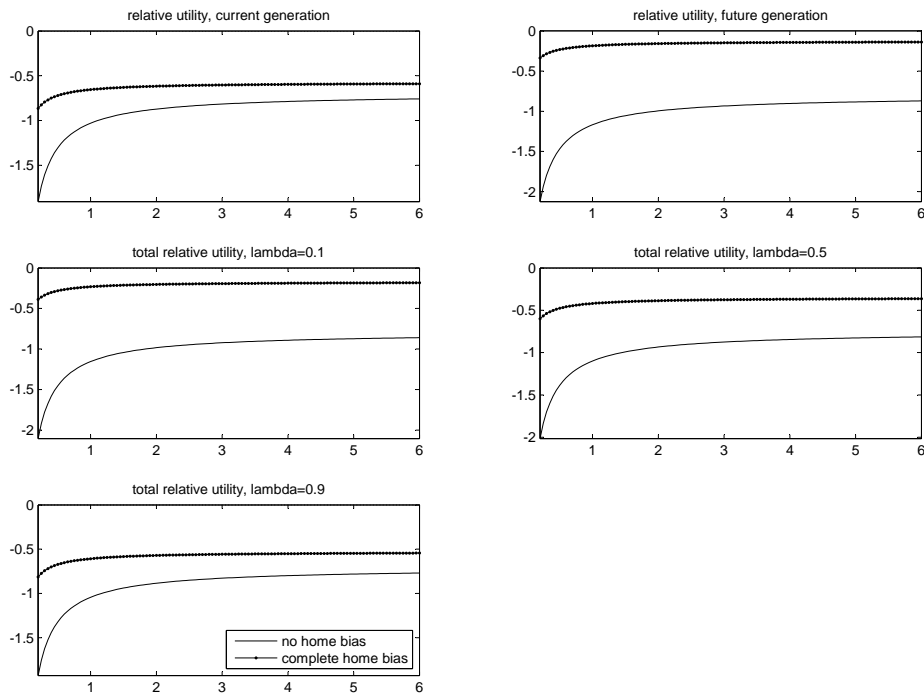
Figure 6: Welfare. A temporary balanced budget increase in public spending.

permanent balanced budget rise in government spending decreases the real income of households over all time horizons. Domestic current and future generations suffer from a decrease in relative utility.

Nevertheless, the welfare effect on current and future generations is not identical. The current generation has to pay the higher tax rate and borrows abroad to smooth the transition in the path of consumption and leisure. Future generations have to carry the burden of increased taxation and to settle the current account imbalance which they have inherited from the current generation. Thus, the future generations suffer a welfare loss that is more severe than the loss experienced by the current generation.

However, the difference in the welfare loss of current and future generations is small. The reason is that the change in taxation determines the welfare impact. Thus, the effect of changes in the weights on welfare of current and future generations on total
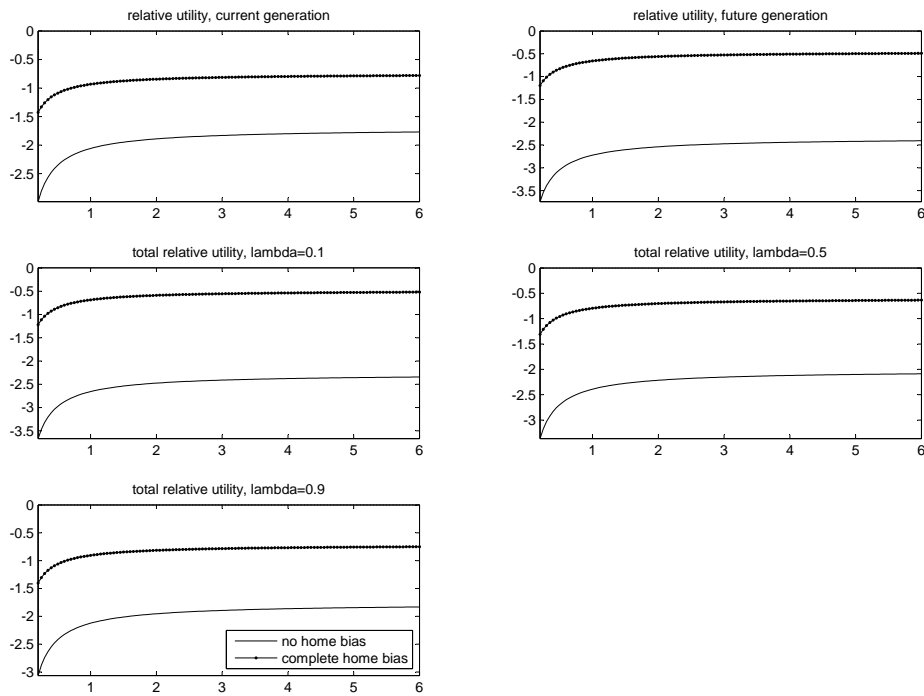
Figure 7: Welfare. Deficit spending.

welfare is small. The same is true for changes in the probability to survive. A change in the probability to survive affects the optimizing behavior of individual households. Again, as the tax increase dominates the welfare effect, changes in γ do not affect total welfare substantially.

The substitutability between home and foreign goods determines the expenditure switching effects and the scope for international lending. Thus, changes in the cross-country substitutability have considerable welfare effects.

An illustration of the welfare effects of a temporary balanced budget increase in government consumption is given in Fig. 6. In general, the welfare loss of current and future generations is lower than in the permanent case.

The reason is found in the temporary nature of the assumed policy. There are notable differences in the effects of a temporary balanced budget change in public consumption
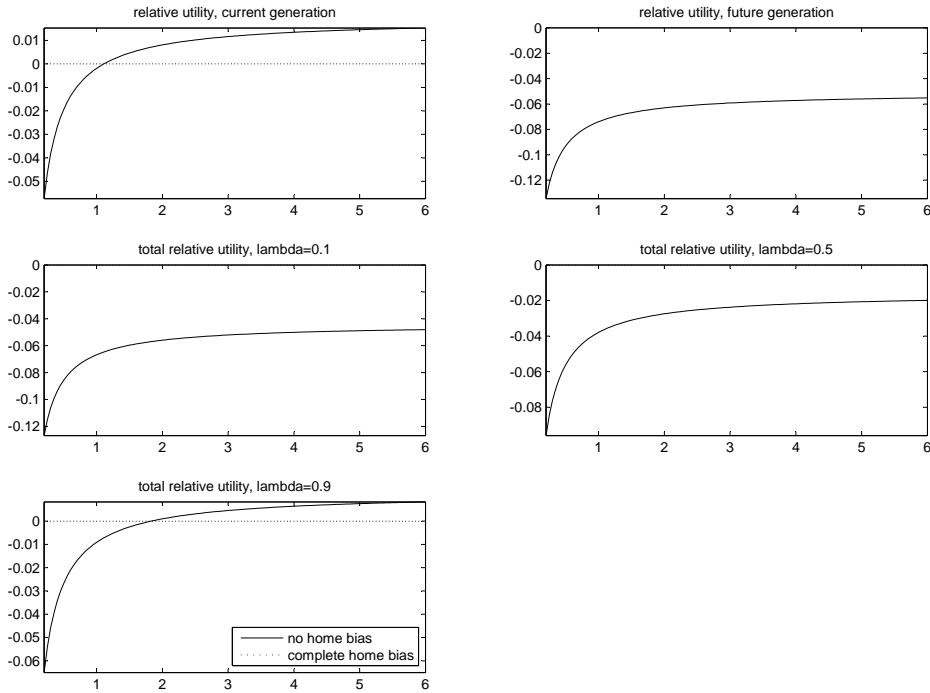
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Figure 8: Welfare. A debt-financed tax cut.

on current and future generations. The current generation has to finance the increase in government spending by an increased tax rate. To smooth the decrease in real income the current generation borrows abroad. In turn, this redistribution of world wealth determines the long run effects. Future generations have to settle the implied imbalance in world wealth but do not suffer from increased tax rates.

The effects of changes in the probability to survive and the cross-country substitutability are similar to the case of a permanent change in public spending. But now changes in the relative weight of the current and future generations have considerable effects on total welfare. This is explained by the circumstance that the long run effect of such a policy depends on its current account effects. The current generation internalizes the welfare loss of future generations for low values of λ.

We depict the welfare effects of deficit spending in Fig. 7. Deficit spending differs from a

temporary balanced budget increase in government spending by the financing decision of the government. The temporary increase in public demand is financed by issuing public debt. Future generations have to finance the debt service by a permanent increase in taxation.

However, given our simple timing assumptions and the underlying assumption that the government only pays the interest rate on the accumulated debt stock, the welfare effects are similar to the case of a temporary balanced budget increase in public consumption. We want to emphasize that this is a result of the applied timing assumptions. This statement is not true, if we allow the government to shift changes in taxation to finance the debt services further into the future.

The assumption to the composition of government spending does not alter the qualitative welfare effects of the fiscal measures. In general, the assumption of complete home bias decreases the welfare losses which are implied by an increase in government spending. This is because all benefits of the fiscal expansion, i.e. an increased demand for consumption goods occurs to domestic producers. Assuming complete home bias in the standard model potentially underestimates welfare losses that are implied by an increase in government spending, no matter how it is financed.

Fig. 8 illustrates the welfare impact of a debt financed tax cut. This fiscal measure differs from the above mentioned in two dimensions: Firstly, it implies an intertemporal reallocation of real income in favor of the current generation and secondly, it does not involve changes to the level of public consumption.

The current generation profits from this phenomenon in terms of an increase in real income. It enables an increased consumption of the current generation which implies welfare gains. In the long run, future generations have to cover the cost of such a policy measure by higher taxation in order to cover the interest payments on the accumulated stock of government debt.

Thus, a debt-financed tax cut increases the welfare of the current generation and implies welfare losses for future generations. As a consequence, the probability to survive together with the weight on the welfare of the current and future generations are impor-

tant elements to determine the total welfare effects of such a fiscal measure.

If γ is close to one, households expect to survive long enough to repay a relatively large fraction of the issued debt. Thus, the utility of the current generation decreases. Small values of λ imply that the current generation cares for their descendants. Total welfare decreases with the weight on the utility of the current generation and increasing life expectancy which mirrors the famous result of Barro (1974).

Changes in the cross-country substitutability affect the welfare of households in the same way as discussed above.

We conclude that in the two-country Blanchard (1985)-Yaari (1965) OLG, fiscal measures have the potential to increase short run output and private consumption demand at the same time. Moreover, a fiscal stimulus does not necessarily diminish total household welfare in the implementing country. It is evident that the positive as well as the normative effects of fiscal policy depend on the precise type of the assumed policy measure.

5 Conclusions

We present a two-country model of a currency union featuring failures of the Ricardian equivalence. The model allows us to study the transmission and welfare effects of fiscal measures in a monetary union, apart from balanced budget policies. We explore the role of the cross-country substitutability and look at the composition of public spending in view of the transmission of fiscal shocks. The model solution yields some intuitive insights into the mechanisms that are underlying the transmission of fiscal policy in a currency union.

Firstly, a permanent balanced budget increase in domestic public spending decreases consumption, but stimulates output in the home country. The real income loss due to increased taxation determines the overall effects of this policy measure. This implies welfare losses for the domestic households, in the short as well as the long run. The spillover effects on the foreign country depend on the precise assumptions regarding the

composition of public spending. Under complete home bias in domestic public spending, real income abroad is decreased over all time horizons. The spillover effects are unambiguously negative. If we assume that public spending aggregates in the same way as household consumption does, then the spillover will switch sign. A permanent balanced budget increase in domestic government spending rises real income and welfare abroad. Secondly, temporary balanced budget increases in the domestic country have similar effects. However, the transmission mechanism is very different. In the case of permanent changes, the tax effects determine the short as well as the long run model response. This is not true for cases of temporary fiscal measures whose impact hinges on their current account in the short run.

We have shown that world output and consumption return to their steady state level in the long run, given that a fiscal measure does not alter the permanent level of public spending. The long run effects of temporary fiscal measures depend on how they affect the distribution of world wealth, i.e. the current account impact of such measures. The magnitude of changes in the distribution of world wealth in the long run depend on the cross-country substitutability which determines the scope for international lending and borrowing.

Thirdly, deficit spending is not equivalent to a temporary balanced budget increase in public spending. Under our simple timing assumptions, the transmission and welfare effects are identical as in case of a temporary balanced budget increase in domestic public spending, but quantitatively smaller. Although deficit spending implies an intertemporal dispersion of the cost and benefits of public spending; this is just a shift by one period in our setting. Technically, deficit spending is a combination of a long run change in taxation and a temporary change in government spending which is not equivalent to a temporary balanced budget change in government spending.

Fourthly, a debt financed tax cut has no effects in Ricardian models. In our model, it affects the consumption decision of households and domestic output. This is explained by a redistribution of real income from future to current generations. Domestic households increase their demand for consumption goods. Production home and abroad increases

in the short run. Depending on the assumptions we make on the expected lifetime of domestic households and their selfishness, a debt-financed tax cut can be welfare improving. The spillovers are positive, foreign households benefit from an increased real income over all time horizons and thus lead to improved welfare.

Overall, our results are close to the empirical findings of Mountford and Uhlig (2005) as far as the domestic consumption and output response to fiscal measures are concerned. The *European Economic Recovery Plan* as well as the OECD (2009) rely on increases in public spending and tax cuts that are targeted to households in order to stimulate the economy during the recent economic downturn. In our model, a temporary debt-financed increase in public spending stimulates output and at the same time decreases consumption in the home country. The spillovers depend on the precise assumptions to the composition of public demand. If the government spends exclusively on national goods, the spillovers on foreign output and consumption are negative. However, although the spillovers on foreign consumption remain negative, the assumption that the home government spends on home and foreign goods changes the sign of the spillover on foreign production. Finally, we can state that the welfare effects of debt-financed increases in public spending are always negative and this in both countries.

A debt-financed tax cut stimulates domestic output and consumption and has positive spillover effects on both variables abroad. In our model, the before mentioned measure is the only policy capable of stimulating private consumption. The welfare effect of a debt-financed tax cut depends on the survival probability of households and how much they care for future generations. The result can be either positive or negative. In the long run, both policies lead to increased taxation and welfare losses for future generations.

We conclude that from our model's point of view, the choice of policy measures employed to stimulate the economy depends on the macroeconomic variable the government wants to target. If the government intends to stimulate private consumption, tax cuts will be the only instrument at hand. Moreover, from a welfare perspective, a debt-financed tax cut can be implemented in such a way so that it does not decrease the welfare of current

generations.

The spillover effects depend on the precise fiscal measure employed, the composition of public spending, the financing decision of the government and the cross-country substitutability. A result that corresponds to the mixed findings regarding the expected spillovers in the literature.

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