National Fiscal Stimulus Packages And Consolidation Strategies In A Monetary Union

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National Fiscal Stimulus Packages And Consolidation Strategies In A Monetary Union

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We present a two-country New Open Economy Macroeconomics model of a currency union featuring an overlapping generations structure of the Blanchard (1985)-Yaari (1965) type as well as monopolistic frictions and staggered adjustment in the goods and labor market. We allow for public investment and distortionary taxation.
We study the effects of fiscal policy measures such as public spending, tax cuts targeted to households and public investment as suggested by the European Commission (2008). In particular, we explore the effects of fiscal policy as a function of the financing decision of the implementing government.
We find that the impact of fiscal measures on national variables as well as the spillovers depend on the assumed degree of household myopia and again, the financing decision of the government. However, the introduction of a complex fiscal sector which enables the government to choose between alternative financing schemes is an important determinant of the effects of fiscal expansions on key macroeconomic variables such as, output and consumptions. Thus, modeling a complex fiscal sector on both sides of the budgets is crucial for the results and therefore the effectiveness of fiscal stimulus packages.

Keywords: Overlapping generations; New open economy macroeconomics; Public Debt; Decentralized fiscal policy; Monetary union.
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1 Introduction

In response to the Great Recession, on November 26, 2008, the European Commission initiated a coordinated fiscal policy response of the European Union, the European Economic Recovery Plan (EERP) in order to halt the economic downturn. The major objectives of the Commission were to stabilize employment, strengthen the purchasing power of European consumers and to invest in Europe's future in the form of public investment programs.

The EERP implicitly assumes that a specific fiscal instrument is appropriate to stabilize a particular macroeconomic variable. Regarding the composition of individual national stimulus packages, the Commission suggested a combination of public spending increases and tax cuts targeted at households.

Indeed, the effects of fiscal policy on key macroeconomic variables such as consumption, employment and output are a lively field of empirical research. The predominant approaches trace back to the seminal work of Blanchard and Perotti (2002) as well as Mountford and Uhlig (2005, 2009) which are based on structural vector autoregressive methods that focus on on the identification of fiscal shocks directly in high frequency data.

The alternative narrative approach suggested by Ramey and Shapiro (1998) identifies fiscal policy shocks in the US by the study of contemporary newspapers. They find several exogenous fiscal shocks in the form of military build-ups. The empirical work on fiscal policy shocks is strongly focused on shocks to government spending in general. Numerous researchers contributed to this empirical literature over the last decade. Excellent surveys of the empirical results and the related methodological issues are provided by Perotti (2007), Gali et al. (2007) and von Hagen and Wyplosz (2008). The main results are that the effects of fiscal policy depend on the choice of instruments, e.g. public consumption or investment and the related financing decision. Regarding an increase of public spending, the empirical literature reached the conclusion that output, consumption and employment rise. Overall, the empirical literature renders some support to the idea of fiscal stabilization policies advocated by the European Commission.

The idea that fiscal policy has the power to increase aggregate demand more than one-to-one is known as the Keynesian multiplier effect. In Keynesian models, aggregate demand is the sum of private demand for consumption and investment, net exports and public consumption. Private demand is a function of current after-tax income. Thus, a debt financed increase in public spending increases aggregate demand more than one-to-one as private demand is crowded in. Modern economic standard models are based on the optimizing behavior of agents. The classical RBC models (e.g. Baxter and King (1993)) as well as standard new Keynesian models (e.g. Gali (2008)) predict that an increase in public spending stimulates aggregate demand, but the effect is mitigated by decreases in private consumption.

The key to this prediction is the validity of the Ricardian equivalence and strong simplifying assumptions to the conduct of fiscal policy. Fiscal policy enters standard models typically as an exogenous shock, debt and taxation are the only financing instruments of the government. Thus, an increase in public demand always implies a decrease in permanent income which mitigates the stimulating impact of additional public spending on output.

A number of researchers aim to reconcile the predictions of theoretical models with empirical evidence. The predominant approach follows the suggestion of Gali et al. (2007) who allow for failures of the Ricardian equivalence by assuming that a fraction of households cannot participate in credit markets. These so-called rule-of-thumb consumers spend their disposable income in each period of time. However, their approach depends crucially on the share of credit constraint consumers. The main objective of Gali et al. (2007) is to enable a fiscal expansion to crowd in private demand. To obtain such a result, they need to assume a large share of credit-constrained consumers that cannot be confirmed in the data. Another route is taken by Linnemann and Schabert (2006) as well as Leeper et al. (2010) who show that productive government spending in an otherwise standard new Keynesian model generates effects that are similar to the empirical evidence. A different approach, suggested by Leeper et al. (2009) is to include public spending in the utility function of households. If private and public spending on

goods and services complement each other, public spending will have the potential to crowd-in private spending which in turn paves the way for Keynesian multipliers. Recent research has combined these approaches and combined these with a complex fiscal sector, extending the number of fiscal instruments on the spending and revenue side of the government budget, e.g. Coenen et al. (2012, 2013).

However, the majority of theoretical work does not explore other important dimensions of fiscal policy measures in practice. Fiscal policy measures as included in the EERP are not restricted to the spending side of the public budget, but include increased public spending as well as temporary tax cuts targeted at households. In particular, spending increases and tax cuts were regularly implemented simultaneously and financed by public debt. Interestingly, a debt-financed tax cut, among the measures expected to halt and even reverse an economic downturn has no effect at all in standard models of fiscal policy.

Contrary to the standard modeling choice of an exogenous spending process, the empirical evidence suggests that public spending responds to the state of the economy in a systematic way. Estimating fiscal policy rules, Gali and Perotti (2003) find that public spending does respond to the state of public finances, in particular, the accumulated stock of public liabilities. A finding which is confirmed by the work of Alesina and Perotti (1996), von Hagen et al. (2001) and Alesina and Ardagna (2010, 2013) who all find that successful consolidations are predominantly based on spending cuts.

In addition, Corsetti et al. (2009) find that increases in public spending are financed by increased taxation and spending cuts. According to them, fiscal expansions are followed by decreases in public spending below the trend. A phenomenon they labeled as spending reversals. Corsetti et al. (2009) show that the financing decision, taxation or spending cuts of the government, has strong effects on the behavior of private households. Government consumption has the power to crowd in private demand, given that it is, at least to some degree, financed by future spending cuts. Results that are confirmed by the work of Paredes et al. (2014). They find that Euro Area governments started to consolidate their budgets in 2010 by heavily relying on decreases in public

spending. Suggesting that Euro Area governments follow a strategy that is not captured in standard models.

In the aftermath of the Great Recession, a number of studies estimated the impact of fiscal stabilization policies as 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. In similar models, Coenen et al. (2012, 2013) and Gadatsch et al. (2015) provide Bayesian estimations of open economy models. They suggest a new Keynesian set up featuring non-Ricardian consumers, productive government spending and a complex fiscal sector. The results of Coenen et al. (2012, 2013) provide further evidence that distinct fiscal measures lead to different multiplier effects. They expand the European Central Bank's New Area-Wide Model by allowing for a complex public sector. As a result, increases in public spending have the potential for Keynesian multipliers provided that public and private consumption complement each other. Gadatsch et al. (2015) estimate a three-region-model where two countries form a monetary union and the remaining region represents the rest of the world. They evaluate the German stimulus package of 2009 and find Keynesian multiplier effects.

The European Commission emphasized the importance of a coordinated approach in which all member states were encouraged to launch national fiscal stimulus packages simultaneously. The approach of the Commission reflects central institutional characteristics of the EU. The EU member states are highly integrated by the single European market. But despite this deep integration, there is no substantial union budget which would allow for the launch of a union-wide fiscal stimulus package. The Commission expected substantial spillovers which were expected to amplify the expansionary effects of fiscal policy across the EU.

Beetsma et al. (2006) estimate the spillovers from fiscal shocks via trade flows in Europe. They find that fiscal expansions boost economic activity in the implementing country and have substantial positive spillover effects on its trading partners. Moreover, in 't

Veld (2013) finds that, based on the QUEST-model (Ratto et al. (2009)) used by the European Commission, spillovers of fiscal consolidations can be sizable in the Euro Area. In a global vector autoregression model, Hebous and Zimmermann (2013) find evidence for positive spillover effects of fiscal policy. In a two-country real business cycle model, Corsetti et al. (2010) show that a fiscal stimulus with "spending reversals" generates positive cross-border fiscal spillovers. In subsequent work, Corsetti et al. (2010), Corsetti et al. (2011) and Bierbrauer (2012) find that the national effects of fiscal policy and the spillovers depend on the financing decision of the government, the size of the implementing country relative to the world economy as well as its trade elasticity. Among these factors, the assumed financing strategy has by far the strongest impact. However, other researchers such as Gadatsch et al. (2015) find that fiscal spillover effects are positive, but can be negligible or, in case of Cwik and Wieland (2011), even negative. In sumary, 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.

We conclude that there are still some gaps to fill. Fiscal policy evaluation in the theoretical literature is strongly focused on the spending side of the public budget, but there are strong indications for the important impact that decisions on the revenue side may have on the effects fiscal expansion. There is a scarcity of theoretical research that allows for a wide range of alternative fiscal instruments; but instead of focussing on the spending side of the government evaluates fiscal expansions in the context of alternative financing decisions. This gap is widely recognized in the literature, see the discusssion in Coenen et al. (2012, 2013).

This paper studies fiscal policy measures which are routinely taken by fiscal policy makers intended to halt and even reverse an economic downturn. In doing so, we focus on measures suggested by the EERP which focused increases in public consumption and investment as well as tax cuts. Our focus is the effect that alternative financing decisions have on the initial impact of en expansive measure implemented by the government. Moreover, we look at the spillovers implied by the chosen measure and its respective financing decision.

We propose a two-country model of a currency union which is featuring an overlapping generations structure of the Blanchard (1985)-Yaari (1965) type as well as monopolistic frictions and staggered adjustment in the goods and labor market. We allow for public investment and distortionary taxation. This enables us to study a wide range of fiscal measures, including different ways of financing a given level of public spending. In the evaluation of fiscal measures, we focus on Germany, as a country that implemented substantial fical measures. Germany issued two fiscal stimulus packages in 2008-2010 which amounted to an overall size of 3% of Germany's gross domestic product. The composition of these packages were focused on public consumption and infrastructure spending as well as tax cuts and subsidies which were all targeted at households. A detailed evaluation of the employed fiscal measures can be found in Roos (2009).

We find that expansions in public consumption always increase national output and employment. The response of private consumption is sensitive to the financing choice of the government. If financed by future taxation, public consumption decreases wealth and consumption demand of Ricardian consumers persistently. The alternative financing choice of future spending cuts mitigates the negative wealth effect. The consumption demand of Ricardian households is decreased on impact but quickly returns to its pre-shock level, but moves to a higher level as compared to the pre-shock level before the financing decision comes fully into effect. In any case, the multiplier effect on national output is smaller than one.

The introduction of finite lifetimes yields a level of household consumption that is always higher as compared to the case of Ricardian consumers in response to a tax-financed increase in public consumption. To enable the model to predict an increase in household consumption and therefore a Keynesian multiplier effect on domestic output, we need to assume a very high degree of household myopia.

When public consumption is financed by future spending cuts, non-Ricardian households always respond by increasing their demand for consumption goods. We obtain Keynesian multipliers on national output.

A lump-sum subsidy to households which is financed by lump-sum taxes in the future

has no effect at all in a Ricardian model. Non-Ricardian households respond by a persistent increase in consumption. Driven by household demand, domestic output and employment increase.

Financing a temporary subsidy to consumers by future spending cuts, alters the model's prediction substantially. Output, employment and household consumption increase on impact, whether we allow for failures of the Ricardian equivalence or not. But, in both cases we find no Keynesian multipliers on output.

We find that increases in public investment have effects similar to a positive productivity shock in the home country. No matter how the government decides to finance these measures and independently of possible failures of the Ricardian equivalence, public investment increases domestic output, employment and household consumption. The Keynesian multiplier on national output is always larger than one. However, we find no double dividends of public investment.

The European Commission expected substantial positive spillovers. In our model spillovers are driven by household consumption and can be even negative on impact. In the medium term, the spillovers of fiscal policy shocks are always positive.

The remainder of this 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. Finally, section 4 presents the conclusions and possible extensions of the model.

2 The Model

We develop a dynamic, two-country, general equilibrium model of a monetary union which is featuring monopolistic competition and staggered adjustment in the goods as well as the labor market. Following Erceg et al. (2000), we assume staggered wage and price setting of the Calvo (1983) type. We identify one country as the home country H while the other country is referred to as the foreign country F. 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).

The characteristic distortion of the Blanchard (1985)-Yaari (1965) OLG model is the introduction of uncertain lifespans by a single parameter γ, the survival probability of individual households. Households have no bequest motive. Finite lifespans imply that an intertemporal redistribution of wealth alters the expected permanent income in the remaining lifespan of an individual and thus lead to failures of the Ricardian equivalence. In the domestic country, a cohort of $n \in [0,1]$ households is born in each period of time whereas $(1-n)$ agents are born abroad. Therefore, the population in the domestic country is $\sum_{a=0}^{\infty} \gamma^a n = \frac{n}{1-\gamma}$ and $\frac{1-n}{1-\gamma}$ is the population abroad. This implies a constant world population that is normalized to one as we assume that a fraction of $1-\gamma$ of the population is dying in each period of time.

2.1 Households

We discuss the behavior of an individual domestic household with the notion that similar equations hold for foreign households. Domestic households $h \in [0,n]$ share identical preferences and maximize their utility over consumption C and leisure $(1-L), L \in [0,1]$. The certainty equivalent utility function of an individual domestic household reads

$$E_t U_t(h) = \sum_{s=t}^{\infty} (\gamma\beta)^{s-t} \left[\ln C_{a+s-t,s}(h) + \frac{\chi_0}{1-\chi} \left(1 - L_{a+s-t,s}(h)\right)^{1-\chi} \right] \tag{1}$$

where $\beta, \chi_0, \chi > 0$ and $\gamma \in [0,1]$ is the probability to survive until the next period of time. The parameter $\chi > 0$ measures the utility of time spend out of work.

The individual real period t budget constraint of a domestic household of age a reads

$$F_{a,t}(h) + (1+\tau_t^c) C_{a,t}(h) = \frac{1}{\gamma} F_{a-1,t-1}(h)(1+r_{t-1}) + \tag{2}$$

$$(1-\tau_t^w) w_{a,t}(h) L_{a,t}(h) - T_t + (1-\tau_t^k) \int_0^n \Pi_t(i) di + \Pi_t^k \tag{3}$$

where τ^c, τ^k, τ^w are distortionary tax rates on consumption, capital and labor. w is the real wage rate and $F = D + B$ denotes the agent's total asset holdings denominated in units of the composite consumption good. D are national government bonds and B bonds which are issued by private households home or abroad.

T is a lump-sum tax and r_{t-1} the real interest rate paid on bond holdings between $t-1$

and t. We assume that households receive an equal share of national profits independently of age. $\int_0^n \Pi_t(i)di, \Pi_t^k$ are the real individual shares of profits of producers of national final goods and capital rental firms, respectively.

Productivity and consumption preferences are assumed to be independently of age. Thus, we are able to calculate per-capita variables by aggregating across ages and then dividing by population size. Variables, without individual h and age a index denote per-capita values. The households' optimizing behavior yields the consumption function

$$C_t = \frac{1-\gamma\beta}{1+\tau_t^c}\left[(1+r_{t-1})F_{t-1} + H_t + \Omega_t\right] \tag{4}$$

where $(1-\gamma\beta)$ is the marginal propensity to consume out of total wealth

$$\Omega_t = \sum_{s=t}^{\infty} \psi_{t,s}\gamma^{s-t}\left[(1-\tau_s^k)\Pi_s + \Pi_s^k\right]$$

the household financial wealth and

$$H_t = \sum_{s-t}^{\infty} \psi_{t,s}\gamma^{s-t}\left[(1-\tau_s^w)w_t L_t - T_t\right]$$

the human wealth in per-capita terms. The present value factor is defined as

$$\psi_{t,s} = \begin{cases} \psi_{t,s} = 1 \qquad \text{if} \qquad s = t \\ \psi_{t,s} = \frac{1}{(1+r_t)\cdot\ldots\cdot(1+r_{t+s})} \qquad \text{if} \qquad s > t \end{cases}$$

The optimizing behavior of households implies the following per-capita *Euler equation* for the optimal intertemporal allocation of consumption

$$(1+\tau_{t+1}^c)C_{t+1} + \frac{1-\gamma}{\gamma}(1-\gamma\beta)F_t = (1+\tau_t^c)(1+r_t)\beta C_t \tag{5}$$

We assume that each individual domestic household h faces a downward-sloping demand curve for its individual skill

$$L_t(h) = \left(\frac{W_t(h)}{W_t}\right)^{-\phi_l} L_t$$

where ϕ_l is the elasticity of substitution between differentiated labor inputs in production, L_t is the aggregate labor demand and W_t the aggregate nominal wage. Individual workers have monopolistic power in the labor market which allows them to set their individual nominal wage rate $W_t(h)$.

We follow Calvo (1983) and assume that in any period of time, only a fraction of workers can reset its wage with probability $0 < (1-\xi_w) < 1$. If a worker is not allowed to reset his wage rate for $j \geq 1$ periods, it will be updated according to the rule

$$W_{t+j} = \pi_{MU}^j W_t(h)$$

where π_{MU} is the inflation target of the common monetary authority. The optimal wage choice of an individual household that resets his individual wage rate in period t reads

$$w_t(h) = \left(\chi_0 \frac{\phi_l}{1-\phi_l}\right) \frac{E_t \sum_{s=t}^{\infty} (\gamma\beta\xi_w)^{s-t} (1 - L_s(h))^{-\chi} (1+\tau_s^c) C_s(h)}{E_t \sum_{s=t}^{\infty} (\gamma\beta\xi_w)^{s-t} (1-\tau_s^w) w_s} E_t \sum_{s=t}^{\infty} (\gamma\beta\xi_w)^{s-t} \prod_{k=1}^{s-t} \Delta w_{t+k} \quad (6)$$

where $\Delta w_t^{-1} = \frac{\pi W_{t-1}}{W_t}$ and $w_t(h) = \frac{W_t(h)}{W_t}$. The law of motion for the aggregate wage level reads

$$W_t = \xi_w \pi W_{t-1} + (1-\xi_w) W_t(h)$$

Each country in the world economy specializes in the production of a homogeneous national consumption good. The consumption basket of domestic households is given by

$$C_t = \left[(1-(1-n)\varphi)^{\frac{1}{\theta}} C_{H,t}^{\frac{\theta-1}{\theta}} + ((1-n)\varphi)^{\frac{1}{\theta}} C_{F,t}^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}} \quad (7)$$

Following Tille (2001) we refer to θ as the cross-country substitutability or trade elasticity. The assumed functional form of the consumption basket follows Sutherland (2005) and Corsetti et al. (2009). The parameter $\varphi \in [0,1]$ measures the relative weight of national goods in the household's consumption basket. A value of $\varphi < 1$ implies that the fraction of domestically produced goods in the household consumption basket exceeds the share of domestic production in the world economy, i.e. home bias in private consumption. The corresponding consumer price index is given by

$$P_t = \left((1-(1-n)\varphi) P_{H,t}^{1-\theta} + ((1-n)\varphi) P_{F,t}^{1-\theta} \right)^{\frac{1}{1-\theta}} \quad (8)$$

We assume no impediments to trade. Hence, the law of one price $P_H = P_H^*$ holds where an asterisk denotes a foreign country's variable. Home and foreign agents are assumed to have symmetric preferences.

A monetary union implies a nominal exchange rate of one, whereby the two countries share a common currency. A value of $\varphi < 1$, i.e. home bias in private consumption implies deviations from the purchasing power parity. $Q_t = \frac{P_t^*}{P_t}$ defines the real exchange rate. 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.

$$TOT = \frac{P_H}{P_F} \quad (9)$$

Thus, from the domestic household's point of view, an increase in the tot is considered to be an improvement. Domestic households maximize their utility from consumption, given their budget in any period of time. We obtain

$$C_{H,t} = (1-(1-n)\varphi) \left(\frac{P_{H,t}}{P_t}\right)^{-\theta} C_t \qquad C_{F,t} = ((1-n)\varphi) \left(\frac{P_{F,t}}{P_t}\right)^{-\theta} C_t \quad (10)$$

as the domestic private demand functions for both, home and foreign final consumption goods.

2.2 Technology and production

In each country, there are firms producing intermediate goods by combining national capital with national labor services. The production technology in the intermediate goods sector is Cobb-Douglas and we assume that intermediate firms set their prices on the basis of Calvo (1983).

The final goods sector consists of a single final good produced in each country and sold both, in the domestic and the foreign market. However, demand for final goods for public consumption and investment is restricted to the national government and capital rental firms, respectively. The final good's sector operates under perfect competition and buys the bundle of domestically produced intermediate goods. These inputs are combined by a Constant Elasticity of Substitution (CES) production function. Finally, a national capital rental firm demands the national final consumption good and transforms it into production capital. We allow for variable capital utilization with quadratic adjustment costs.

2.2.1 The capital rental firm

A representative domestic capital rental firm transforms the homogeneous consumption good into a capital good K which is used by producers of intermediate goods as productive input. We assume that each domestic household holds an identical share of the representative national capital rental firm. The capital rental firm maximizes the discounted value of its real profits

$$\frac{\Pi_t^k}{P_t} = \sum_{s=0}^{\infty} \left(\frac{1}{1+r_t} \right)^s \left[(1-\tau^k) r_{k,t+s} K_{t+s} - I_{t+s} - \frac{\kappa_k}{2} K_{t+s} \left(\frac{I_{t+s}}{K_{t+s}} - \delta \right)^2 \right]$$

where $r_{k,t}$ is the real rental cost for capital, I_t real investment and K_t the capital stock. The formulation of the capital rental sector follows Adda and Cooper (2003).

The parameter $\kappa_k > 0$ scales the capital adjustment costs, when used in production, capital depreciates at the rate of $\delta > 0$. The law of motion for the capital stock is given

by

$$K_{t+1} = (1-\delta)K_t + I_t \tag{11}$$

and the first order conditions for capital and investment are

$$q_t = 1 + \kappa_k \left(\frac{I_t}{K_t} - \delta \right) \tag{12}$$

$$q_t = \frac{\frac{P_{t+1}}{P_t}}{1+i_t} \left[(1-\tau^k_{t+1}) r_{k,t+1} + q_{t+1}(1-\delta) - \frac{\kappa_k}{2} \left(\frac{I_{t+1}}{K_{t+1}} - \delta \right)^2 + \kappa_k \left(\frac{I_{t+1}}{K_{t+1}} - \delta \right) \frac{I_{t+1}}{K_{t+1}} \right] \tag{13}$$

where q_t is the Lagrangian multiplier of the firm's optimization problem.

2.2.2 Intermediate goods producer

We assume a continuum of domestic intermediate goods' producers $i \in [0, n]$. Each producer demands capital and labor for the production of a unique variety $y_t(i)$ of the domestic intermediate good. Because of their monopolistic power, individual domestic intermediate goods' firms have the market power to set prices. Intermediate producers maximize their profits given a constant returns to scale Cobb-Douglas production technology

$$y_t(i) = K_t(i)^{\alpha} L_t(i)^{1-\alpha-\theta_p} K_{p,t}^{\theta_p} \tag{14}$$

where $0 < \alpha + \theta_G < 1$. We allow for government investment in infrastructure $K_{p,t}$. For an extensive discussion of the modelling decision, see Romp and de Haan (2007).
The optimal combination of capital and labor for a given stock of public capital is obtained from cost minimization of intermediate producers

$$mc_t = \frac{r_{k,t}}{\alpha \frac{y_t(i)}{K_t(i)}} \tag{15}$$

$$mc_t = \frac{w_t}{(1-\alpha-\theta_p) \frac{y_t(i)}{L_t(i)}} \tag{16}$$

where mc_t is the real marginal cost which is symmetric across intermediate firms.
Following Calvo (1983), an intermediate producer i renews his price in any period of time with probability $1 - \xi_p$. Thus, the probability that an intermediate goods' firm cannot reset its price in any of the periods between t and $t+j$ is ξ_p^j. If an intermediate producer cannot update his pricing calculations, prices will adjust according to the rule

$$P_{H,t+j}(i) = \pi^j_{MU} P_{H,t}$$

The optimal pricing decision in period t is given by

$$p_{H,t}(i) = \frac{\phi_g}{\phi_g - 1} \frac{E_t \sum_{j=0}^{\infty} (\gamma\beta\xi_p)^j mc_{t+j} \left(\prod_{k=1}^{j} \pi_{MU,t+k} \right) Y_{t+j}}{E_t \sum_{j=0}^{\infty} (\gamma\beta\xi_p)^j Y_{t+j}} \tag{17}$$

and the law of motion for the aggregate price level reads

$$P_{H,t} = \xi_p \pi_{MU} P_{H,t-1} + (1 - \xi_p) P_{H,t}(i)$$

2.2.3 The producer of final goods

The representative domestic final goods' firm transforms intermediate goods into the homogeneous domestic final good. The final goods' producer applies a CES technology

$$Y_t = \left(\int_0^1 y_t(i)^{\frac{\phi_g - 1}{\phi_g}} dh \right)^{\frac{\phi_g}{\phi_g - 1}} \tag{18}$$

where $\phi_g > 0$ is the substitutability between intermediate inputs. The final goods' producer chooses his inputs $i \in [0, n]$ to maximize real profits which implies

$$y_t(i) = \left(\frac{P_{H,t}(i)}{P_{H,t}} \right)^{-\phi_g} Y_t \tag{19}$$

as the demand schedule for variety i facing each individual domestic intermediate goods' producer. Under the assumption of perfect competition on the final good market, the final goods pricing rule is given by

$$P_{H,t} = \left(\int_0^1 P_{H,t}(i)^{1-\phi_g} di \right)^{\frac{1}{1-\phi_g}} \tag{20}$$

2.3 The monetary and fiscal authorities

We focus on the effects of fiscal policy. To facilitate the analysis, we use a standard monetary policy rule. The common monetary authority sets its instrument, the nominal interest rate i_t, according to the Taylor rule

$$i_t = \frac{1}{\beta} - 1 + \phi_\pi (\pi_{MU,t} - \pi_{MU}) \tag{21}$$

where $\pi_{MU} = 0$ is the inflation target. We assume that the central bank targets a union wide inflation rate which is defined as a weighted average of national variables,

i.e. $\pi_{MU,t} = n\pi_t + (1-n)\pi_t^*$ is the relevant union-wide inflation rate where $0 < n < 1$ is the relative size of the domestic country. The common central bank follows the Taylor principle and chooses $\phi_\pi > 1$.

For the given monetary policy, the domestic government decides on the level of taxation and public spending. Government spending is given by

$$G_t = G_{c,t} + I_{p,t} \tag{22}$$

where $G_{c,t}$ is the level of purely dissipative government consumption of goods and $I_{p,t}$ the level of public investment in infrastructure. The law of motion for public capital $K_{p,t}$ is given by

$$K_{p,t+1} = (1-\delta)K_{p,t} + I_{p,t} \tag{23}$$

where the capital depreciation rate is identical with that of the private sector. Government revenues stem from distortionary taxes on consumption τ_t^c, wages τ_t^w, capital income τ_t^k, the level of a non-distortionary lump-sum tax/transfer T_t and issuing public debt D_t. The real government flow budget is given by

$$\frac{D_{t-1}}{1+\pi_t} + G_t = T_t + \tau^w w_t L_t + \tau^c C_t + \tau^k r_{k,t} K_t + \tau^k \int_0^1 \Pi_t(i)di + \frac{D_t}{1+r_t} \tag{24}$$

The model setup allows for a wide variety of possible fiscal policy measures such as, dissipative public spending on goods, public investment or cuts in distortionary taxation as well as lump-sum taxation. There are several instruments on the spending and revenue side of the public budget which enable the government to balance its budget or to decrease the level of public debt. Fiscal policy enters the model as an exogenous change in the level of taxation, public investment or consumption. Fiscal shocks, e.g. a shock to government consumption

$$G_{c,t} = \rho G_{c,t-1} + \epsilon_t \tag{25}$$

evolve according to a AR(1) process, where $0 < \rho < 1$ measures the persistence of the shock. We assume that, for legislative issues, fiscal expansions are always pre-financed by debt.

After a period of one year, the government decides on the measures which it considers being appropriate as to return the level of the public debt stock to the assumed target by employing a simple feedback rule

$$T_t = \tau D_{t-1} + \tau^d (D_{t-1} - D) \tag{26}$$

which may imply changes in each of the tax rates or the level of public spending on goods and investment. Changes in public consumption or investment and distortionary taxation complete the set of possible financing instruments.

2.4 Dynamic equilibria and calibration of the model

The per-capita law of motion for consumption (5), the optimal wage choice of households (6), the definition of the household consumption basket (7), the aggregate demand for home and foreign goods (10), and the definition of the consumption-based price index (8) in the domestic country as well as their foreign counterparts describe the demand side of the model. The supply side is characterized by the aggregate production function of the intermediate goods sector (14), the law of motion for the capital stock (11), the first order conditions for capital and investment (13), (12) from the capital rental sector, the optimal pricing decision for intermediate goods (17), the optimal combination of capital and labor (16), (15) for a given stock of public capital in the intermediate goods sector. This set of equations, together with the resource constraints

$$Y_t = C_t + I_t + G_t \qquad Y_t^* = C_t^* + I_t^* + G_t^* \tag{27}$$

the Fisher equations

$$1 + i_t = (1 + r_t) E_t \frac{P_{t+1}}{P_t} \qquad 1 + i_t = (1 + r_t^*) E_t \frac{P_{t+1}^*}{P_t^*} \tag{28}$$

the government budget constraint (24) in the home and foreign country and the current account equation

$$B_t = (1 + r_{t-1}) B_{t-1} + Y_t - C_t - I_t - G_t \tag{29}$$

where $B = F - D$ denotes the net foreign assets position in a given period, fully characterizes the dynamic equilibria of the model in per-capita terms. In the aggregate, we assume that $nB + (1 - n) B^* = 0$ holds in any period of time. The model is closed by the feedback rules for monetary policy (21) and fiscal policy (26). We assume that national governments provide a constant level of public investment in order to maintain the public capital stock and consume a constant amount of national goods in equilibrium.

Following Leeper (1991), we categorize fiscal and monetary policy as being either *active* or *passive*, depending on their stance to the state of public finances. A policy authority

β	$2/\chi$	$1/\kappa_k$	δ	α	θ_p	ξ_p	ξ_w	τ^c	τ^w	τ^k	ρ	τ^d	ϕ_π	n	φ	θ
0.99	0.5	0.04	0.025	0.3	0.1	0.75	0.83	0.1	0.279	0.279	0.9	0.05	1.5	0.27	0.185	2/3

Table 1: Calibration of the model parameters

that does not respond to the level of national public debt is active. Thus, a systematic response of fiscal policy to the level of national liabilities as such so that public debt is stabilized around a target level, is characterized as passive fiscal policy. We assume that national fiscal policy is constrained and sufficiently responds to the state of public finances.

Leith and von Thadden (2008) show that the Blanchard (1985)-Yaari (1965) OLG with capital accumulation has determinate equilibria when monetary policy is active and fiscal policy passive. The model has no closed-form solution and is solved numerically by using DYNARE. The applied approach is a first order Taylor approximation around the steady state, following the approach of Schmitt-Grohe and Uribe (2004).

We calibrate the model's parameters as such so that one period of time corresponds with one quarter. For a summary of our set of parameter chosen, see table 1. Except for the country-size, all selected parameters are symmetrical for the home and foreign country. The calculation of the relative size of the domestic country $n = 0.27$ is based on ECB data to match Germany in terms of its share of the EMU's gross domestic product.

We suggest four alternative values for the survival probability which are $\gamma = 0.95, 0.975, 0.99$ and 1. These imply average individual planing horizons of 5, 10, 25 and an infinite number of years. Such a setup allows us to explore the impact of failures of the Ricardian equivalence with regard to the effects of fiscal policy. We are not aware of any empirical consensus for γ. In the literature, a value of $\gamma = 0.99$ is frequently suggested, see e.g. Smets and Wouters (2002).

For trade elasticity and the home bias in private consumption, we set $\theta = 2/3$ and $\varphi = 0.185$, respectively. These values are taken from Corsetti et al. (2009). However, a broad variety of values for the trade elasticity can be found in the empirical literature, see Corsetti et al. (2008). A higher elasticity of substitution between home and foreign

goods, in our model, affects the size of spillovers. In fact, spillovers increase alongside the degree of substitutability between home and foreign production.

We set the discount factor in the utility function to $\beta = 0.99$ and the Frisch elasticity of labor supply to $\frac{2}{\chi} = 0.5$. For a discussion of the latter choice, see Domeij and Floden (2006). We assume that, in equilibrium, workers spend one third of their time endowment working.

As for the capital depreciation rate, we assume a value of $\delta = 0.025$ and set $\frac{1}{\kappa_k} = 0.04$ which is a conventional value for quadratic capital adjustment costs, according to Adda and Cooper (2003).

In the Cobb-Douglas function, the elasticity of output with respect to private and public capital is set to $\alpha = 0.3$ and $\theta_p = 0.1$, respectively. The latter value finds itself within the range of empirical estimates, reported in the survey of Romp and de Haan (2007).

Our model features monopolistic competition in the goods and labor markets. We choose conventional markups of 10%. In the goods market, the average price duration is set to 4 quarters which corresponds to $\xi_p = 0.75$ and is in accordance with the empirical evidence, see Alvarez et al. (2006). Wage contracts last longer than price spells, we set $\xi_w = 0.83$ which implies one and a half years being the average duration of wage contracts. The assumption that wages are more sticky than prices is common in the literature, see Christoffel et al. (2009) or Corsetti et al. (2009).

For the Taylor rule describing the behavior of the common central bank, we assume a standard value of $\phi_\pi = 1.5$ for the Taylor coefficient. The distortionary tax rates are set in accordance with Andres and Domenech (2006) who estimate rates of $\tau^c = 0.1, \tau^w = 0.279, \tau^k = 0.279$ on the basis of European data.

For the persistence of public spending shocks, we assume $\rho = 0.9$ where we follow the example of Corsetti et al. (2009). The fiscal authorities pre-finance spending measures by issuing public liabilities. The level of public debt is returned to the target level according to the rule (26) where we assume $\tau_t = r_t, \tau^b = 0.05$.

The first choice implies that the government finances interest payments fully by either increased taxation or spending cuts. The second assumption implies that in each quarter

the government repays five percent of the above-target stock of public debt. However, such an assumption is more ambitious than the proposals of the European Council for the Euro Plus Pact of 24/25 March 2011.

3 Fiscal stabilization policies

We assess the impact of fiscal instruments as suggested by the EERP which aimed at holding and even reversing the economic downturn in the wake of the financial crisis in an open economy model of a monetary union. Discretionary increases in public investment were expected to strengthen aggregate demand in the short run and contribute to the prosperity of the EU in the long run. Both measures were expected to stabilize employment and therefore labor income of European consumers. Tax cuts targeted to households were suggested as to strengthen the purchasing power of households and with that to stabilize private demand and thus to contribute to the stabilization of aggregate demand.

The model is calibrated to mirror the relation between Germany, as the major economy in the EMU, and the remaining members of the monetary union. Our focus is on discretionary fiscal measures, included in the German Konjunkturpaket II.

Our model allows for alternative financing choices by the government. We evaluate an increase in public consumption and investment as well as a lump-sum subsidy to households. We investigate how failures of the Ricardian equivalence influence the stabilizing power of fiscal policy. Furthermore, we analyze how alternative financing decisions influence national effects and the spillovers on other members of the currency union.

3.1 Government consumption

We assume an exogenous increase in public consumption according to the AR(1) process (25). The domestic government finances the increased spending on goods in advance by issuing public debt. With a time lag of one year, the fiscal authorities decide on how to return the level of public liabilities to the initial level. For now, we assume that the

increase in public consumption is financed by lump-sum taxation according to the simple feedback rule (26). The numerical results of this policy are reported in Figs. 1, 2.

Here, as in all subsequent illustrations, the horizontal axes indicate the timepath of variables in the periods of time in the aftermath of a fiscal policy shock. One period of time corresponds to one quarter. Variables are expressed in deviations from their steady state values where solid lines refer to the Ricardian case where $\gamma = 1$, dotted, dashed and dash-dotted lines refer to our alternative values of the survival probability, $\gamma = 0.99$, $\gamma = 0.975$ and $\gamma = 0.95$, respectively.

In the case of Ricardian households, $\gamma = 1$, the model reproduces the results of standard new Keynesian open economy models. A shock to public consumption which is pre-financed by debt and paid by domestic households via taxation in the long run, implies a negative wealth effect.

The government exclusively purchases national goods. A discretionary increase in domestic public spending augments the demand for home goods one-to-one. Increases in demand for domestic goods allow producers to raise prices. They increase their demand for the productive inputs capital and labor, with the effect that marginal costs and domestic inflation rise. We observe a persistent increase in domestic output and labor demand.

We observe an increase in hours worked, while nominal labor income is rising and the domestic real wage rate declining. The decrease in the real wage rate does not allow households to fully offset the resulting income loss. As a consequence, households adjust their consumption plans downwards. However, the decrease in private demand for domestic final goods is more than offset by the increases in public demand.

The union-wide monetary authority targets a weighted average of the inflation rates of the member countries of the currency union. It responds to the fiscal spending shock by increasing the nominal interest rate to keep the union-wide inflation at bay. Moreover, the domestic government finances public spending in advance by issuing public debt. These mechanisms put an upward pressure on the domestic real interest rate.

The domestic inflation rate is higher than the union-wide average which is targeted by

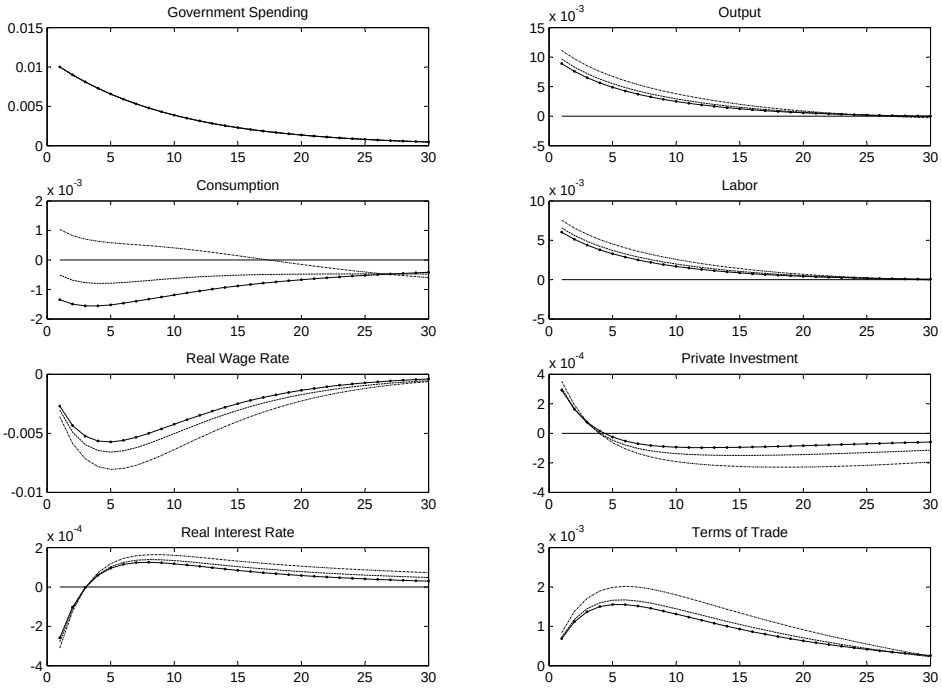

Figure 1: An increase in domestic public consumption financed by lump-sum taxation.

the common central bank. Thus, the increase in the union-wide nominal interest rate is too mild as compared to the case of a national central bank. A strong rise in domestic inflation implies a decrease in the domestic real interest rate. However, domestic inflation quickly returns to its pre-shock level which allows the domestic real interest rate to rise above its steady state level.

We observe an immediate increase in domestic private investment which is followed by a persistent period of crowding out. However, it should be recalled that the nominal interest rate is determined at union level. Thus, these effects are small and the response of private investment is negligible.

In summary, a temporary increase in public consumption which is financed by taxation affects the domestic components of aggregate demand in different ways. Public demand increases, while private demand for consumption and investment purposes decreases.

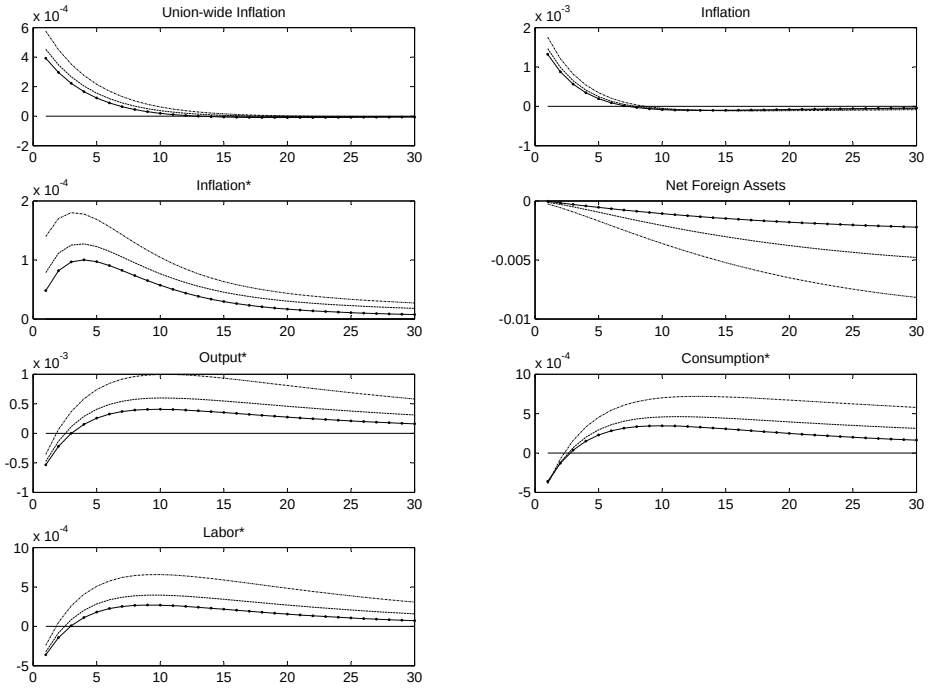

Figure 2: An increase in domestic public consumption financed by lump-sum taxation.

Domestic output is increased when compared to the pre-shock level.

Government spending falls exclusively on domestic final goods. Potential spillovers are driven by domestic private demand. Because of the inflation differential, the home country's terms of trade improve. The composition of public demand differs from household consumption. Households consume home and foreign final goods according to the consumption basket (7). The demand for each type of good depends on the substitutability between home and foreign goods, the size on the national economy as well as the assumed degree of home bias in consumption. Households have the opportunity to substitute foreign goods for domestic goods in their consumption basket. Expenditure switching explains why the domestic country's net foreign asset position worsens persistently.

We observe an initial drop in foreign output which is then followed by a persistent in-

crease. In our baseline parametrization of the consumption basket, we assume a value of $\theta = 0.66$ at the lower bound of the empirical estimates for the elasticity between home and foreign goods. Domestic and foreign output are poor substitutes.

The household's consumption choice has an inter- as well as an intratemporal dimension. The first choice is governed by the decrease in permanent income which is implied by the assumed policy choice, i.e. the consumption-savings decision. The second choice depends on the trade elasticity.

We observe a pronounced decrease in domestic consumption demand which slowly returns to its initial level. Expenditure switching does not increase the demand for foreign final goods, at least not during the first quarters after the fiscal shock. As domestic consumption returns to its initial level, expenditure switching pushes domestic household's demand for foreign output above its steady state level.

We observe positive spillovers on output, consumption and employment abroad. But these spillovers are weak and sensitive to changes in the value of the trade elasticity, e.g. a value of $\theta = 4$ at the upper bound of the empirical estimates lets negative spillovers on foreign output disappear.

The assumption of uncertain lifetime affects the consumption-saving decision of households. If $\gamma < 1$, then taxation and public debt are no equivalent financing instruments. Household demand (4) is a function of current and future total wealth where the weight of each component depends on the survival probability. Changes in the level of public debt, in lump-sum taxation and in labor income imply changes in total wealth and affect household consumption.

In the period of time during which a fiscal shock hits the economy, household income is reduced by a drop in the real wage rate. This decrease in disposable income cannot be fully offset by the increase in hours worked. The financing decision in terms of increased taxation comes into effect with a lag of four quarters and decreases future income. Between the timespan during which the increase in public consumption occurs and the subsequent financing decision, households benefit from the positive wealth effects of increased public debt.

Finite lifespans mitigate the negative effects of a tax-financed increase in public consumption on private demand and even reverse them for low values of γ. The shorter the planing horizon, the more pronounced the positive wealth effects are.

We observe a more pronounced increase in domestic output and hours worked. Again, the response of private investment is negligible, the real wage rate is decreased and households profit from improved terms of trade and substitute foreign for domestic goods. The stimulus of aggregate demand is more pronounced as compared to the assumption of Ricardian households and the same is true for the positive spillovers on the foreign country. Our results confirm previous findings in the literature, e.g. Gali et al. (2007), Coenen and Straub (2005) or Cwik and Wieland (2010).

To carve out the impact of the financing decision on the effects of fiscal shocks, we discuss the extreme case in which the assumed increase in public consumption is completely financed by future spending cuts. The numerical results are given in Figs. 3, 4. If the government decides to finance additional current spending by reducing future spending on goods, the effects of fiscal policy on aggregate demand will change substantially over time. In the period of time during which the public spending shock hits the economy, public demand for goods is increased above the steady state level.

With a time lag of one year, the government begins to return the level of public liabilities to the target level. During this process, depending on the choice of the fiscal policy parameter τ^d, government consumption decreases below the initial level. This is precisely what Corsetti et al. (2009) label a spending reversal. Moreover, Paredes et al. (2014) confirm spending reversals in 2010 as the typical consolidation strategy which was implemented by European governments to cope with increasing levels of public liabilities.

We start the discussion with the Ricardian case. An increase of public consumption which is financed by future spending cuts affects the permanent income of households. In the long run, public consumption is decreased as the cut in future spending exceeds any temporary stimulus because of interest payments on public debt.

Public consumption stimulates the demand for domestic goods one-to-one. The domestic price level rises and we observe an increase in demand for domestic productive inputs.

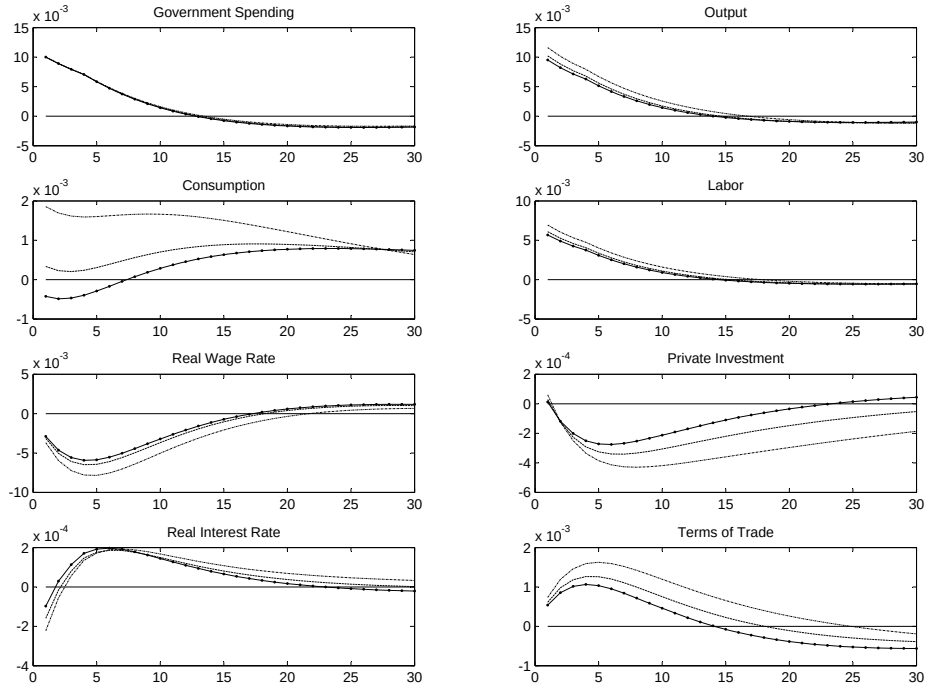

Figure 3: An increase in domestic public consumption financed by future spending cuts.

Employment in the home country increases and the real wage rate is persistently decreased. The income loss cannot be fully offset by the increase in employment. Domestic household's demand is decreased for more than eight quarters following the fiscal shock. However, the decrease in private demand for domestic final goods is more than offset by the increase in public demand. We observe a persistent increase in domestic production in the periods of time that follow the fiscal shock.

The common central bank responds to the increase in its monetary target by increasing the union-wide interest rate. As before, this response is too mild from the domestic country's point of view and too restrictive for the other countries of the monetary union. The domestic real interest rate is decreased. However, this effect as well as the response of domestic investment is small.

In contrast to the case of a tax-financed increase in domestic public consumption, this

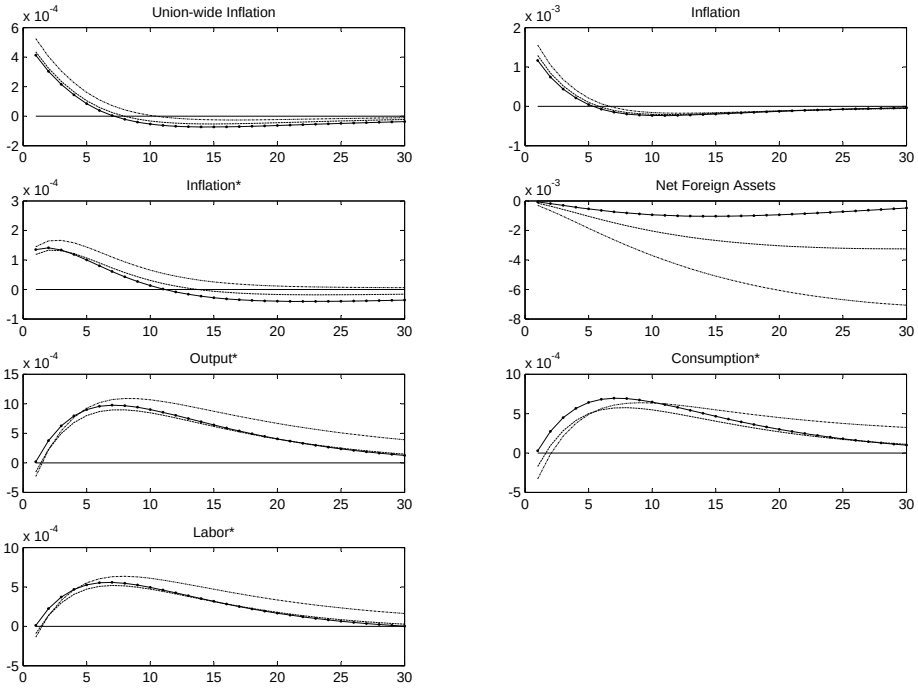

Figure 4: An increase in domestic public consumption financed by future spending cuts.

variable does not only return to the initial level, but decreases below the equilibrium level. The effect on aggregate demand for home goods is reversed.

A decrease in demand for domestic goods puts a downward pressure on the domestic inflation rate and pushes it beneath the equilibrium value. The nominal wage rate adjusts upwards in a staggered fashion. These two effects imply an increase in the real wage rate above its equilibrium level over time. In addition, domestic households benefit from interest payments by the domestic government. Thus, the effects of the assumed policy on domestic permanent income are reversed, too.

Forward-looking households recognize the implications of such a policy. Domestic consumption increases above the steady state level well before the spending reversal occurs. The increase in private demand cannot offset the decrease in aggregate demand which is implied by the spending reversal in public consumption, in the medium term. Domestic

output decreases below its initial level five years after the initial fiscal shock occurred. With reference to the previous case of a tax-financed increase in public spending, the spillovers of this policy depend on the response of household consumption as well as on the parameter choice for the trade elasticity. We observe an improvement in the domestic terms of trade and a persistent decrease in the home country's net foreign asset position.

Domestic households substitute foreign for domestic goods. Consequently, the initial response of foreign output and consumption is negative followed by persistent increases in these variables which mirrors the response of domestic private demand. Moreover, we observe a positive spillover on foreign employment.

Again, part of the initial negative spillover is due to the parametrization of the model. When we switch from our baseline scenario $\theta = 0.66$ to a value of $\theta = 4$ at the upper bound of the empirical estimates, the negative spillover on foreign output vanishes. We observe an initial decrease in domestic private demand which slowly returns to its initial level. Moreover, home consumption demand increases above its equilibrium level. The spillovers of a domestic expansion of public consumption are positive and more pronounced than in the baseline calibration. The magnitude of the spillover effects increases with the chosen value for the elasticity between home and foreign goods by the same mechanism as discussed above.

Uncertain lifetimes $\gamma < 1$ work through their impact on the consumption-savings decision of households. Household demand (4) is a function of current and future total wealth were the weight of each component depends on the survival probability of individuals. An increase in public debt is perceived as an increase in total wealth. Moreover, real labor income and future taxation that enter total wealth affect the consumption decision of finitely-lived households. In the period of time during which the fiscal shock hits the economy, household income is decreased by the drop in the real wage rate. The accumulation of public debt that is required to finance such a fiscal policy, has a positive effect on per-capita wealth.

Finite lifetimes imply that households may die before the fiscal measure is completed.

They may not live long enough to witness the spending reversal or the period in which the level of public debt has returned to its initial level. Thus, finite planning horizons mitigate the negative effects of fiscal policy on household income.

We observe a less pronounced drop in private demand in the time periods that follow directly after the fiscal shocks. Overall, the level of private demand increases in relation to the planing horizons of individuals, e.g. the higher the demand increases, the shorter the planning horizons become.

The expansionary effects of fiscal policy and the spillovers are more pronounced. Most noticeable, given the alternative financing decision of a future cut in public consumption, private demand is increased up to values of the survival probability which are common in the theoretical literature.

We conclude that both, failures of the Ricardian equivalence as well as the financing decision of the government, have a strong impact on the model predictions.

3.2 A lump-sum transfer to households

The German Konjukturpaket II included direct transfers and debt-financed tax cuts which were targeted at households. We explore the effects of such policies by assuming a lump-sum subsidy to domestic consumers that is either financed by future taxation or decreases in public consumption. We assume a lump-sum transfer which is financed beforehand by issuing public debt. After a time period of one year the government decides on the fiscal instrument in order to return the level of public debt to the target level.

We start the discussion by assuming that the fiscal measure is financed by taxation. The numerical results are given in Figs. 5, 6. A lump-sum subsidy financed by future lump-sum taxation is a intertemporal redistribution of income. Current generations receive a subsidy which is financed by future generations. The overall tax burden of households is the sum of the transfer shock and the increase in taxation which is required to finance this transfer.

The expansive effects depend entirely on the consumption-savings decisions of households. Thus, should the Ricardian equivalence hold, we will observe, apart from changes

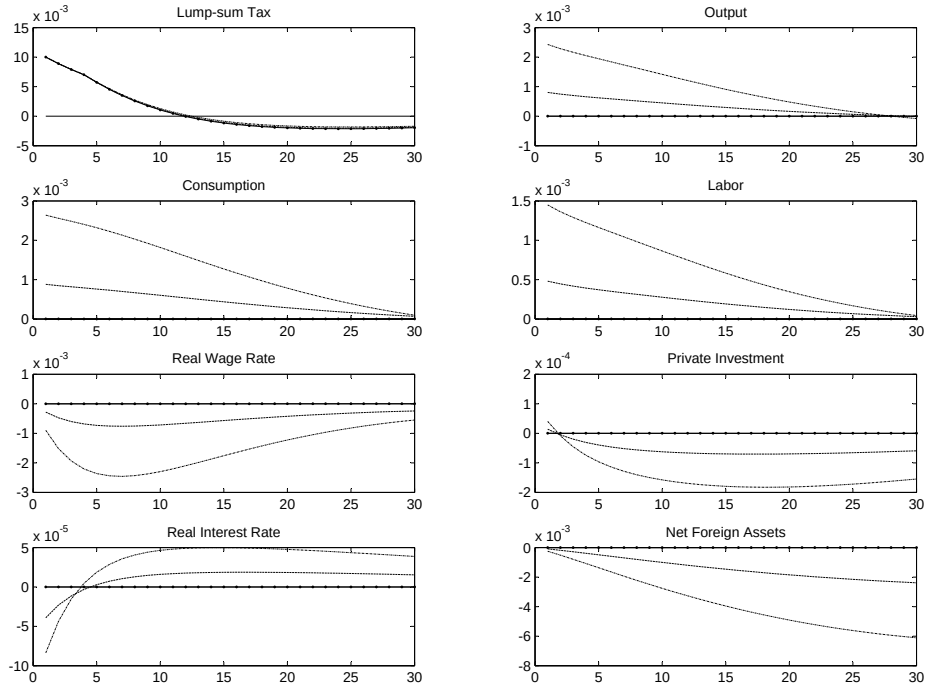

Figure 5: A lump-sum subsidy to domestic households financed by lump-sum taxation.

in public liabilities and lump-sum tax rates, no effect at all.

If households face uncertain planning horizons, public debt enters the model's equilibrium conditions and becomes a relevant state variable. Non-Ricardian households perceive public debt as net wealth. From the time period onwards at which the transfer shock hits the economy, income of domestic households rises. The government prefinances the subsidy by issuing debt. Domestic households benefit from a positive wealth effect. With a time lag of one year, steadily increasing lump-sum taxes are levied to finance the temporary subsidy, i.e. to pay debt services on public liabilities and to return the stock of public debt to the target level.

Depending on the persistence of the transfer shock and the fiscal policy parameters τ, τ^d, the net effect on household income turns negative. Moreover, the sum of taxation levied to return the level of public debt to the target level exceeds the temporary subsidy in

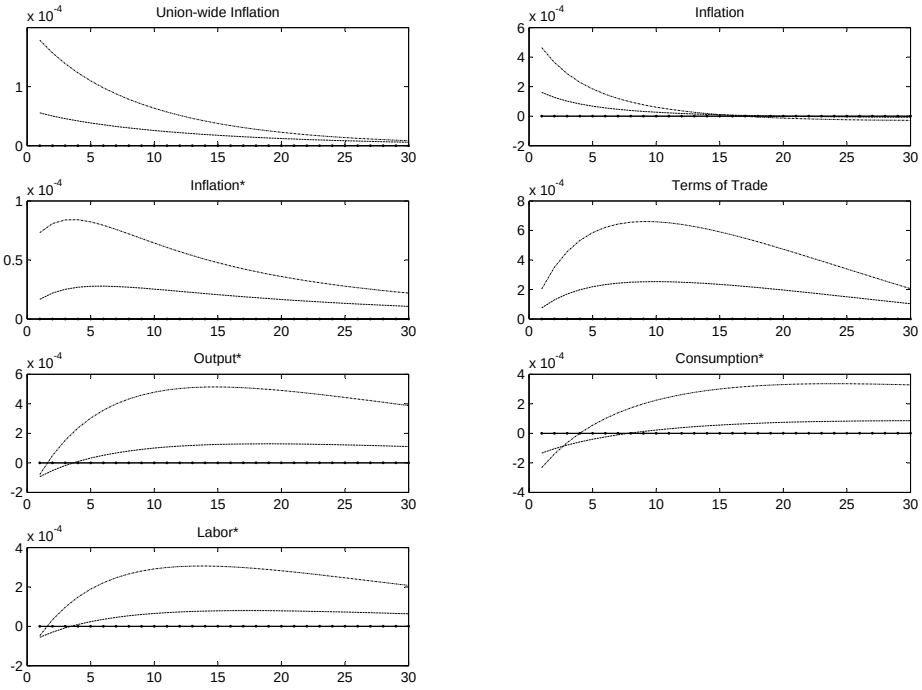

Figure 6: A lump-sum subsidy to domestic households financed by lump-sum taxation.

the long run, because there are interest payments on public debt to make. The effect of a lump-sum subsidy together with the related increase in public debt on total wealth is positive on impact but turns negative as soon as the taxes levied with regard to returning the level of public liabilities exceed the volume of the subsidy. The positive wealth effect of public liabilities vanishes as soon as the level of public debt has returned to the target level.

Wealth effects entirely depend on γ. The lower the probability to survive, which is reflected in an increasing myopia of households, the stronger is the positive effect on total wealth. Non-Ricardian households exploit this opportunity and use the additional income to increase their consumption. In the domestic country, the hike in demand for final consumption goods enables producers to increase their prices. They demand more labor and capital in order to increase their production.

As a consequence, the domestic inflation rate is higher than abroad and the response of monetary policy is too dovish for the domestic country and too hawkish for the remaining members of the monetary union. Similarly as before, the response of domestic investment is small and driven by the real interest rates in the home country.

In summary: Under the assumption of non-Ricardian behavior, a redistribution of household income from future generations in favor of the current generations increases current household demand. Households increase their consumption, with the effect that domestic output and employment go up. In contrast to public spending, households spend on home and foreign goods. The inflation differential between the home and foreign country leads to an improvement of the domestic country's terms of trade. We observe positive spillovers.

We contrast the tax-financed lump-sum transfer to the case where a subsidy to current

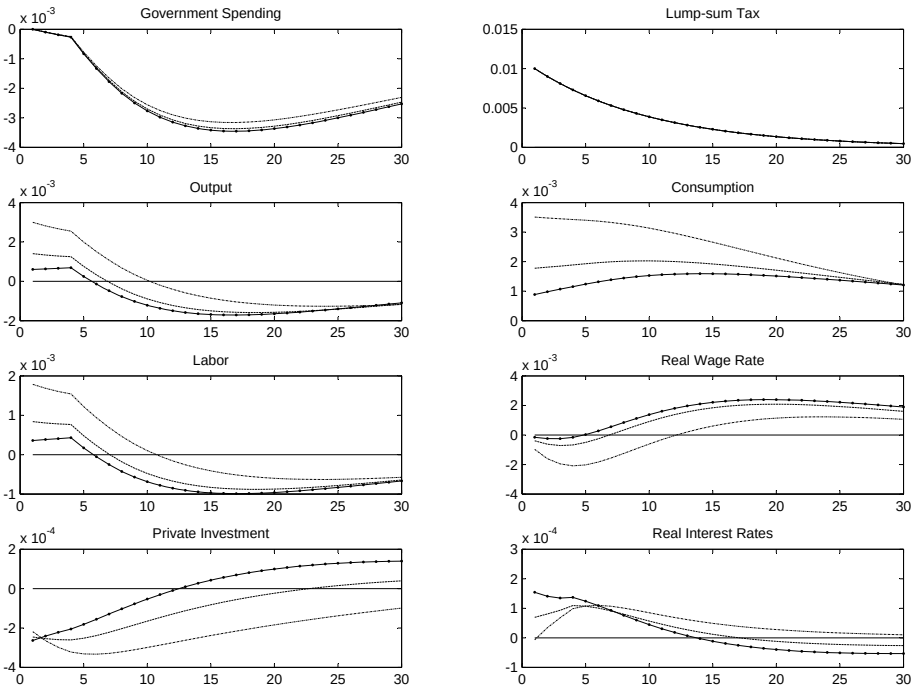

Figure 7: A lump-sum subsidy to domestic households financed by future spending cuts.

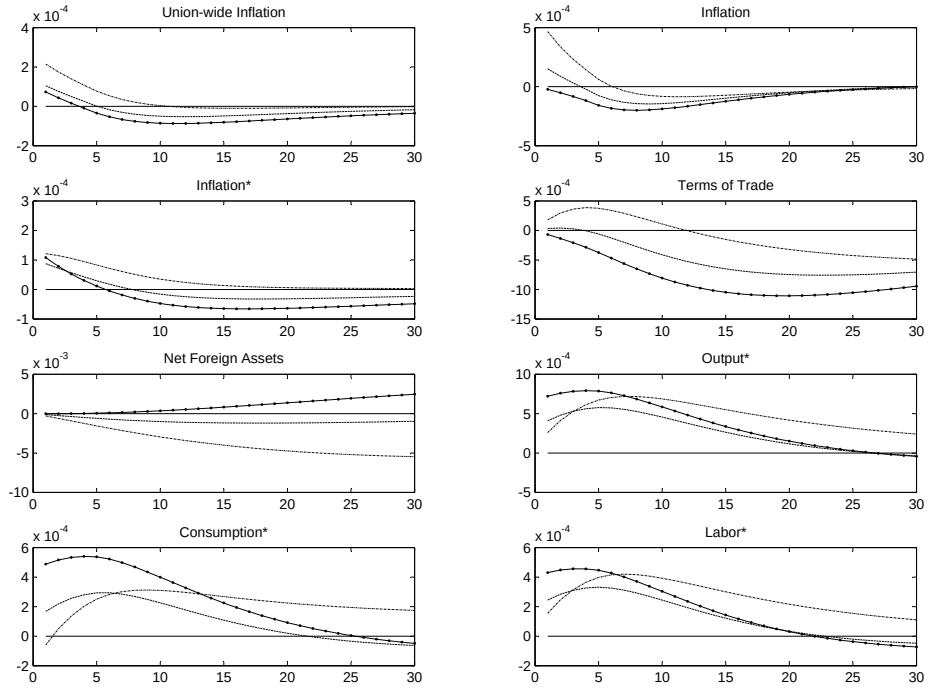

Figure 8: A lump-sum subsidy to domestic households financed by future spending cuts.

generations is financed by decreases in future public consumption, see Figs. 7, 8. The assumption that a subsidy to current generations is financed by future spending cuts, changes the impact of the assumed fiscal measure on aggregate demand.

In terms of the standard model, this policy corresponds to a temporary balanced-budget decrease in domestic tax rates. Ricardian households benefit from a positive wealth effect. We observe a persistent increase in private demand. Domestic output and employment as well as domestic inflation increase on impact. The real wage rate in the home country decreases.

However, as the financing decision of cuts in public consumption comes into effect, the response of these domestic variables is reversed. Public demand falls exclusively on domestic goods. The increase in private demand cannot offset the drop in aggregate demand for domestic goods which is implied by the financing decision.

Domestic households do not spend their additional income completely on domestic goods but derive utility from home and foreign products. Thus, a fraction of the additional income is spend on foreign goods.
In the medium term, the demand for domestic goods decreases and foreign producers benefit from improved demand by domestic households. Thus, the inflation rate in the domestic country is lower than the inflation rate abroad. By construction of the central bank's inflation target, the response of monetary policy is too mild for the home country and too restrictive abroad. The terms of trade of the home country worsen considerably. The spillovers of this policy depend on its impact on private demand. Domestic households demand more consumption goods. However, home bias in consumption and worsened terms of trade mitigate this effect on demand for foreign goods. Foreign producers benefit from increased demand for their production. We observe positive spillovers.
Allowing for failures of the Ricardian equivalence does not change the effects of a temporary decrease in taxation which is financed by future decreases in public consumption substantially. Failures of the Ricardian equivalence work by the additional wealth channel since public debt is perceived as net wealth. The increase in private demand is more pronounced and offsets the decrease in public demand for domestic goods for several additional quarters if compared to the Ricardian case.
The terms of trade effects are reversed. The terms of trade improve on impact and worsen over time as private demand returns to its pre-shock level. The assumption of finite lifetime leads to an increase in the spillovers as an overall increase in private demand adds to the demand for foreign goods.

3.3 Public investment

The European Commission (2008) strongly advocates increases in public investment to strengthen aggregate demand in the short run and to secure Europe's prosperity in the long run. In practice, policymakers rely on the occurrence of such double-dividends of public investment. Thus, public investment in infrastructure has been an important part of the German Konjunkturpaket II.

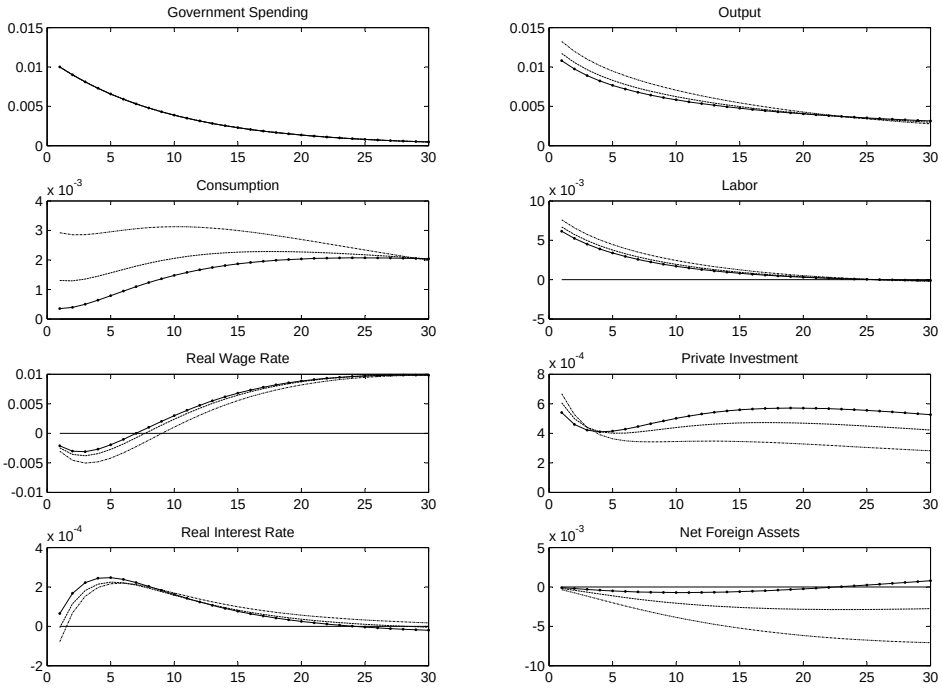

Figure 9: Domestic public investment financed by lump-sum taxation.

We evaluate a temporary increase in public investment which was intended to stimulate the domestic economy. As before, fiscal policy is pre-financed by the issuance of public debt. With a time lag of one year, the government decides on the fiscal instruments employed to finance debt-services and to return the level of public liabilities to the target level. The choice is between an increase of lump-sum tax rates and a future cut in public consumption.

We start our discussion with the Ricardian case by assuming that the fiscal authorities decide to use lump-sum taxation as their preferred financing instrument. For the numerical results, see Figs. 9, 10. The effects of a temporary increase in public investment on the economy are similar to a positive productivity shock in the home country. Moreover, the domestic government does exclusively use home final goods to increase the public capital stock. Thus, apart from its effects on domestic productivity, public investment

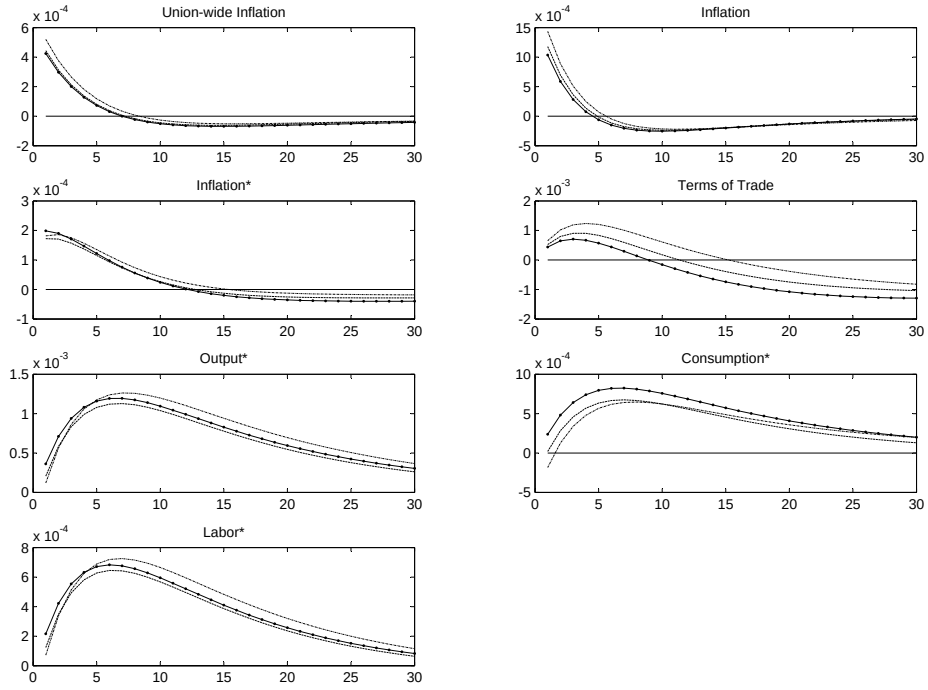

Figure 10: Domestic public investment financed by lump-sum taxation.

increases the demand for domestic goods.

Domestic households anticipate the wealth effects which are implied by the governments financing decision. The positive effects on permanent income prevail and the income of households increased. Households have to decide whether they wish to consume the whole amount of additional income today or to save it. According to the Euler equation (5), domestic households base their consumption-saving decision on their expected life-time income. Moreover, households prefer to smooth consumption over time.

They decide to consume some of their higher income and save the rest to enable increased consumption of goods and leisure as well as to finance future rises of tax rates. We observe a persistent increase in consumption and private investment.

Domestic producers set their prices in a forward-looking manner. However, price-setting is staggered and the fiscal policy shock has two opposing effects on price-setting. Firstly,

the domestic government demands more goods to bolster the domestic stock of public capital. Secondly, households in the home country increase their demand for domestic goods and with that increase their overall consumption and to save. Both effects imply an increase in aggregate demand for home production and, in principle, allow domestic producers to demand higher prices. But domestic producers are also more productive which puts a downward pressure on the prices of domestic goods.

We observe an increase in domestic prices on impact. The level of domestic public investment decreases over time. After approximately one year, the second effect prevails and prices fall below the pre-shock level. This phenomenon is mirrored in the response of domestic employment which is increased on impact but falls below the pre-shock level over time.

The common central bank responds to the average inflation rate in the monetary union. The increase in public investment is restricted to the domestic country. Thus, the home inflation rate rises above the level of the inflation rate abroad. The response of monetary policy is too loose for the home country and too restrictive for the rest of the currency union. As soon as the effects of enhanced domestic productivity prevail, the situation is reversed.

The inflation rate differential is mirrored in the response of the terms of trade. These improve on impact and worsen over time as the domestic price level declines below the pre-shock level.

The spillovers are driven by private demand. Domestic households demand more home and foreign goods as they have become more wealthy because of increased domestic productivity. Moreover, while domestic terms of trade are improved because of the strong effects of this policy on the demand for domestic goods, foreign production is comparatively cheap. We observe positive spillovers.

If we allow for failures of the Ricardian equivalence, the effects of a tax-financed increase in public investment will not change substantially. Depending on the assumed degree of household myopia a fraction of the implied increase in future tax rates occurs in time periods beyond their planning horizon. Thus, failures of the Ricardian equivalence imply

a more pronounced response of household consumption. As a consequence, the responses of domestic macroeconomic variables, e.g. domestic output and employment, are more pronounced. In particular, as domestic consumption falls on home and foreign goods, the spillovers on the foreign country are amplified.

However, an exogenous and temporary increase in domestic public consumption works as an increase in domestic productivity, the effects of failures of the Ricardian equivalence are small.

The alternative financing decision which would imply future cuts in the budget for

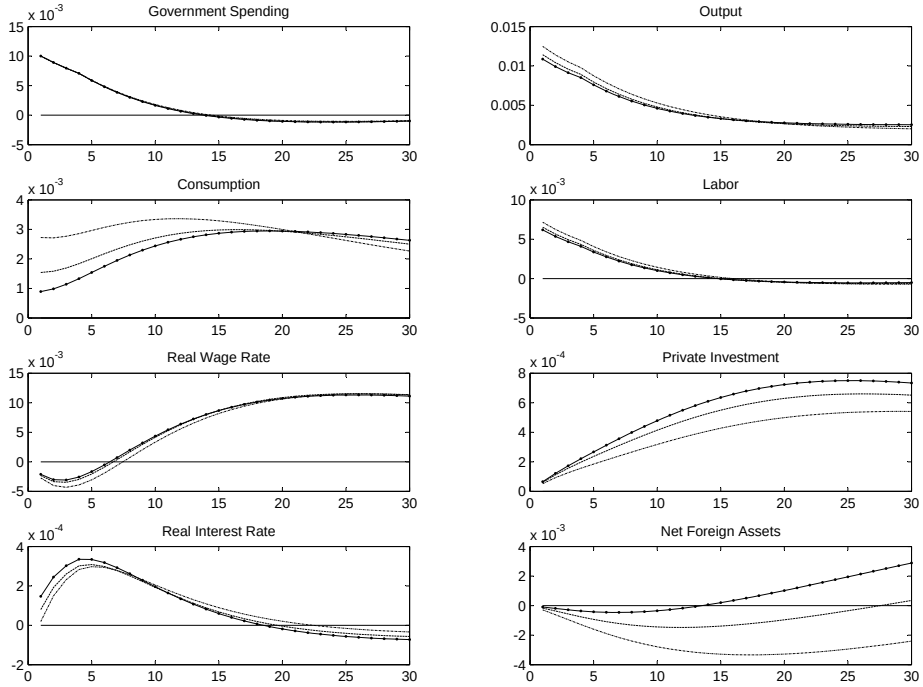

Figure 11: Domestic public investment financed by future spending cuts.

public consumption in order to finance a temporary increase in public investment, does not change the effects of public investment shocks substantially either. Again, financing public investment by reduction in future government spending alters the policy impact on household wealth. We observe similar, but more pronounced effects, see Figs. 11, 12.

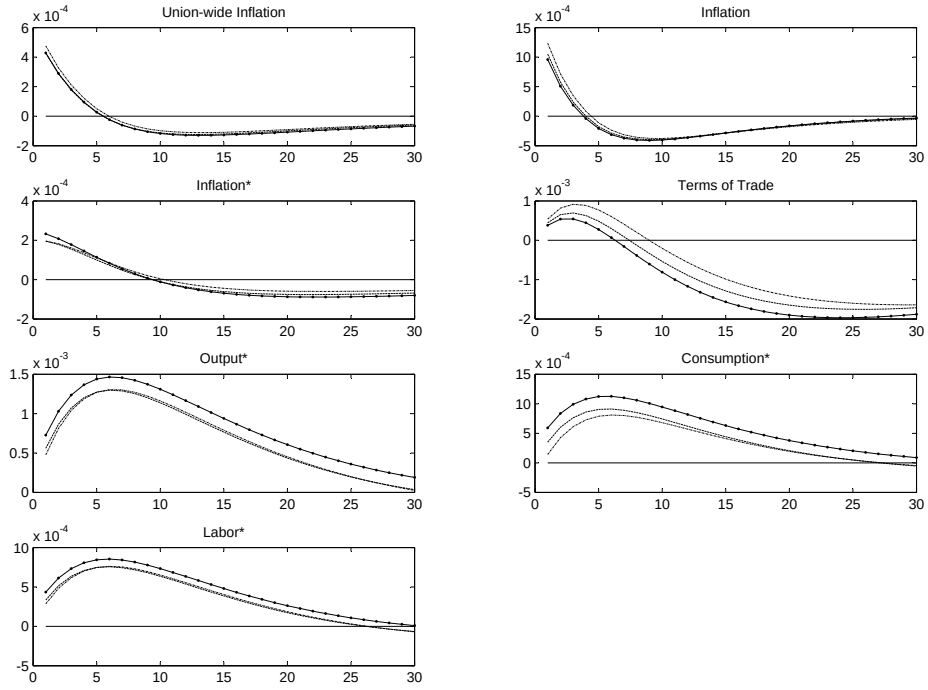

Figure 12: Domestic public investment financed by future spending cuts.

The changes in the response of variables are driven by household behavior.

The government levies a constant level of taxation which is defined by the steady state rates of distortionary tax rates. In particular, additional tax revenues are not spend but redistributed to households or used to cover debt services. An increase in domestic investment financed by cuts in public consumption redistributes existing tax revenues from unproductive consumption to the enhancement of national productivity.

A temporary hike in public investment increases the production possibilities in our model economy. By assuming that the government finances this measure by decreasing future public consumption, the negative wealth effects of such a policy choice in terms of increasing tax rates vanishes.

The alternative financing decision of future spending cuts increases the positive wealth effects for households. The increase in private consumption is more pronounced as com-

pared to a tax-financed increase in public investment. In turn, the response of household consumption amplifies the increase in domestic output and employment. Thus, the observed inflation rate differential between the home and foreign country as well as the spillovers increase.

Allowing for failures of the Ricardian equivalence has only small effects on the model's predictions. Again, the response of the home and foreign variables is driven by the productivity enhancement in the domestic country. In contrast to other fiscal instruments, e.g. an increase in public consumption, failures of the Ricardian equivalence do not have the power to change the model's prediction qualitatively and the quantitative changes remain small.

4 Conclusions

In this paper, we elaborate an extended new open economy macroeconomics model of a monetary union with the aim of exploring the effects of fiscal policy measures as a function of alternative fiscal consolidation strategies which are implemented at national level. In doing so, we aim at contributing to close a gap in the literature. The overwhelming majority of research related to public spending is focused on the spending side of public budgets.

We find that an increase in public consumption increases national output and employment, independently of the financing decision. The response of household consumption is sensitive to the financing choice of the government. If public consumption is financed by future taxation, Ricardian households suffer from negative wealth effects and adjust their consumption plans downwards. Private demand remains persistently below the pre-shock level which mitigates the expansive effects of public consumption with regard to both, national production and employment.

When assuming that the government decides to finance increases in current spending on goods by future decreases in public consumption, the negative wealth effects of this policy choice are moderate. The consumption demand of Ricardian households is de-

creased on impact but quickly returns to its pre-shock level. It even rises to a higher level as compared to the pre-shock level, even before the financing decision comes into effect. For both financing strategies, the multiplier effect on national output is smaller than one.

The introduction of finite lifetimes implies failures of the Ricardian equivalence. Households perceive public debt as net wealth. A fraction of the negative effects on household wealth, such as increases in taxation, comes into effect in time periods beyond the expected lifetime of households. The level of household consumption is always higher as compared to the case of Ricardian consumers.

But we need to assume a very high degree of household myopia, to enable the model to predict an increase in private consumption in response to a tax-financed increase in public consumption, i.e. a Keynesian multiplier effect on domestic output being above one. If public consumption is financed by future spending cuts, non-Ricardian households will always respond by increasing their demand for consumption goods. We observe a Keynesian multiplier.

The effects of a lump-sum subsidy to households crucially depend on the financing decision of the government as well as on the assumed validity of the Ricardian equivalence. Should a lump-sum subsidy to Ricardian households be financed by future increases in taxation, the result is that there are, apart from changes in the level of public debt and taxation, no effects at all.

Non-Ricardian households respond to a lump-sum subsidy which is financed by future increases in taxation by a persistent increase in consumption. Household demand drives domestic output and employment, in fact both variables increase. Thus, the response of all variables mentioned before increases with the degree of household myopia.

The alternative financing decision in the form of cuts in future public consumption as to finance contemporary subsidies to households, alters the model's predictions substantially. National output, employment and household consumption increase on impact and they do so independently of failures of the Ricardian equivalence. Future cuts in public consumption influence the spending side of the public budget and thus future demand

by the government for domestic production. Output and employment are increased, but drop below the pre-shock level when the financing decision comes into effect.

The European Commission (2008) expected double dividends of a short run increase in aggregate demand and a long run improvement of aggregate supply from increases in public investment. We find that increases in public investment have effects similar to a positive productivity shock in the home country. No matter how the government decides to finance these measures and independently of possible failures of the Ricardian equivalence, public investment increases domestic output, employment and household consumption.

However, the financing decision has effects on household wealth, i.e. the magnitude of the positive response of private consumption. If public investment is financed by future taxation, its expansive effects will be mitigated by the negative wealth effects of the financing decision. We always find a Keynesian multiplier on national output.

In our model, a temporary increase in public investment boosts economic activity only for a limited timespan. The assumed permanent level of public investment is only sufficient to maintain the steady state level of public capital. We find no double dividends of public investment.

A major concern of the European Commission was that substantial positive spillovers of national fiscal shocks would lead to free riding problems. In our model, spillovers are driven by household consumption. Thus, these spillover can be negative on impact in case of fiscal shocks that have strong negative effects on household wealth, e.g. increases in dissipative public spending. In the medium term, the spillovers of fiscal policy shocks are always positive.

However, there is more than one reason to advise a co-ordinated approach to fiscal policy in a currency union. National fiscal policy shocks induce asymmetries in national inflation rates. The common central bank is ill-equipped to respond to asymmetric shocks as its inflation target is a union-wide average.

Complete home bias to public spending is the standard assumption in the literature. In our model, the spillovers of fiscal policy are driven by their impact on household

consumption as household spending falls on home and foreign goods. Thus, allowing for public spending on home and foreign goods would move the model's predictions closer to the expectations of the European Commission.

We observe Keynesian multipliers depending on the precise assumption to the fiscal consolidation strategy and the degree of household myopia. The standard approach to fiscal policy in theoretical models restricts its attention to exogenous changes in public consumption, which are financed by changes in lump-sum taxation. The latter relates our findings to recent research that find conflicting results for the size of the multipliers, see e.g. Cwik and Wieland (2011) and Coenen et al. (2012, 2013). Based on our results, one should expect different results for the multipliers, in particular in estimated models, which do not contain specific assumptions with regard to the financing decision of the government. Even more so, in cases in which authors assume contrary to stylized facts that public spending is exclusively financed by lump sum taxation, see Paredes et al. (2014).

The assumption of distortions of the intertemporal optimizing behavior of households, e.g. by the introduction of rule-of-thumb consumers, is the predominant approach in the theoretical literature to reconcile theory and evidence in the assessment of fiscal shocks. Indeed, we find that this route enables theoretical predictions close to the empirical findings. But in order to obtain model predictions such as an increase in private demand in response to a public consumption shock, i.e. Keynesian multiplier effects, we need to assume an extremely high degree of household myopia.

With reference to the measures that were suggested by the EERP, we extended an otherwise standard model by allowing for failures of the Ricardian equivalence. At the same time, we extended the array of fiscal instruments on the spending and revenue side of the public budget, as to show that the latter is a promising way to reconcile predictions of modern macroeconomic models with empirical evidence.

Modeling fiscal policy beyond exogenous shocks to public consumption and taxation as the single instrument of fiscal policy to finance stabilizing policies, alters the predictions of standard model substantially.

We conclude that a more realistic approach to the choice of instruments on the spending and revenue side of public budgets opens promising perspectives for future research.
The financing strategy of the government has strong effects on the impact of fiscal policy. We conclude that a fiscal stimulus is more effective, when it is financed by future spending cuts instead of increases in taxation. This result mirrors the empirical results that suggest cuts in public budgets being a prerequisite for a successful consolidation of public budgets.
Moreover, our results suggests that in situations in which a fiscal package is intended to stimulate the economy during a recession - a credible commitment to abstain from tax increases will be required. Stimulus measures should be financed by future spending cuts as such a move would amplify the intended effects. Thus, our results lend support for the SGP and the Euro Plus Pact suggested by the European Council. However, respective policy measures have to be implemented in a credible way which might pose a challenge to fiscal policymakers in practice.
A natural next step would be the estimation of our model using European data. This follow-up work would lead to quantitative predictions regarding the national effects as well as the spillovers of fiscal policy. Extending the range of fiscal instruments further by including distortionary tax rates within the set of financing decisions would be another step forward.

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