

# Government expenditure composition and fiscal policy spillovers in a small open economy within a monetary union

This paper shows that productive government investment can improve an economy's external competitiveness and stimulate private investment.



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European Stability Mechanism



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## Abstract

We examine the implications of government expenditure that is complementary to private consumption, and government investment that can improve the productivity of private capital in a global DSGE model. We show that government investment can improve an economy's external competitiveness and stimulate private investment. If governments can finance this investment by reducing consumption that is not complementary to private consumption, then this is ex-ante budget-neutral, provides a small, but persistent stimulus without a deterioration in competitiveness, and leads to lower debt in the medium run. We also examine the cross-border transmission channels of government expenditure shocks in a monetary union when government consumption is complementary to private and public investment is productive. While both assumptions enhance cross-border spillovers, a direct import content is required to generate spillovers similar to those found in the literature

## Key words

Government expenditure, Competitiveness, EMU, Spillovers, Trade

## JEL codes

E22, E62, H54

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# 1 Introduction

In small open economies (SOEs) belonging to a monetary union, fiscal policy is the only standard stabilisation instrument available to national authorities to smooth business cycle fluctuations. While economists disagree on the size and even the sign of fiscal multipliers, they are closer to an agreement that factors such as leakages into saving and imports (Ilzetzki et al., 2013) and the response of monetary policy to fiscal actions (Spilimbergo et al., 2009) matter. Smaller economies that are more open to trade and countries in which monetary policy offsets the fiscal stimulus will tend to have lower multipliers. In addition, the choice of fiscal instruments used can have important consequences. Expenditure rather than taxation measures are thought to have differential effects (Freedman et al., 2009).<sup>1</sup> But the type of government expenditure matters as well. Karras (1994) and Fiorito and Kollintzas (2004) argue that government consumption is, at least in part, complementary to private consumption. Similarly, as it has been argued long ago by Anschauer (1989) and Baxter and King (1993), and later used by Leeper et al. (2010) and Coenen et al. (2012), government investment can influence the productivity of private capital.

Differently from D’Auria (2015), Leeper et al. (2010) and Coenen et al. (2012b), we use a multi-country model to examine the effects of government investment that can enhance the productivity of private capital, and government consumption that can be complementary to private consumption. Our analysis considers three aspects. First, we focus on a SOE within the European Monetary Union (EMU), as the majority of the euro area consists of such countries, and investigate the effects of the types of government expenditure outlined above in such a setting.<sup>2</sup> We show that if government investment is productive, it can both stimulate the economy and improve its external competitiveness in the medium run.

Second, we argue that this gives rise to a potential trade-off for governments. We illustrate this by considering an ex-ante budget neutral reorientation of government expenditure to investment from consumption. Such a measure may provide a stimulus without a reduction in external competitiveness both in the short and medium run, if government consumption is not a strong complement to

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<sup>1</sup>One reason is that increased expenditure has a direct impact on demand, whereas individuals may save at least some part of a tax cut.

<sup>2</sup>The cohort of countries of interest is even larger if one considers that many SOEs outside monetary unions peg their exchange rate to the currency of a much larger economy. As such, traditional instruments such as the nominal interest and exchange rates do not necessarily react as desired to macroeconomic developments. These economies are, therefore, in a similar situation to SOEs in a monetary union with such little weight in area-wide aggregates that nominal interest and exchange rates are effectively exogenous.

private consumption. This is similar to a fiscal devaluation in the sense that it is an ex-ante budget neutral measure (e.g. Gomes et al., 2014), but the measures taken are on the expenditure rather than the taxation side, and the channels through which they operate differ.

Third, we examine the spillovers of government expenditure measures, taken in the remainder of the euro area (REA), on a SOE that is linked with the REA through trade and a shared central bank. This differs from the literature, as complementarities of consumption and productive government investment modify the cross-border transmission channels of fiscal policy.<sup>3</sup> We find that trade linkages do play an important role in the cross-border transmission of fiscal policy shocks, but despite the amplification coming from consumption complementarities or productivity of government investment, a direct import content of government spending is required to generate the sizeable spillovers found in some empirical studies (e.g. Beetsma and Giuliodori 2011). The main reason is that the interest rate increase in response to the fiscal stimulus in most of the euro area negatively affects private spending in the economy that does not participate in the fiscal expansion. Nevertheless, countries with stronger trade linkages with the REA are more affected by spillovers. This implies that if there is an increase in public investment in the EMU (e.g., the so-called *Juncker Plan*) that is not evenly distributed across countries, then countries with close trade linkages may still benefit from spillovers.<sup>4</sup>

To investigate the issues above, we extend the fiscal policy analytical capabilities of a global dynamic stochastic general equilibrium (DSGE) model, the EAGLE (Gomes et al. 2012), by introducing complementarity of government and private consumption and allowing government investment to be productive, as outlined above. Moreover, we allow for a direct import content of government spending, which takes into account that some government purchases in SOEs are on imported goods. To illustrate the effect of trade linkages, we calibrate the model to two countries with very different trade linkages, an important transmission channel for fiscal policy spillovers (Corsetti et al. 2010). We select Ireland and Slovenia. The former trades primarily with countries outside the EMU, while the latter trades predominantly within the EMU. One would therefore a priori expect

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<sup>3</sup>To the best of our knowledge, these channels have so far not been explored in a structural model and in the context of a SOE in a monetary union. Some have been investigated separately or in the context of a large economy with its own currency (e.g. Leeper et al., 2010; Corsetti and Müller, 2011; Coenen et al., 2012b) and without a focus on cross-border spillovers and the expenditure policy trade-off. The complementarity of government consumption and the productivity of government investment makes our analysis different from those reported in e.g. Kilponen et al. (2015) or Freedman et al. (2009).

<sup>4</sup>The *Juncker Plan* calls for an increase in public investment expenditure, with the hope that it could spur private investment and thus boost euro area economic growth.

that shocks originating in the EMU will not have as strong an effect on Ireland as on Slovenia. These countries also differ along a number of structural dimensions, such as the degree of real and nominal rigidities present.<sup>5</sup>

Our findings are in accordance with empirical evidence of the effects of government spending, although papers that explicitly focus on small and very open economies within a monetary union are infrequent. Beetsma and Giuliodori (2011) have examined fiscal policy spillovers in mostly larger economies in a monetary union and found significant spillovers to their main trading partners. Auerbach and Gorodnichenko (2013) reach a similar finding. Similarly, papers that investigate the different impacts of government consumption and investment typically uncover differential effects. Galstyan and Lane (2009) find that, for a panel of OECD countries, an increase in government consumption is associated with real appreciation, while an increase in government investment may generate real depreciation. Ilzetzki et al. (2013) find that the government investment multiplier in developing countries is larger and more persistent and point out that the composition of government spending plays a role. A similar point is made by Benetrix and Lane (2013).

We next provide an overview of the baseline EAGLE model, details of the extension to the fiscal sector and its calibration. Section 3 discusses the effects of a government expenditure shocks, with a reorientation from (complementary) public consumption to (productive) public investment in Section 4. We then demonstrate the channels through which government expenditure shocks spill over between euro area blocs, and the implications for policy, in Section 5. We follow this with a sensitivity analysis of some of the key model assumptions, and ascertain their influence on the results. The final section summarises and concludes.

## 2 The model

### 2.1 The EAGLE and its fiscal extension

We provide only a brief overview of the main features of the EAGLE here, and refer the reader to Gomes et al. (2012) for details. The EAGLE is structured as four regions of the world economy, two of which constitute a monetary union. Each region is modelled as an open New-Keynesian economy, following the Smets and Wouters (2003) model. The various regions are modelled symmetrically and linked with each other through bilateral trade relations. This formulation allows for a comprehensive treatment of cross-border macroeconomic interdependences

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<sup>5</sup>Note that despite sharing a currency, the reactions of different economies in a monetary union to common shocks may differ widely (see, e.g., Beetsma and Jensen, 2005; Benigno, 2004; Gali and Monacelli, 2008).

and spillovers. The model has a proportion of non-Ricardian households and a number of real and nominal rigidities, such as habit formation, adjustment costs for investment and imports, Calvo-type pricing of final goods and wage setting, with partial indexation. Final goods are aggregates of non-tradable and tradable final goods, with tradable goods themselves an aggregate of domestically-produced and imported goods.<sup>6</sup>

Although the EAGLE features a sophisticated tax structure, the government expenditure component is quite stylised and is focused exclusively on home non-tradable consumption goods and transfers to households. The transmission of government spending shocks to the other sectors of the economy (home tradables and imported goods) therefore depends entirely on the degree of complementarity between these goods. We therefore extend the EAGLE in several ways, significantly altering the responses of the model to government expenditure shocks. First, we explicitly account for an imported component of government expenditure. In a SOE, many of the goods purchased by the government are not produced domestically, as the economy is not necessarily large enough to produce all of the required goods. Second, we distinguish between government consumption and investment expenditure. Third, we do not treat all government expenditure as wasteful. We allow for (i) a degree of complementarity between private and government consumption and (ii) government investment that increases the stock of public capital, thereby improving the productivity of the private sector. These features open several transmission channels that are especially relevant for very open economies, as they affect trade flows and amplify the channels of fiscal policy spillovers. Although the importance of these transmission channels remains the subject of debate, there is plenty of empirical evidence for their existence.<sup>7</sup> Nevertheless, we perform an extensive sensitivity analysis in Section 6 to explain the consequences of alternative values for key parameters controlling these channels for our model results.

To permit government spending on imported goods, we assume that governments purchase composite final goods. This is produced by firms that act under perfect competition and assemble final government consumption and investment bundles,  $Q_t^{GC}$  and  $Q_t^{GI}$ , respectively. This is done with a constant

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<sup>6</sup>We use a version of the EAGLE that permits an import content of exports. See Brzoza-Brzezina et al. (2014), for details.

<sup>7</sup>Karras (1994) and Fiorito and Kollintzas (2004) estimate the relationship between private and government consumption for a number of countries and generally find complementarity. Aschauer (1989) claims that public non-military investment, especially in infrastructure, plays an important role in explaining productivity. While this has also been a matter of debate (Gramlich, 1994), including the exact mechanism at work (Fisher and Turnovsky, 1998), the belief that public capital can be productive and stimulate private investment seems to persist (see, e.g., German Expert Commission, 2015, or Leeper et al., 2010).

elasticity of substitution (CES) technology, using tradable goods,  $TT_t^{GC}$ , and non-tradable goods,  $NT_t^{GC}$ :<sup>8</sup>

$$Q_t^{GC} = \left[ \nu_{GC}^{\frac{1}{\mu_{GC}}} (TT_t^{GC})^{\frac{\mu_{GC}-1}{\mu_{GC}}} + (1 - \nu_{GC})^{\frac{1}{\mu_{GC}}} (NT_t^{GC})^{\frac{\mu_{GC}-1}{\mu_{GC}}} \right]^{\frac{\mu_{GC}}{\mu_{GC}-1}}. \quad (1)$$

Government demand for non-tradable goods is therefore:

$$NT_t^{GC} = (1 - \nu_{GC}) \left( \frac{P_{NT,t}}{P_{GC,t}} \right)^{-\mu_{GC}} Q_t^{GC}, \quad (2)$$

and analogously for government tradable goods.  $P_{NT,t}$  is the price of non-tradable goods and  $P_{GC,t}$  is the price of final government goods. The parameter  $\nu_{GC}$  governs the share of each type of goods in the bundle and the parameter  $\mu_{GC}$  is the elasticity of substitution between these goods.<sup>9</sup> The tradable goods consumed by the government is a bundle of home-produced tradable goods,  $HT_t^{GC}$ , and imported goods,  $IM_t^{GC}$ :

$$TT_t^{GC} = \left[ \nu_{TG_C}^{\frac{1}{\mu_{TG_C}}} (HT_t^{GC})^{\frac{\mu_{TG_C}-1}{\mu_{TG_C}}} + (1 - \nu_{TG_C})^{\frac{1}{\mu_{TG_C}}} (IM_t^{GC})^{\frac{\mu_{TG_C}-1}{\mu_{TG_C}}} \right]^{\frac{\mu_{TG_C}}{\mu_{TG_C}-1}}. \quad (3)$$

This implies that government demand for home-produced tradable goods is:

$$HT_t^{GC} = \nu_{TG_C} \left( \frac{P_{HT,t}}{P_{TTGC,t}} \right)^{-\mu_{TG_C}} TT_t^{GC}. \quad (4)$$

As above,  $\nu_{TG_C}$  determines the share of each type of goods in the bundle and  $\mu_{TG_C}$  the elasticity of substitution between them.  $P_{HT,t}$  is the price of home tradable goods and  $P_{TTGC,t}$  is the price of government-consumed tradable goods. Imports of government consumption goods,  $IM_t^{GC}$ , consist of a bundle of (bilateral) imports of tradable goods,  $IM_t^{GC,CO}$ , produced in all other blocs:

$$IM_t^{GC} = \left[ \sum_{CO \neq H} \left( \nu_{MG_C}^{H,CO} \right)^{\frac{1}{\mu_{MG_C}}} \left( IM_t^{GC,CO} \right)^{\frac{\mu_{MG_C}-1}{\mu_{MG_C}}} \right]^{\frac{\mu_{MG_C}}{\mu_{MG_C}-1}}, \quad (5)$$

where  $\nu_{MG_C}^{H,CO}$  sum to 1 and government demand for imports from bloc  $CO$  is

<sup>8</sup>As the equations are identical for the government consumption and investment goods, only those for consumption goods are detailed.

<sup>9</sup>Note that when  $\nu_{GC} = 0$  we are back to the original EAGLE, where all government consumption is spent on non-tradable goods.

$$IM_t^{G_C,CO} = \nu_{MG_C}^{H,CO} \left( \frac{P_{IM,t}}{P_{IMG_C,t}} \right)^{-\mu_{MG_C}} IM_t^{G_C}. \quad (6)$$

The superscript  $H$  indicates the home country and the superscript  $CO$  the bloc from which the goods are imported. Again,  $\nu_{MG_C}^{H,CO}$  determines the share of goods from each bloc,  $\mu_{MG_C}$  is the elasticity of substitution between them,  $P_{IM,t}$  is the price of imported goods and  $P_{IMG_C,t}$  is the price of government consumption imports. Prices are defined by equations which correspond to the CES-aggregated goods bundles. Prices of government consumption goods,  $P_{G_C,t}$ , government tradable consumption goods,  $P_{TTG_C,t}$ , and government imported consumption goods,  $P_{IMG_C,t}$ , respectively, are:

$$P_{G_C,t} = [\nu_{G_C}(P_{TTG_C,t})^{1-\mu_{G_C}} + (1 - \nu_{G_C})(P_{NT,t})^{1-\mu_{G_C}}]^{\frac{1}{1-\mu_{G_C}}}, \quad (7)$$

$$P_{TTG_C,t} = [\nu_{TG_C}(P_{HT,t})^{1-\mu_{TG_C}} + (1 - \nu_{TG_C})(P_{IMG_C,t})^{1-\mu_{TG_C}}]^{\frac{1}{1-\mu_{TG_C}}}, \quad (8)$$

and

$$P_{IMG_C,t} = \left[ \sum_{CO \neq H} \nu_{MG_C}^{H,CO} (P_{IM,t}^{CO})^{1-\mu_{MG_C}} \right]^{\frac{1}{1-\mu_{MG_C}}}, \quad (9)$$

where  $P_{IM,t}^{CO}$  is the price of imports from bloc  $CO$ . We follow Coenen et al. (2012b) and introduce government consumption as a partial complement to private consumption in the utility function. Utility depends on  $\tilde{C}$ , which is a CES-aggregate of government and private consumption:

$$\tilde{C}_t = \left[ \nu_{CCES}^{\frac{1}{\mu_{CCES}}} (C_t)^{\frac{\mu_{CCES}-1}{\mu_{CCES}}} + (1 - \nu_{CCES})^{\frac{1}{\mu_{CCES}}} (G_{C,t})^{\frac{\mu_{CCES}-1}{\mu_{CCES}}} \right]^{\frac{\mu_{CCES}}{\mu_{CCES}-1}}. \quad (10)$$

The share of government consumption goods in the final composite goods bundle is determined by  $\nu_{CCES}$ , while  $\mu_{CCES}$  determines the degree of complementarity. Changes in government consumption therefore affect optimal private consumption decisions directly, as opposed to the indirect wealth effect when government consumption is separable. The extended model explicitly accounts for the fact that government investment,  $G_{I,t}$  is not wasteful, as in Leeper et al. (2010), and contributes to public capital,  $K_{G,t}$ :

$$K_{G,t+1} = (1 - \delta_G)K_{G,t} + G_{I,t}, \quad (11)$$



where  $\delta_G$  is the depreciation rate.  $K_{G,t}$  enters the private sector's production function in a non-rivalrous way as follows:

$$Y_{T,t}^S = z_{T,t} K_{G,t}^{\alpha_G} (K_{T,t}^D)^{\alpha_T} (N_{T,t}^D)^{1-\alpha_T} - \psi_T \quad (12)$$

and analogously for the non-tradable sector.<sup>10</sup>

Government capital enhances the productivity of private capital in a similar manner to technological progress. This implies that an increase in government capital will reduce the marginal costs,  $MC_{T,t}$ , of the intermediate goods' sector:

$$MC_{T,t} = \frac{1}{z_{T,t} K_{G,t}^{\alpha_G} (\alpha_T)^{\alpha_T} (1 - \alpha_T)^{1-\alpha_T}} (R_t^K)^{\alpha_T} \left( (1 + \tau_t^{W_f}) W_t \right)^{1-\alpha_T}. \quad (13)$$

The same holds for non-tradable goods.<sup>11</sup>

## 2.2 Calibration

Data from the national account statistics are used to adjust key steady-state ratios which represent the underlying structure of the economy.<sup>12</sup> The parameters governing the trade linkages between the model blocs are based on a mix of national accounts data (for the volume of trade) and input-output tables (for the composition, consumption or investment, of traded goods and the bilateral component of trade). In order to match empirical evidence that the non-tradable sector tends to be more labour intensive, the production function of the tradable sector is permitted a higher share of capital. The remaining parameters in the model are either based on country-specific empirical evidence, where available, or kept consistent with the original model.<sup>13</sup> The values of the calibrated parameters and steady-state ratios for both countries are reported in Tables 1 to 3. The main

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<sup>10</sup>Here,  $Y_{T,t}^S$  is output,  $z_{T,t}$  is the level of productivity,  $\alpha_G$  determines the productivity of public capital,  $K_{T,t}^D$  is private capital rented,  $N_{T,t}^D$  is labour hired,  $\alpha_T$  is the capital share in the tradable sector and  $\psi_T$  represents fixed costs.

<sup>11</sup>The parameter  $\tau_t^{W_f}$  accounts for labour taxes paid by firms,  $W_t$  are wages and  $R_t^K$  is the rental cost of capital.

<sup>12</sup>Given the large fluctuations in the Irish economy in recent years, the elicitation of appropriate steady-state values is challenging. The data are the long-run (1980-2010) averages from the national account statistics, as gathered from the ESRI model database. This dataset allows for the longest possible horizon to be used, while omitting the large structural changes to the economy that took place prior to this period. The calibration for Slovenia relies on the national accounts and trade data averages from 2010-2013 to reflect substantial structural changes since the 2008 recession. The key findings are robust to calibration using the 2000-2010 period.

<sup>13</sup>The EAGLE uses standard values, prevalent in the literature, for the majority of parameters. See Gomes et al. (2012) for details.

differences between the two economies are in terms of the share of investment and government consumption spending, which are higher in Slovenia, and with respect to the shares of imports in GDP and the structure of imports, such as high import-content of exports in both economies (higher in Ireland). The degree of real and nominal rigidities also differs between the two countries. The relative size of the home bloc is recalibrated to reflect an SOE's GDP share in the world economy. Previously, the large size of Germany relative to the REA meant that there was some spillover to the REA from shocks emanating in the home bloc. The small size of the recalibrated home bloc means that this channel is effectively removed.

The benchmark calibration of parameters that determine the aggregation of private and government consumption expenditure follows Coenen et al. (2012b). The elasticity of substitution between private and government consumption is set to 0.20, and the quasi-share of government consumption expenditure in the aggregator is set to 0.25. This ensures that the observed responses of consumption to government spending shocks are in line with either country-specific or euro-area evidence.<sup>14</sup> As such, government and private consumption are strong, but not perfect, complements, in line with the evidence in Karras (1994) and Fiorito and Kollintzas (2004). We opt for a calibration of government goods with a low elasticity of substitution between non-tradable and tradable goods, but with relatively high substitution between tradable goods and imported goods from the different blocs. The quasi-share of imported government consumption goods is calibrated to achieve a 2 percent of GDP government consumption that is spent directly on imports in the steady state. The rationale for this relatively small number is that consumption goods purchased by the government are to a large extent domestically produced, even in SOEs. This amounts to about 10 and 15 percent of government consumption in Slovenia and Ireland, respectively. We assume that the share of imported government investment goods is higher, as investment goods tend to be very specific and less likely to be produced domestically in a SOE. We therefore calibrate the quasi-share of imported government investment goods to achieve a 25 percent share of government investment spending.<sup>15</sup> The fiscal rule is such that lump-sum taxes are adjusted to

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<sup>14</sup>See Kirchner et al., 2010, Coenen et al., 2012b, and Jemec et al., 2013

<sup>15</sup>In calibrating the import content of government consumption and investment expenditure, we rely on estimates by Corsetti and Müller (2006), in particular on their guideline that home bias is stronger in government expenditure than in private consumption or investment. We used the values reported in their Table 1 and relied on the approximate relation that government expenditure has about half the import content of private expenditure. For the REA, RW, and the US we assumed a 10 percent import content of government investment, which is consistent with the estimate by Corsetti and Müller, who state 12 percent as the upper bound for government imports. For the import content of government consumption, we use Corsetti and Müller's lower bound of 6 percent for the REA and the RW, and the exact value of 5.8 percent for the US. For both Ireland and Slovenia, we set the import content of government consumption to 12

close the model. The preference parameter for home tradables of the other blocs in the model varies according to the trade matrix of the relevant home bloc, either Ireland or Slovenia.

TABLE 1. Steady-state Ratios and Trade Matrix (as % of nominal GDP)

	<b>IE</b>	<b>SI</b>
<b>Great Ratios</b>		
Private consumption	57.9	56.9
Private investment	17.6	15.1
Target public debt (% of annual GDP)	60.0	60.0
<b>Trade linkages</b>		
Imports	63.0	69.8
Consumption goods	15.0	22.0
From REA	5.4	17.6
From RW	7.4	4.4
From US	2.2	0.1
Investment goods	9.2	13.0
From REA	3.4	10.1
From RW	4.7	2.5
From US	1.6	0.3
Imports of exports	35.3	31.8
From REA	11.3	23.4
From RW	15.3	6.9
From US	8.7	1.5
<b>Government expenditure</b>		
Consumption expenditure	12.9	20.8
Imports	2.0	2.0
Investment expenditure	4.0	4.0
Imports	1.0	1.0
<b>Country size</b>		
Size (as % of world GDP)	0.3	0.2

percent, the highest value reported by Corsetti and Müller, while for government investment we use a 25 percent import content. The reason is that both countries are very open, especially regarding investment goods. Note that these ratios should be modified for policy simulations when governments consider a particular policy action that is known to be more biased towards foreign or domestic goods.

TABLE 2. Calibration - Households and Firms

	IE	SI
<b>Households</b>		
Subjective discount factor	1.03 <sup>1/4</sup>	1.03 <sup>1/4</sup>
Depreciation rate (private capital)	0.025	0.025
Depreciation rate (public capital)	0.025	0.025
Int. elasticity of substitution	1.00	1.00
Habit formation	0.60	0.60
Frisch elasticity of labour (inverse)	2.00	2.00
<b>Intermediate goods firms</b>		
Tradable - bias toward capital	0.35	0.42
Non-tradable - bias toward capital	0.30	0.30
<b>Final cons. goods</b>		
Subst. btw. domestic and imported	2.50	2.50
Subst. imported	2.50	2.50
Bias toward domestic tradables	0.39	0.36
Subst. btw. tradable and non-tradable	0.50	0.50
Bias toward tradable	0.48	0.70
<b>Final inv. goods</b>		
Subst. btw. domestic and imported	1.50	1.50
Subst. imported	2.50	2.50
Bias toward domestic tradables	0.23	0.24
Subst. btw. tradable and non-tradable	0.50	0.50
Bias toward tradable	0.75	0.89
<b>Final government cons. goods</b>		
Subst. btw. domestic and imported	2.50	2.50
Subst. imported	2.50	2.50
Bias toward domestic	0.21	0.52
Subst. btw. tradable and non-tradable	0.50	0.50
Bias toward tradable	0.80	0.80
<b>Final government inv. goods</b>		
Subst. btw. domestic and imported	2.50	2.50
Subst. imported	2.50	2.50
Bias toward domestic	0.43	0.38
Subst. btw. tradable and non-tradable	0.50	0.50
Bias toward tradable	0.60	0.60

Finally, it is assumed that the dynamic adjustment of government consumption and investment goods is not subject to real rigidities.<sup>16</sup> Private investment adjustment costs are calibrated to replicate the well-known variability of investment over the course of the business cycle (King and Rebelo 1999).

TABLE 3. Calibration - Real and Nominal Rigidities, Tax Rates

	IE	SI
<b>Real rigidities</b>		
Investment adjustment	6.00	3.00
Import adjustment (cons.)	5.00	1.00
Import adjustment (inv.)	2.00	1.50
Quasi-share of govt cons.	0.25	0.25
Complementarity of consumptions	0.20	0.20
<b>Nominal rigidities</b>		
Wage stickiness	0.80	0.81
Wage indexation	0.75	0.75
Price stickiness (domestic)	0.75	0.75
Price indexation (domestic)	0.50	0.50
Price stickiness (imported)	0.75	0.75
Price indexation (imported)	0.50	0.50
Price stickiness (services)	0.75	0.93
Price indexation (services)	0.50	0.50
<b>Tax rates</b>		
Consumption tax	0.12	0.15
Labour income tax	0.16	0.13
Capital tax	0.10	0.14
SSC paid by firms	0.09	0.14
SSC paid by households	0.07	0.15

### 3 Expenditure shocks

To illustrate the effect of the model extension, we simulate shocks to both government consumption and investment and use them to explain the transmission

<sup>16</sup>In new-Keynesian models, investment-adjustment costs are often used to achieve the hump-shaped responses of private investment found in empirical work. As government investment is the decision of the government, it does not necessarily follow a hump-shaped path.

channels of such shocks.<sup>17</sup> This is useful to understand the more involved shocks considered later, especially in the section discussing fiscal policy spillovers.

### 3.1 Effect of a government consumption shock

We analyse a 1 percent of ex-ante GDP increase in the government consumption expenditure share,  $G_C/Y$ , detailed in Figure 1. In the benchmark calibration  $G_C/Y$  is approximately 20 percent of GDP in Slovenia and about 13 percent in Ireland. Therefore, the shock amounts to a roughly 5 percent increase in government consumption in Slovenia and about 8 percent in Ireland.

The aggregate consumption that enters the utility function is a CES-bundle of government and private consumption (equation 10). We opt for calibration where both types of consumption are sufficiently complementary to obtain a positive co-movement between the two.<sup>18</sup> The increase in government consumption spending stimulates domestic demand through several channels. The standard transmission channel is the direct impact of government demand on production.<sup>19</sup> This stimulates hours worked, as aggregate capital is fixed in the short run. As government consumption expenditure is largely oriented towards domestically produced goods, this results in a reallocation of production and inputs from tradable to non-tradable goods.

The new transmission channel is due to the complementarity between private and government consumption, leading to a strong and persistent increase in private consumption that further stimulates domestic demand. There is no crowding-out of private consumption as in many models. Because the private consumption bundle contains a relatively high share of non-tradable goods, the increase in consumption results in a temporary increase in the production of these goods. The

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<sup>17</sup>The simulations are fully anticipated under perfect foresight using a Newton-type algorithm available in DYNARE (Adjemian et al., 2013). All the shocks are for one period, with the persistence of the shock equal to 0.90 in every case. Shock sizes for government consumption and investment have been standardised to 1 percent of ex-ante GDP to facilitate comparison. As long as the model is (approximately) linear, the effects of different shock sizes can be assessed by appropriately rescaling the impulse responses.

<sup>18</sup>Depending on the exact calibration, the positive co-movement does not necessarily occur on impact, where for calibrations with a high elasticity of substitution between private and government consumption goods, private consumption can initially decline. This is the case if government and private consumption are less complementary and habit formation is high. In this case households desire a smoother path for the consumption bundle as a whole, and so offset the sharp initial increase in government consumption with a corresponding decrease in private consumption. After a few quarters, however, private consumption increases. See Section 6 for a discussion of the sensitivity to parameter values.

<sup>19</sup>Our model allows for the import of government consumption goods. However, the low value for the direct import share of government consumption goods implies that they will primarily be produced domestically.

differences in the response of private investment in both countries are due to higher price rigidity of non-tradable goods prices in Slovenia. These imply that after a government consumption increase, non-tradable goods become cheaper relative to tradable goods, which shifts demand towards non-tradable goods (both because government spending is largely biased towards domestic goods and because private demand shifts toward the relatively less expensive non-tradable goods). This leads to greater demand for labour from firms that wish to satisfy the increased demand. Wages increase, which further increases domestic demand, especially from the non-Ricardian consumers. This increased demand also stimulates private investment, which increases initially.<sup>20</sup> Without rigid prices in the non-tradable sector, these effects are less pronounced and wages and private investment decrease (as in Ireland). The negative effects on home tradables production, due to the appreciation of the real effective exchange rate (as a result of the increase in domestic marginal costs and prices), prevail in the medium run. Exports decrease, while imports increase from a combination of the favourable exchange rate movements and high domestic demand for tradable goods.

### 3.2 Effect of a government investment shock

To show the effect of a change in government investment expenditure, we analyse a 1 percent of ex-ante GDP increase in government investment expenditure share,  $G_I/Y$ , displayed in Figure 2. Unlike the government consumption expenditure shock, government investment expenditure is both much smaller (4 percent of GDP in our benchmark calibration) and has a very high import content (1 percent of GDP, a quarter of government investment), for the reasons we discussed earlier. This has two direct consequences. First, a 1 percent of (ex-ante) GDP increase in government investment means that government investment increases by roughly 25 percent. Second, the high import content causes an immediate increase in imports and a deterioration in the trade balance.

As government investment does not directly affect household utility, the only immediate effect on consumption is indirectly through the wealth effect. On impact, output and hours worked increase as the economy has to produce the portion of government investment goods that are not imported. With government investment goods consisting of both home tradable and non-tradable goods, production increases in both sectors. Resources are diverted away from the private sector as government investment spending increases. This would typically result in a decrease in private consumption and investment. The effects in our model, however, are more involved. Initially, the increase in consumption by liquidity

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<sup>20</sup>This is particularly the case if investment-adjustment and import-adjustment costs are lower, as is the case for Slovenia.

constrained households immune to the wealth effect alleviates the decrease in consumption by Ricardian households. But it is Ricardian households which increase consumption in the medium run, as the build-up of productive public capital undoes the negative wealth effect from higher expected taxes. Because Ricardians represent a larger share of households, total consumption increases in the medium run.

The key mechanism is the contribution of the public capital stock to the productivity of the private sector. The accumulation of public capital reduces private sector firms' marginal costs (see equation 13) and improves competitiveness of the domestic economy in the medium run.<sup>21</sup> This results in a reduction of domestic inflation, after the initial demand-driven increase, and in a depreciation of the real effective exchange rate, which stimulates production in the domestic tradable sector. Improved competitiveness draws in private investment, which further contributes to the increase in output. Due to the higher productivity induced by the public capital increase, the substitution effect prevails over the wealth effect and Ricardian households both work more and increase consumption. Note that the model with productive government investment does not need to rely on the existence of non-Ricardian households to generate positive co-movement between private consumption and government investment in the medium run. Moreover, the build-up of public capital induces co-movement between private and government investment and consumption in the medium run.

While the immediate effect of government investment worsens the trade balance, exports increase and the trade balance moves into surplus when public capital accumulates.<sup>22</sup> This is contrary to the typical belief that government spending is inflationary and results in a deterioration of an economy's competitive position. The transmission mechanism is in line with the notion that government expenditure focused on the improvement of infrastructure reduces costs to the private sector and that these benefits accrue over a longer period of time (e.g., as claimed by Aschauer, 1989, for non-military public capital). This has often been used to strengthen the case for greater infrastructure spending. In the case of Ireland, for instance, Morgenroth (2011) states explicitly that there are positive effects of government infrastructure investment over the short and long run if additional infrastructure benefits the private sector. However, he also notes that government investment can have no or even negative effects if the additional infrastructure is not needed. We investigate this in Section 6.

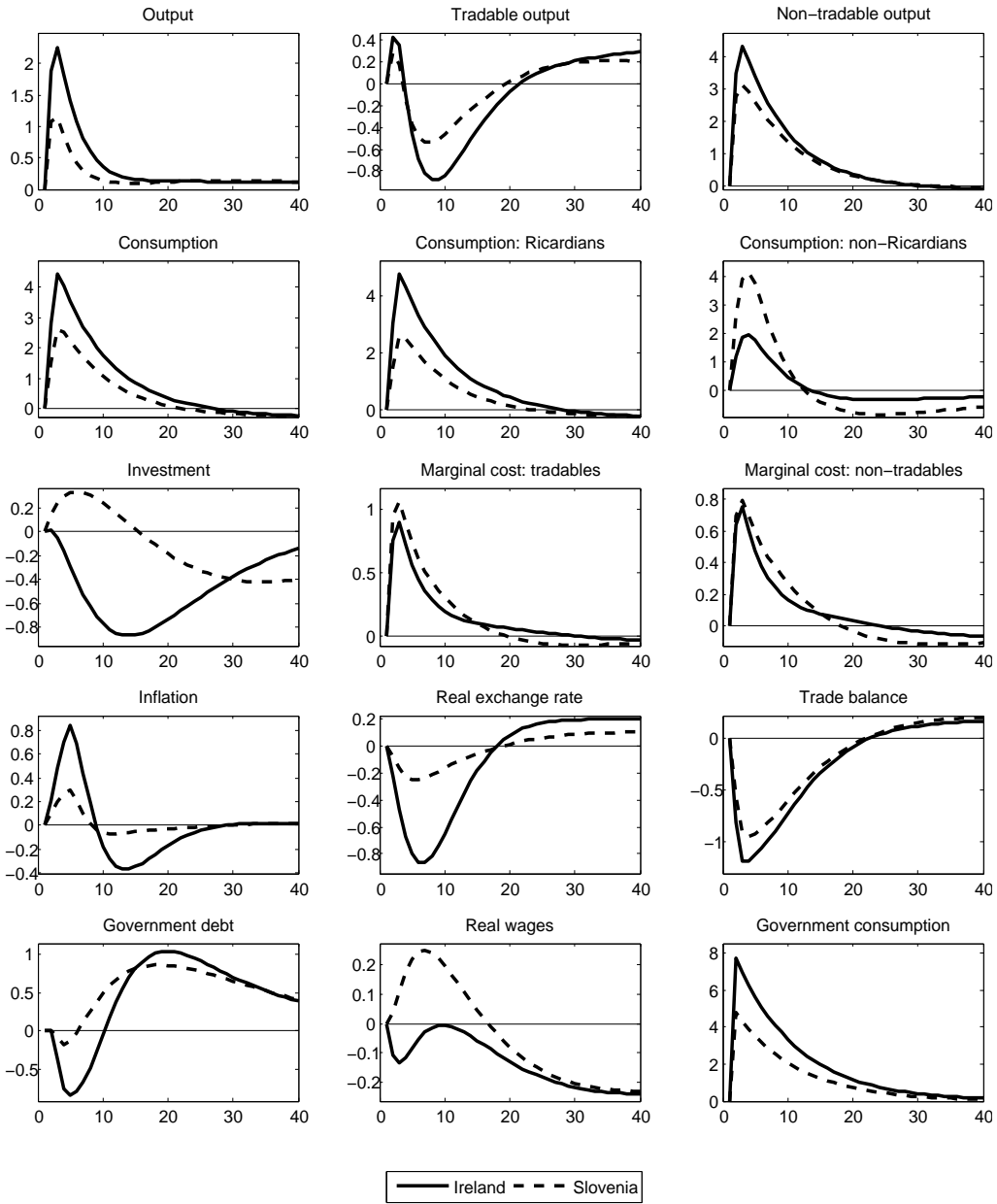
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<sup>21</sup>The effects of a government investment increase are persistent because government investment adds to public capital stock.

<sup>22</sup>The initial deterioration in the trade balance can be avoided if government investment purchase is more oriented towards domestically-produced goods. See Section 6 for details.

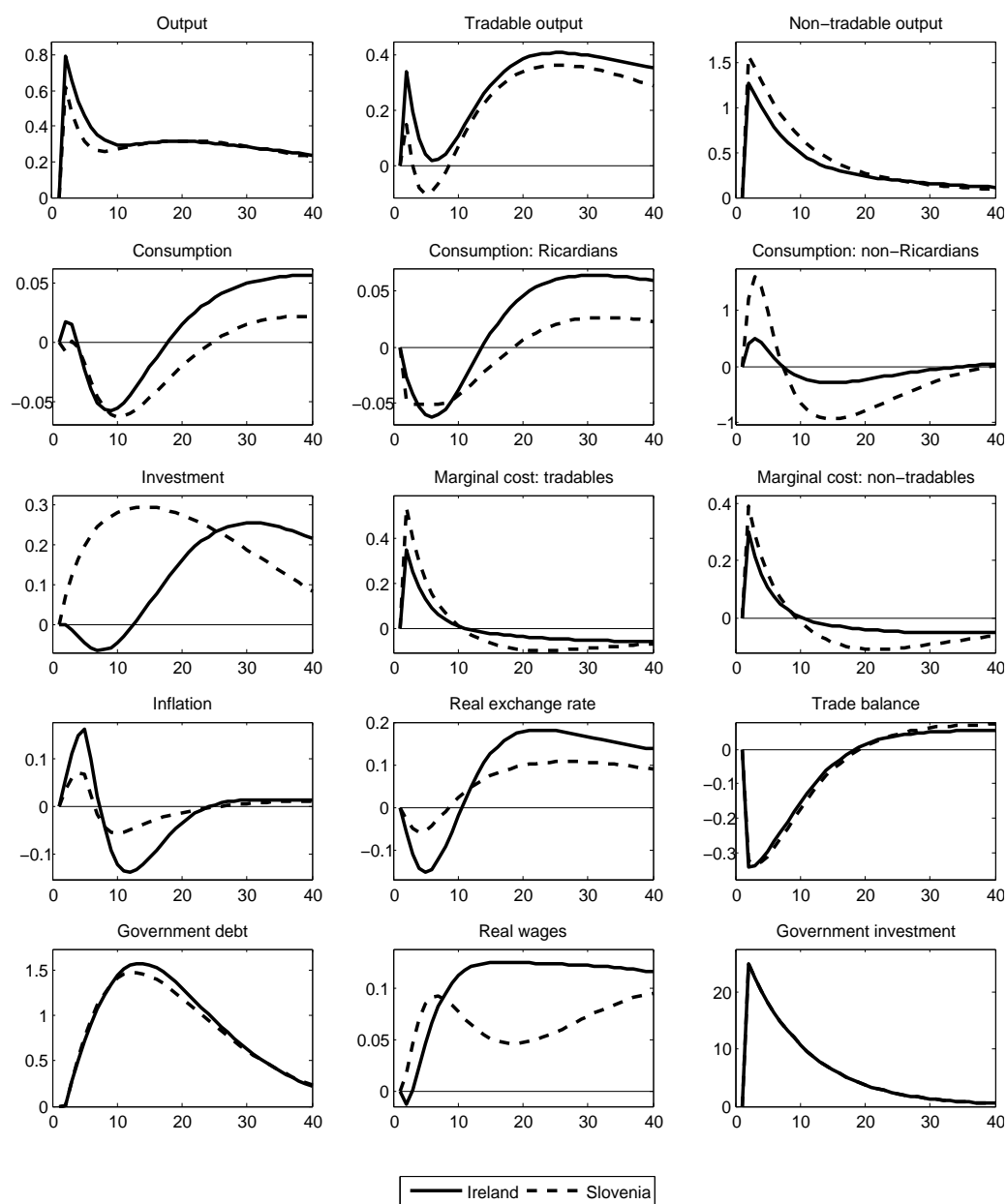


FIGURE 1. An increase in government consumption expenditure



Notes: Impulse responses to a 1 percent (ex-ante) GDP increase in government consumption expenditure. All variables are in percentage deviations from the steady state, except trade balance and government spending (all defined as ratios to GDP) and inflation; the impulse responses of these variables are in percentage-point deviations.

FIGURE 2. An increase in government investment expenditure



Notes: Impulse responses to a 1 percent (ex-ante) GDP increase in government consumption expenditure. All variables are in percentage deviations from the steady state, except trade balance and government spending (all defined as ratios to GDP) and inflation; the impulse responses of these variables are in percentage-point deviations.

## 4 Government expenditure reorientation

The results of the previous section suggest that governments could improve both the performance of the economy and its external competitiveness by reducing government consumption and using the proceeds to finance investment. We now perform such an experiment, with the expenditure switch scaled to be one percent of ex-ante GDP. We do this once assuming government consumption is complementary to private consumption, and once without this assumption.<sup>23</sup> The results are presented in Figure 3.

We find that such a re-orientation has negative consequences for output in the short run, if the link between government and private consumption is strong (depicted in black in Figure 3). The effect is stronger for Ireland, because government consumption has to decrease by more in percentage terms to collect 1 percentage point of GDP.<sup>24</sup> In the medium run, competitiveness improves due to the increase in public capital and real exchange rate depreciation persists longer. Output increases after the initial drop and then persists at a higher level than at the start. Nevertheless, in the longer run, private consumption and investment increase, which causes the reduction in the trade balance, while higher wages lead to a small and very gradual erosion of competitiveness. Government debt increases in the beginning, but decreases in the long run. These results imply that if a government wishes to stimulate the economy and reduce debt in the short run, it should reverse the reorientation of government expenditure, i.e., away from investment towards complementary consumption. In the medium run, the cost of the stimulus will be a deterioration of the economy's competitiveness.

If the government raises the funds for this investment by reducing those consumption items that are not complementary to private consumption (depicted in grey in Figure 3), all the benefits in the medium and long run remain, while there is a small stimulus to output and consumption in the short run. Moreover, the increase in public debt is negligible and turns into a small decrease after about four years. The trade balance improves in approximately the same period and remains in surplus for a long time (until public capital depreciates). The real exchange rate depreciates mildly, but very persistently, despite the increase in wages that is only mildly smaller than in the previous case. Note that if government consumption were a substitute for private consumption, the initial stimulative effect would be much stronger.

The proposed expenditure reorientation is different from a fiscal devaluation, but essentially achieves a similar goal. Such a policy could be used to address

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<sup>23</sup>We keep the import-content of government consumption the same when we shut down complementarity.

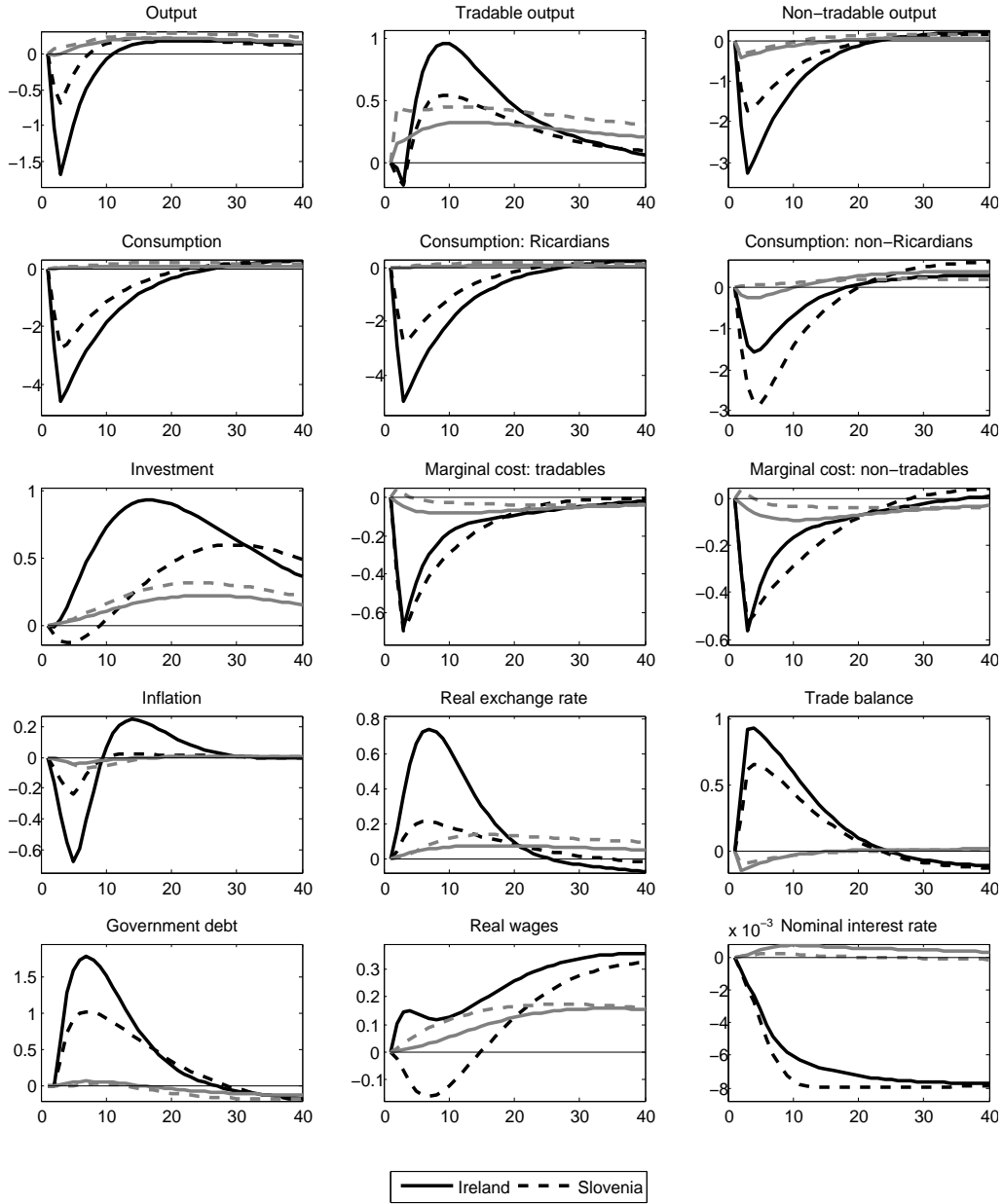
<sup>24</sup>Recall that the share of government consumption expenditure in Ireland is only 13 percent of GDP, while it is 20 percent of GDP in Slovenia.

the external imbalances that accumulated in the periphery during the first decade of the EMU, without a significant increase in the debt-to-GDP ratio. Note that governments in distress often have the incentive to do the opposite - government investment is often the first to be reduced, as it is the easiest component of government spending to cut in the short run for political reasons (Gali and Perotti, 2003).<sup>25</sup>

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<sup>25</sup>National accounts data shows that government investment in Ireland at the end of 2012 was half its peak value, while it was also substantially decreased in Slovenia over the same period.

FIGURE 3. A budget-neutral government expenditure reorientation



Notes: Impulse responses to a 1 percent (ex-ante) GDP increase in government investment expenditure and simultaneous off-setting decrease of government consumption expenditure. All variables are in percentage deviations from the steady state, except trade balance and government spending (all defined as ratios to GDP), inflation, and nominal interest rate; the impulse responses of these variables are in percentage-point deviations. The alternative with non-complementary government consumption is shown in grey.

## 5 Spillovers from government spending shocks

We next illustrate the government expenditure cross-border spillover channels in our model. To our knowledge, this is the first model-based analysis of such spillovers in a structural model with public spending involving complementarity of government and private consumption and productive government investment, applied to SOEs in a currency union. Given the large number of countries in this cohort, we feel that this represents an important contribution to the understanding of cross-border spillovers from fiscal policy.

A fiscal expansion typically causes an endogenous increase of the central bank interest rate, which reduces private demand and dampens fiscal stimulus (Coenen et al., 2012a). A small country that keeps government spending constant, but shares a common monetary policy with a large country or area that engages in fiscal stimulus, would be expected to experience mostly negative effects. These can come from trade outside the currency area due to an exchange rate appreciation, trade from within the area as government stimulus crowds out private demand, and from the higher area-wide interest rate that reduces domestic demand. However, this seems to be at odds with empirical evidence. For instance, Beetsma and Giuliodori (2011) find that fiscal expansions in (large) European countries tend to have expansionary effects on their main trading partners. Similar findings are reported by Corsetti and Müller (2011) for the effects of fiscal expansions in the U.S. on the euro area and the United Kingdom (i.e. countries not sharing a common currency).<sup>26</sup>

Our model can explain such positive spillovers, as an expansionary fiscal policy abroad can stimulate foreign private consumption and investment, which affect the domestic economy through higher foreign demand. The purchase of imported goods by the government can directly affect foreign economies. Negative effects arise from an increase in the area-wide interest rate (akin to the “global” interest rate in Corsetti et al., 2010) and an appreciation of the euro. The key issue is whether the positive effects through foreign demand are sufficiently strong to dominate the negative effects.<sup>27</sup> We investigate the strength of spillovers by considering an expansionary fiscal policy in the REA and analyse the effects on Ireland and Slovenia, where fiscal policy is assumed to remain unchanged.<sup>28</sup>

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<sup>26</sup>They find that U.S. imports tend to remain constant after the fiscal expansion, while U.S. exports increase. This indicates that a fiscal expansion in the U.S. does not lead to higher exports from the euro area to the U.S.

<sup>27</sup>Note that we do not use a zero-lower-bound setting as Coenen et al. (2012a), because we wish to establish whether the strength of transmission channels induced by complementarity of government consumption or productivity of government investment can explain empirical evidence. Shutting down the interest rate channel would obviously favour such conclusions.

<sup>28</sup>This could, for example, represent a situation where budgetary pressures in an economy do not permit an expansion, or where there is no productive investments which can be made.

Given the two countries' differing trade linkages, it is a priori expected that shocks originating in the REA will have a weaker effect on Ireland.

## 5.1 Spillovers from a government consumption shock

The effect of a government consumption increase by 1 percent of ex-ante GDP in the REA is shown in Figure 4. Although output increases in the short run, the medium-run responses are contractionary. Direct imports for REA government consumption increase the home country's trade balance and output. The contemporaneous increase in foreign private consumption increases exports of goods for consumption abroad (see bottom right panel of Figure 4), providing some amplification in countries linked through trade in consumption goods. While the intensity of the government spending impulse is the same in both countries, the amplification through exports of private goods is, as expected, lower in Ireland due to their lower trade with the REA. The transmission of foreign demand impulses depends mainly on two features.

First, higher price rigidity in the non-tradable sector in Slovenia makes these goods relatively cheaper than tradable goods. This leads to a shift in domestic demand towards non-tradable goods, supported by roughly unchanged real wages in the short run.<sup>29</sup> Strong foreign demand for tradable goods increases the demand for labour in this sector, but labour does not shift between sectors in Slovenia as much as in Ireland. As a result, marginal costs in Slovenia increase by a larger amount in both sectors, and more persistently. Real wages still decrease slightly because of higher inflation, but much less than in Ireland. The positive effects of strong foreign demand on output in Slovenia are slightly amplified by the increase in private consumption, but this is dwarfed by the decrease in investment, driven by low investment adjustment costs. The greater openness of Slovenia towards the REA shows in the somewhat more persistent trade balance, which is supported by the path of private consumption in the REA, but also by the drop of domestic investment with high import content.

Second, Ireland's trade balance increases to a larger extent because of the larger steady-state current account surplus. Given the approximately same percent difference between the increase in exports and in imports in both countries, this results in a stronger contribution of the trade balance to GDP.<sup>30</sup> In both countries exports to non-euro blocs decrease due to the exchange rate appreciation (not

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<sup>29</sup>Rigid prices in the non-tradable sector imply that the foreign stimulus on the domestic tradable sector spills over by means of higher demand for non-tradable goods, putting upward pressure on wages. In Ireland the relative price effect is lower and labour reallocates from non-tradable to tradable sector and causes less upward pressure on wages.

<sup>30</sup>Because of exports' high import content, both tend to move together after foreign demand shocks.

shown). Over the medium term, a drop in foreign demand from the euro area and persistently higher interest rates cause a recession.

## 5.2 Spillovers from government investment

The effects of a government investment increase by 1 percent of ex-ante GDP in the REA are shown in Figure 5. The increase in area-wide interest rate means that private consumption and investment in the REA only increase after a substantial lag of 15 - 20 quarters, and so the contribution of non-government components to export demand is negative until very far in the future. The strong initial increase in exports and (tradable) output of Ireland and Slovenia is entirely the result of the direct import of government investment goods.<sup>31</sup>

Wages increase due to higher labour demand, but also due to higher domestic consumption. This is due to stronger and more persistent reduction in debt, which induces Ricardian consumers to consume more. Essentially, consumers spread the initial burst in foreign demand over a longer period, by working less and consuming more in the medium run. Given higher productivity of a major trading partner in the medium run due to the larger productive public capital stock, there appear to be no long-lasting adverse consequences in the sense that both consumption and private investment increase in the medium run, which is the main factor that drives the negative trade balance over the longer horizon.

## 5.3 Policy implications from spillovers

Our results imply that the stronger and more positive the effect of fiscal expansion on private consumption and investment in the region engaged in the stimulus, and the greater the import content of these goods, the more beneficial is the spillover to non-expanding countries that have close linkages to the expanding region. In this respect, policies such as, for example, subsidies for the replacement of old cars in Germany were beneficial for regions that supply car parts to German manufacturers or manufacture cars sold in Germany.<sup>32</sup> Obviously, if government expenditure itself has a high import component, then this has an immediate and strong cross-border effect. Policies such as the so-called *Juncker Plan*, while not meant as a cyclical stabilisation tool, may have positive effects even on countries that would not benefit directly (i.e. do not have infrastructure projects), but the

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<sup>31</sup>The initial output increase is larger than for government consumption increase in the REA because both are standardised to be a one percentage point of ex-ante GDP. Because government investment is smaller than consumption, the increase has to be larger, hence the stronger effect. Note, however, that the increase in the area-wide interest rate is also higher, and hence the dampening effect is stronger.

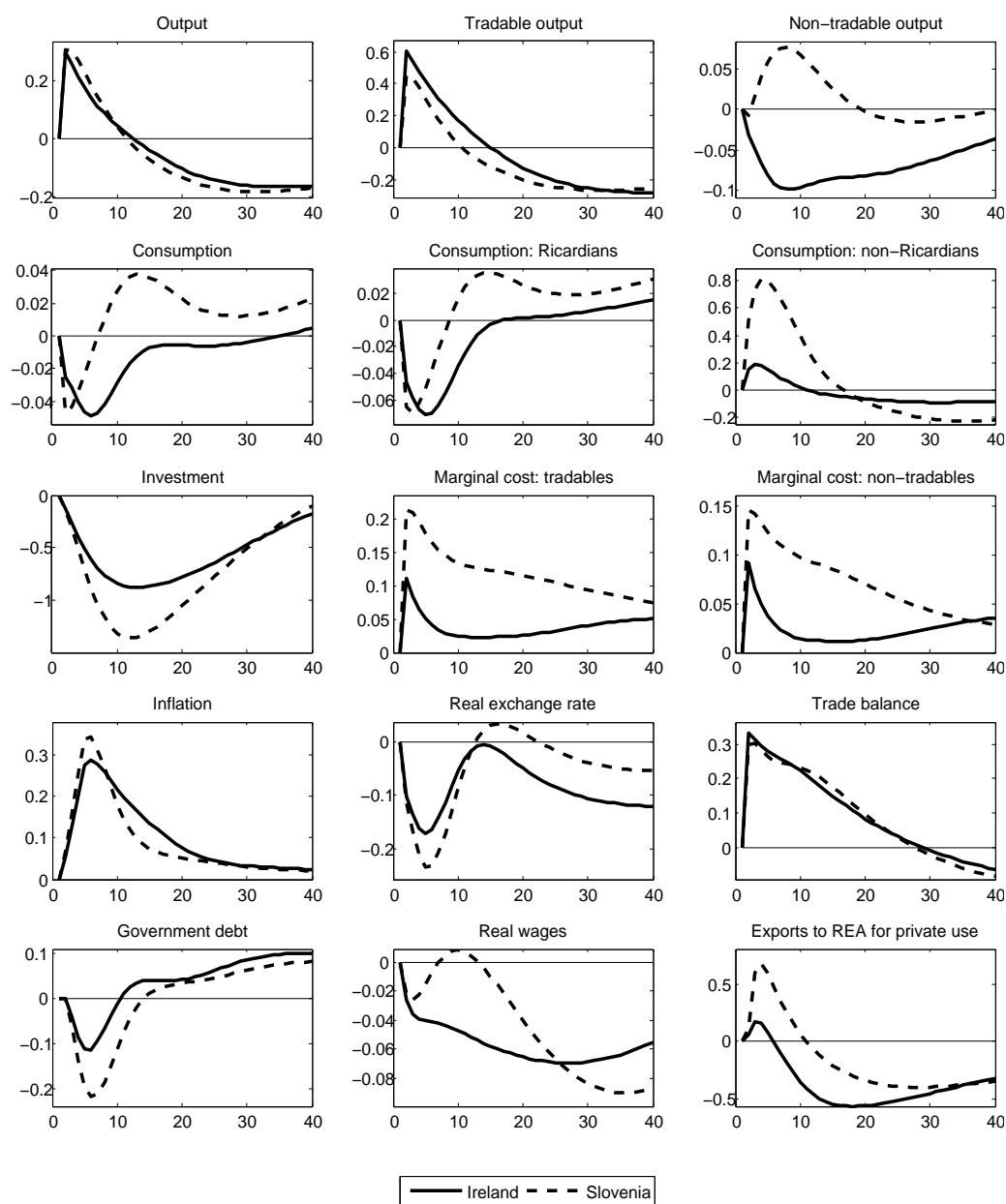
<sup>32</sup>We are grateful to Gabriel Fagan for pointing this out.



condition is that they either produce goods that will be used in such projects, or that the plan will induce immediate increase in private consumption or investment that will generate spillovers.

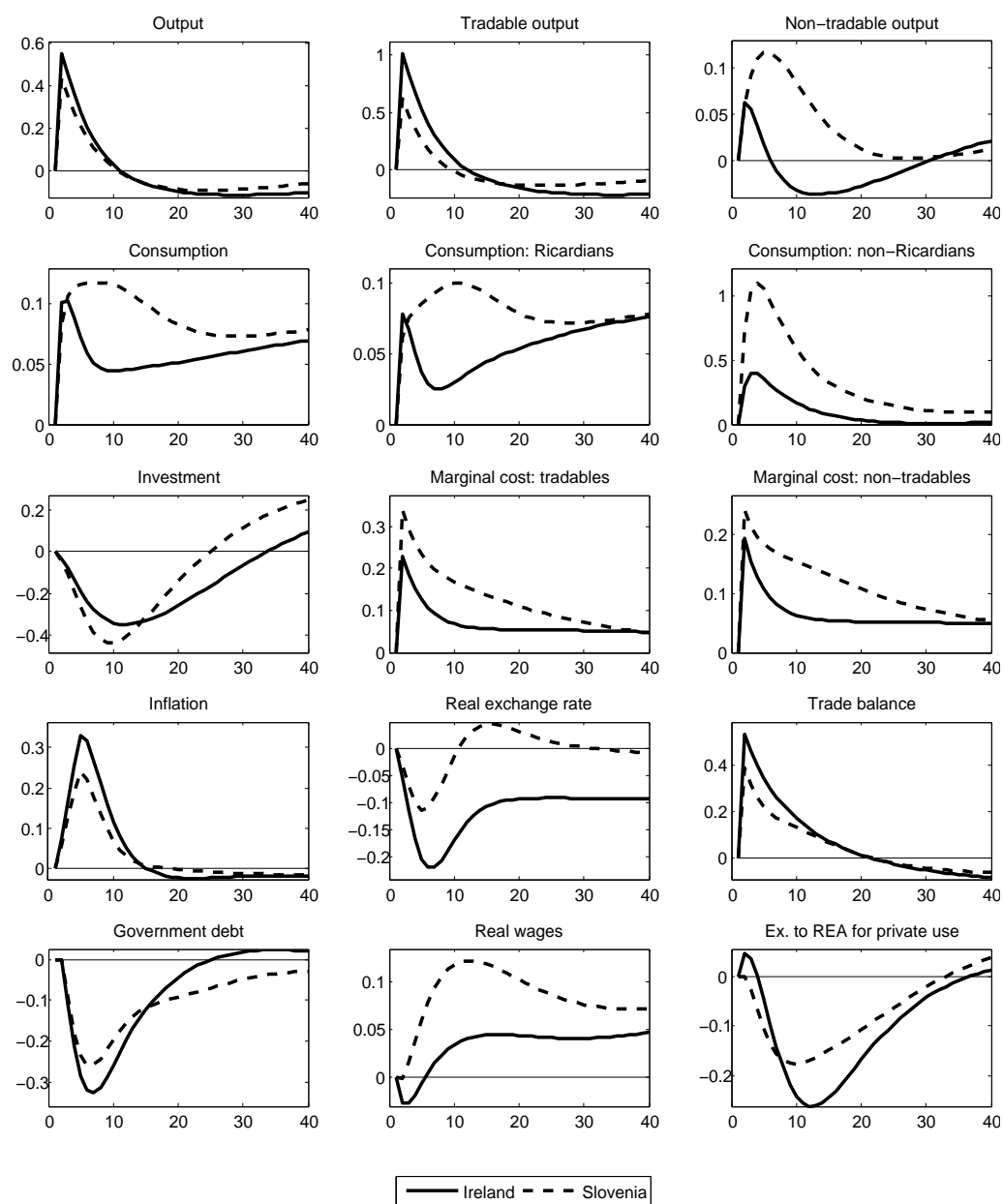
Again, the interest rate and exchange rate channels from a fiscal expansion in a large region of the euro area tend to be very strong. It is thus very difficult to dominate these effects with trade linkages, as a positive spillover hinges on a large share of direct imports of domestic goods by foreign households or governments.

FIGURE 4. A government consumption increase in the REA



Notes: Impulse responses to a 1 percent (ex-ante) GDP increase in government consumption expenditure. All variables are in percentage deviations from the steady state, except trade balance and government spending (all defined as ratios to GDP), inflation, and nominal interest rate; the impulse responses of these variables are in percentage-point deviations.

FIGURE 5. A government investment increase in the REA



Notes: Impulse responses to a 1 percent (ex-ante) GDP increase in government investment expenditure. All variables are in percentage deviations from the steady state, except trade balance and government spending (all defined as ratios to GDP), inflation, and nominal interest rate; the impulse responses of these variables are in percentage-point deviations.

Nevertheless, our results imply that if a SOE has an important small(er) trading partner, such that its fiscal policies do not affect the area-wide interest and exchange rates, then trade channels will be more potent and spillovers from fiscal expansion larger. The same would hold if monetary policy would hold the area-wide interest rate constant for a period.<sup>33</sup>

## 6 Sensitivity Analysis

To illustrate the impact of our modelling and calibration choices on the model transmission mechanisms, we investigate the changes in three key parameters. These are the complementarity between private and government consumption,  $\mu_{CCES}$ , productivity of public investment,  $\alpha_G$ , and the scale of direct imports in government investment expenditure,  $\nu_{TG}$ . Results are shown in Figures 6 to 8, where the benchmark case is shown in black and the alternative in grey. The responses for Ireland are shown with solid lines and for Slovenia with dashed.

**Public and private consumption complementarity.** To investigate the effect of complementarity between public and private consumption, we simulate the same increase in public consumption as in the benchmark case, but with consumption complementarity shut down. Not surprisingly, the effects of government stimulus on output are approximately halved and more short-lived, as shown in the left column of Figure 6. The reason is that consumption of Ricardian households does not increase following an increase of government consumption, but is crowded out instead.<sup>34</sup> This results in a substantially smaller domestic stimulus, which is reflected in lower real exchange appreciation and lower trade deficit. This implies that a fiscal stimulus should be focused on those public consumption goods that are complementary to private consumption.<sup>35</sup> Public saving, on the other hand, should be focused on government consumption goods that are close substitutes for private goods.

**Productivity of public capital.** We investigate sensitivity by considering an increase in public investment when the productivity of public investment is at the

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<sup>33</sup>See Coenen et al., 2012a, for an analysis in large blocs that are not currency unions.

<sup>34</sup>Consumption of non-Ricardian households still increases, but this effect is dominated by Ricardian households who represent 75 percent of all households in the model. Note that we do not make government consumption a substitute for private consumption; if we did, private consumption would drop sharply on impact and undo the entire fiscal stimulus.

<sup>35</sup>Karras (1994) conjectures that transportation is such a good. Fiorito and Kollintzas (2004) claim that these are goods such as health, education, and public services, and provide empirical evidence for complementarity in 12 European economies.

higher range of plausible values, 0.10, as in Baxter and King (1993) and Leeper et al. (2010).<sup>36</sup> Results are displayed in the middle column of Figure 6. There is little difference in the very short run, because an increase in government investment only increases aggregate demand for (investment) goods. But once the public capital stock accumulates, differences in its productivity begin to play a role. Private investment begins to increase immediately and much more strongly than in the benchmark case, in anticipation of the accumulation of productive public capital. Improved productivity in the medium run results in substantial depreciation of the real effective exchange rate and improves external competitiveness. While the trade surplus is positive in the longer run, the short-run deficit remains, which is largely due to the increase in domestic private investment with substantial import component. Positive co-movement between private and public investment can only occur if public capital substantially enhances the productivity of private capital. Anecdotal evidence that public investment attracts private investment (as advocated by e.g. German Expert Commission (2015)) should be treated with caution, as it holds only if the productivity of public investment is high.<sup>37</sup> The same holds for competitiveness gains.

**Import content of government investment.** In our baseline calibration, the share of government consumption expenditure that is directly imported is 10 percent, while the import content of government investment is 25 percent. We analyse the impact of an increase in government investment when import content of government investment is the same as that of government consumption, 10 percent (or 0.004 percent of GDP). The right column of Figure 6 details the results. The differences are not very large and limited only to the short-run. With lower government imports, the trade balance deteriorates by less on impact, but this is dampened to some extent because the stimulus to the domestic economy is stronger, which results in a sharper exchange rate appreciation and a loss of competitiveness. Importantly, this is undone in the medium run. The reason is that the medium-run benefits of increased public investment depend only on the stock of public capital, and not on the origin of this capital (whether it was imported or produced at home).<sup>38</sup>

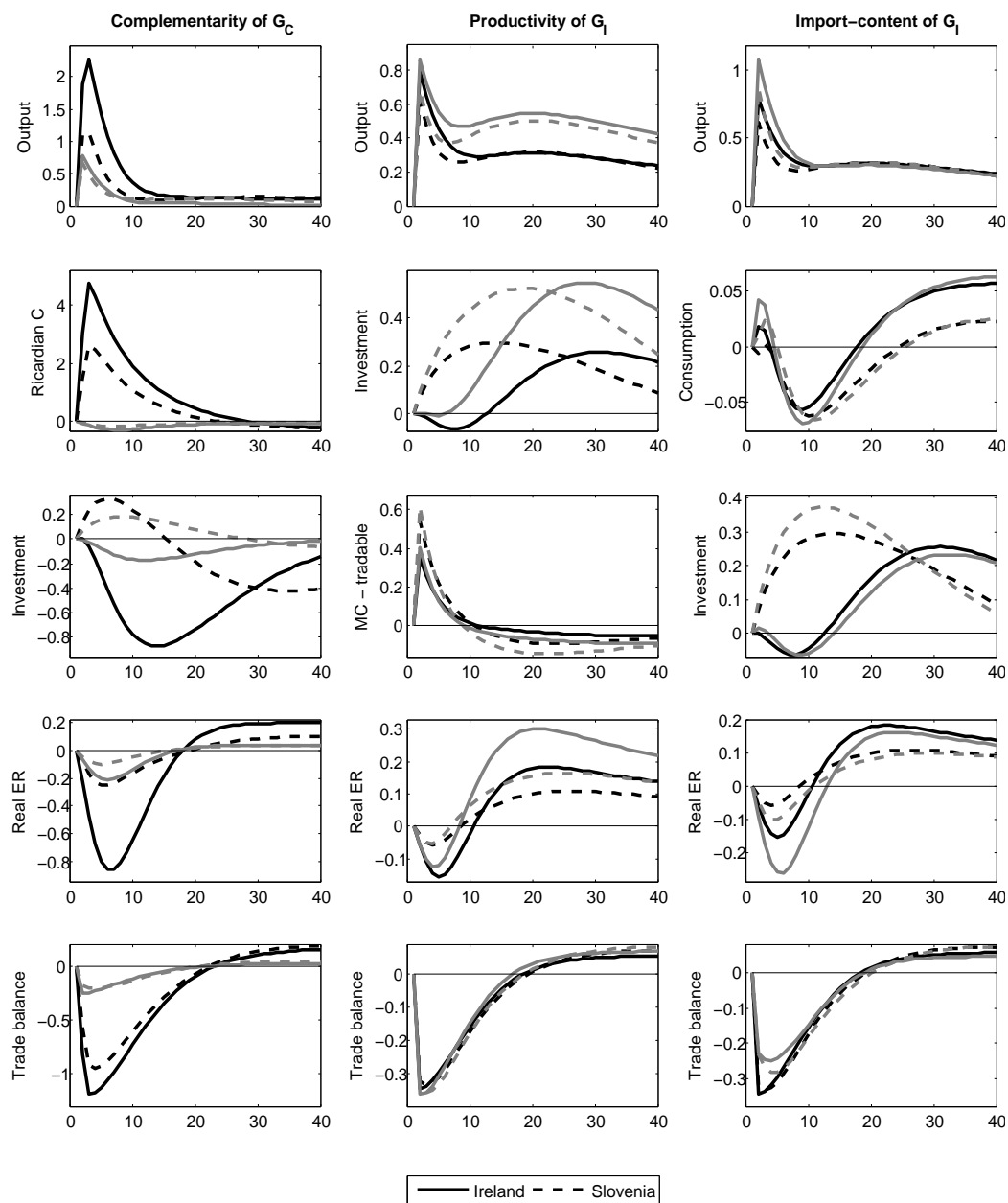
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<sup>36</sup>Note that this is not excessive. Ascahuer (1989) estimates productivity of public capital at 0.24 for infrastructure, 0.04 for other buildings, and 0.06 for hospitals. Baxter and King (1993) examine values ranging from 0 to 0.4 in a general equilibrium model.

<sup>37</sup>The Report of the Commission of German experts for instance claims explicitly on p. 5 that "The Expert Commission stresses that public investment and private investment are highly complementary."

<sup>38</sup>Similar effects would be observed for the direct import of government consumption, except for the positive medium-run effects. The results are available upon request.

FIGURE 6. Sensitivity to key parameters



Notes: Impulse responses to a 1 percent (ex-ante) GDP increase in government consumption or investment expenditure. All variables are in percentage deviations from the steady state, except for the trade balance, which is defined as a ratio to GDP and should be interpreted as percentage-point deviation.

## 6.1 Complementarity and cross-border spillovers.

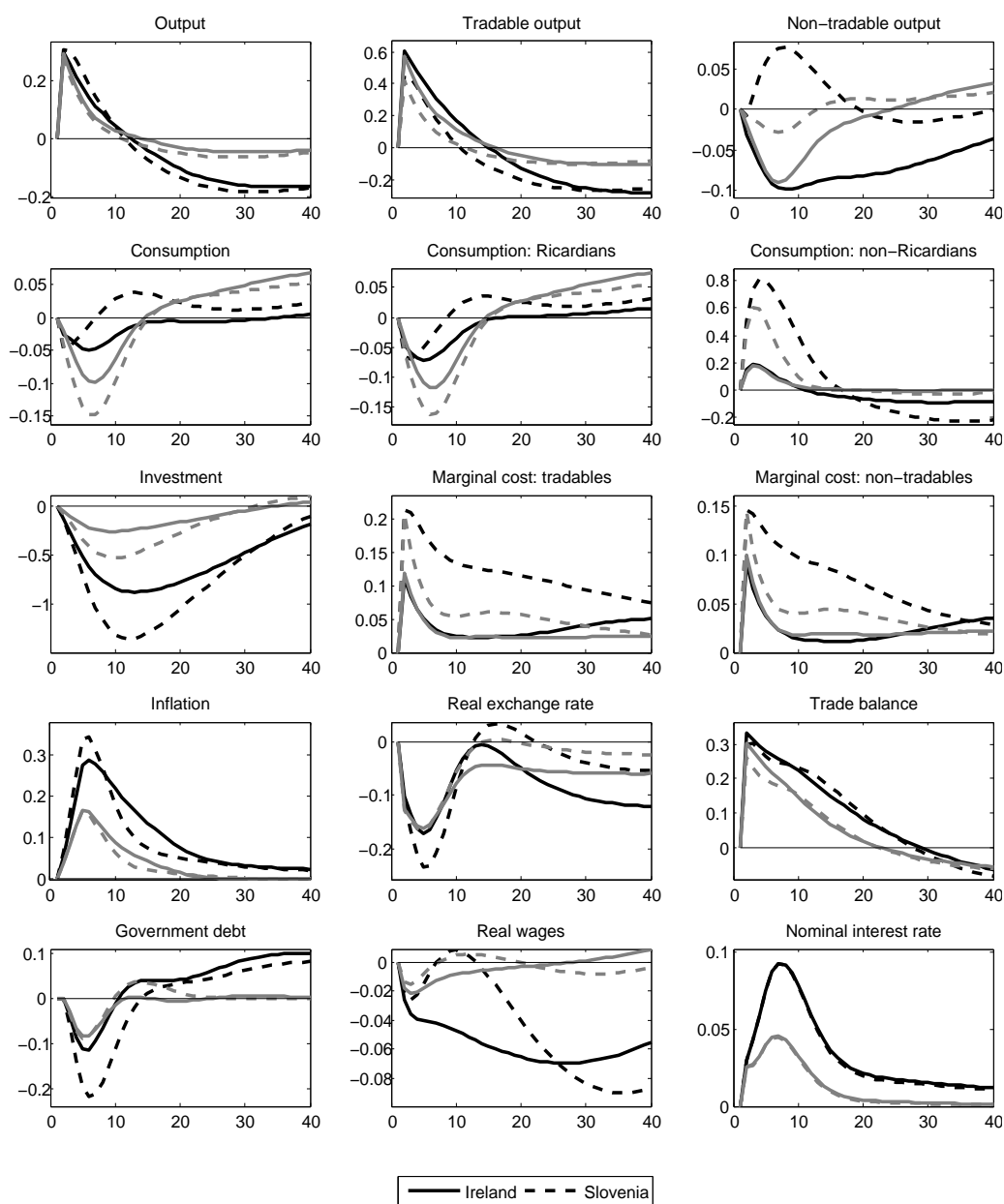
The elimination of complementarity between government and private consumption affects cross-border spillovers through several channels, as shown in Figure 7. There is still a strong initial expansion of output due to direct government demand from abroad. This is however not supplemented by private consumption demand, which results in a lower trade balance, especially in Slovenia, which trades mainly with the REA.<sup>39</sup> There is a much less persistent increase in marginal costs due to a less persistent increase in return on capital, caused by lower investment-adjustment costs. This leads to a lower increase in domestic inflation. However, as direct foreign demand for government imports increases the real interest rate, the reduction in consumption is amplified and causes non-tradable output to decrease. Note that except for the initial push from direct foreign government purchases, these effects are absent in Ireland, as it does not trade with the REA as much as Slovenia.<sup>40</sup> Eliminating complementarity induces the area-wide interest rate to increase by much less, resulting in a substantially lower decline of domestic investment in both countries. This explains why output is not even lower when demand stimulus from abroad is absent. Moreover, this is the main reason why output in Ireland is relatively close to that of Slovenia despite different trade linkages. Domestic investment in Ireland does not decrease by as much as in Slovenia, which partly compensates the missing foreign demand due to lower trade intensity with the REA.

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<sup>39</sup>In particular, the hump-shaped part of the trade balance response after the initial increase is missing, because there is no increase in REA consumption. The response of tradable output after one year is for instance by about a third lower in Slovenia and only about 10 percent lower in Ireland.

<sup>40</sup>Marginal costs, the real effective exchange rate, and consumption are almost the same in Ireland in both scenarios.

FIGURE 7. Complementarity of government consumption and spillovers



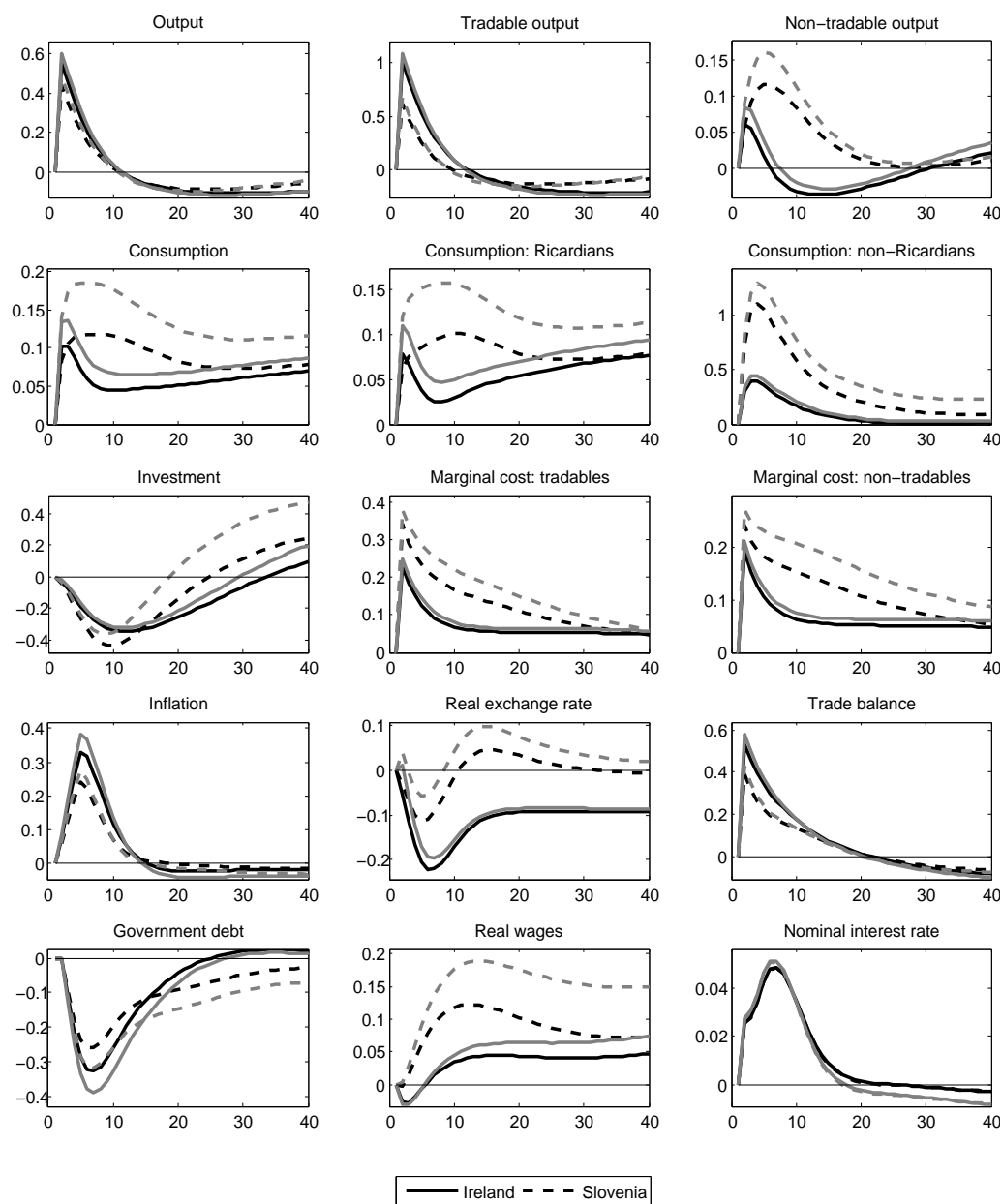
Notes: Impulse responses to a 1 percent (ex-ante) GDP increase in government consumption expenditure in the REA. All variables are in percentage deviations from the steady state, except trade balance and government spending (all defined as ratios to GDP) and inflation; the impulse responses of these variables are in percentage-point deviations. The alternative with non-complementary government consumption is shown in grey.



## 6.2 Productivity of investment and cross-border spillovers.

To analyse the influence of public capital productivity on spillovers, we set  $\alpha_G$  in the REA to 0.10 and increase government investment by 1 percentage point of ex-ante GDP with. The result in grey is shown together with the benchmark in black in Figure 8. The most striking result is that higher public capital productivity in the REA has practically no effect on Ireland. The reason is that, first, the higher productivity of public investment in the REA does not alter the path of the area-wide interest rate substantially, and second, Ireland does not trade with the REA as much as Slovenia. The latter experiences a higher increase in domestic consumption, driven by larger reduction in public debt and higher wages, and hence higher non-tradable output. Note that competitiveness increases if investment in the REA is more productive. The reason is that higher investment productivity stimulates private consumption and private investment in the REA, both resulting in higher prices in the REA. This improves the competitiveness of countries that trade with such an area, as is the case for Slovenia.

FIGURE 8. Productivity of public investment and spillovers



Notes: Impulse responses to a 1 percent (ex-ante) GDP increase in government consumption expenditure in the REA. All variables are in percentage deviations from the steady state, except trade balance and government spending (all defined as ratios to GDP) and inflation; the impulse responses of these variables are in percentage-point deviations. The alternative with more productive government investment is shown in grey.

## 7 Conclusions

This paper examines the impact of government spending in a SOE in a monetary union. Our key findings can be summarised as follows. First, government investment expenditure has a persistent positive effect on the domestic economy, even if a large portion of government investment is imported, provided that public capital is productive. Productive public capital lowers the marginal costs of firms in the medium run, which causes a real effective exchange rate depreciation and stimulates exports, which is a particularly strong channel in a SOE. Productive public capital also draws in (after a delay) private investment. The result is that after a possible initial negative reaction, private investment, private consumption and output all increase. Second, with a sufficient degree of complementarity between government and private consumption, government consumption expenditure can have strong effects on private consumption and hence output. These effects however, tend to be relatively short-lived and eventually lead to a loss of external competitiveness. Third, a high import content of government expenditure has direct negative effects on government spending multipliers.

We find that governments could provide a moderate stimulus to the economy without reducing its external competitiveness if they finance public investment, conditional on its being productive, with a reduction of government consumption that is wasteful or a substitute to private consumption. This operation is ex-ante budget-neutral and leads to a reduction in public debt and an improved current account in the medium run.

A high import content of government expenditure means that part of the government spending increase ends as a stimulus to foreign exporters. The stimulus from a foreign government expenditure does not come with an increase in expected future taxes, but it does bring higher interest rates for the entire currency area, which counters the positive effects of the stimulus. Our results show that fiscal stimulus in one region can generate positive spillovers despite the area-wide interest rate increase, if it generates a sufficient increase in private spending and hence imports. The effects will obviously be stronger and more persistent if monetary policy keeps interest rates constant.

The notion of government investment stimulating the economy is an underlying premise of the so-called *Juncker Plan*, an idea to revive growth in Europe and stimulate private investment by investing in infrastructure. We show that this may indeed attract private investment, but the condition is that the government undertakes investment that increases the productivity of the private sector. If this is not the case, private investment is crowded out.

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