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Franc Klaassen

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Roel Beetsma, Universiteit van Amsterdam, CESifo, Tinbergen Institute and CEPR
Massimo Giuliadori, Univeristy of Amsterdam and De Nederlandsche Bank
Franc Klaassen, Univeristy of Amsterdam and Tinbergen Institute

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Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

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ABSTRACT

Trade Spillovers of Fiscal Policy in the European Union: A Panel Analysis*

We explore the international spillovers from fiscal policy shocks via trade in Europe. A fiscal expansion stimulates domestic activity, which leads to more foreign exports and, hence, higher foreign output. To quantify this, we combine a panel VAR model in government spending, net taxes and GDP with a panel trade model. On average, a public spending increase equal to 1% of GDP implies 2.3% more foreign exports over the first two years. The corresponding figure for an equal-size net tax reduction is 0.6%. Both estimates are statistically significant. As far as the effect on foreign activity is concerned, a 1% of GDP spending increase (net tax reduction) in Germany on average raises GDP of trading partners by 0.23% (0.06%) over the first two years. These figures are likely to form lower bounds for the actual effects and suggest that it may be worthwhile to further investigate the benefits from coordinated fiscal expansions (contractions) in response to European-wide cyclical downturns (upswings)

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Roel Beetsma
Department of Economics
Universiteit van Amsterdam
Roetersstraat 11
1018 WB Amsterdam
THE NETHERLANDS

Tel: (31 20) 525 5280
Fax: (31 20) 525 4254
Email: r.m.w.j.beetsma@uva.nl

Massimo Giuliadori
University of Amsterdam
Department of Economics
Roetersstraat 11
1018 WB Amsterdam
THE NETHERLANDS

Tel: (31 20) 525 4011
Fax: (31 20) 525 4254
Email: m.giuliadori@uva.nl

Franc Klaassen
Department of Economics
University of Amsterdam
Roetersstraat 11
1018 WB Amsterdam
THE NETHERLANDS

Tel: (31 20) 5254191
Fax: (31 20) 5254254
Email: F.J.G.M.Klaassen@uva.nl

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1. Introduction

Macroeconomic coordination of fiscal policies is a recurring theme in policy discussions. Recent developments have given a new impulse to these discussions. In particular, the move to a common monetary policy in Europe has quite naturally raised the question whether European fiscal policies should be more tightly coordinated.¹ The importance of this question is likely to increase further in the future owing to ongoing financial and trade integration.

The practical case for fiscal coordination rests in the first place on the empirical importance of spillovers from national fiscal policies. In this paper, we shall explore the relevance of international trade for the cross-border transmission of fiscal shocks within the European Union (EU). Despite the relevance of this issue, to the best of our knowledge, such fiscal spillovers have hardly received any attention in empirical work. Moreover, while many recent analyses of the effects of fiscal impulses have to rely on relatively small samples and/or on quarterly fiscal data,² in this paper we use a panel involving bilateral trade flows between countries over a relatively large number of years. The resulting dataset is large and we thus avoid the need to resort to potentially unreliable quarterly fiscal data. Further, with the use of bilateral trade data, we avoid potential biases caused by the aggregation of trade flows over countries.

The empirical analysis is based on the conjecture that a fiscal expansion stimulates domestic activity, which leads to more domestic imports and thus more exports by other countries. This, in turn, boosts foreign income. Our quantification of these effects is innovative along several dimensions. We combine a panel vector autoregression (PVAR) model, which allows us to identify the fiscal shocks and to compute the responses of output to these shocks, with a panel trade model for the effect of output on bilateral foreign exports, to calculate the “full” effect of a fiscal impulse on bilateral foreign exports. The advantages of this approach are that we can (1) combine two models with different dimensionality and (2) disentangle the contributions of the

¹ For example, Jacquet and Pisani-Ferry (2001) argue strongly in favor of enhanced European fiscal coordination. One area they consider explicitly is the response of fiscal policy to economic shocks.

² The quality of such data is not undisputed, because it is often not clear how the data are constructed (many fiscal series at the quarterly level are interpolated from annual or semi-annual data). Moreover, since new budgets are usually presented at yearly intervals (though sometimes they may be revised during the course of the year), fiscal shocks identified in quarterly data may be hard to interpret economically.

various channels leading to the overall trade spillover of fiscal policy. Finally, both the fiscal and the trade models allow for substantial deterministic heterogeneity.

The panel VAR model shows that both an increase in government spending (i.e. government consumption plus investment) and a reduction in net taxes (i.e. revenues minus transfers) give a significant boost to domestic economic activity, which persists for some years. The panel trade estimates reveal a significantly positive effect of domestic output on foreign exports, which dies out after one year. Combining the two models, the average overall effect of a public spending increase equal to 1% of GDP is 2.3% more foreign exports over the first two years. The corresponding figure for an equal-size net tax reduction is 0.6%. Both estimates are statistically significant. As far as the effect on foreign activity is concerned, a 1% of GDP spending increase (net tax reduction) in Germany on average raises GDP of trading partners by 0.23% (0.06%) over the first two years. Given that we ignore further feedback effects among the economies as well as foreign multiplier effects from an export stimulus, these figures likely form lower bounds on the actual effects.

In this paper, we follow a “partial” approach and focus on the cross-border spillovers of fiscal policy via trade, largely ignoring other potential spillovers.³ In particular, we shall ignore possible spillovers via changes in the interest rate.⁴ There are several reasons to motivate this choice. First, the possibility of positive spillovers of fiscal expansions via trade have received much less attention in the discussions surrounding the European fiscal framework than the negative spillovers via a rise in the common interest rate. Second, especially in the case of Europe, the trade channel may well be more important than the interest rate channel. One reason is that the spillovers via trade are mostly confined to Europe, because intra-European trade is substantially larger than trade crossing the European border. Further, to the extent that the European capital market is integrated with the capital market in the rest of the world, the interest rate increase following a debt-financed fiscal expansion in some European country is diluted.⁵ Apart from this, the type of coordination that we have in mind concerns a joint

³ For a recent theoretical analysis of the various spillovers from fiscal policy in the context of a model of a monetary union, see Huart (2002).

⁴ Theoretically, a fiscal expansion can generate a spillover via both the common short-run and the common long-run interest rate. If the expansion puts upward pressure on inflation, the ECB is forced to raise the short interest rate. If public debt rises, then the long-run interest rate may go up.

⁵ We might expect a spillover of the interest rate increase to other countries if the increase is the result of crowding out (that is, the total demand for funds increases). If the rise in the interest rate is caused by an increase in the likelihood of default, then there is a priori no reason that the rise should be transmitted to other countries.

fiscal expansion when there is widespread recession in Europe or, vice versa, when most European economies are booming. Such coordinated expansions and contractions would leave the public debt roughly constant over the cycle and the effect on interest rates would at most be minor.

The remainder of the paper is structured as follows. Section 2 briefly reviews the relevant literature. Then, Section 3 presents the set up of the empirical model, after which we estimate the panel-VAR and panel-trade models. In Section 4 we combine the impulse responses from the two models to obtain the responses of the fiscal impulses on trade and on foreign output. Finally, Section 5 concludes this paper.

2. Literature review

Various articles use simulations of calibrated models to assess the trade spillovers from fiscal policy. For example, Gros and Hobza (2001) do this for Europe for a number of widely used multi-country models. In 't Veld (2004) employs the European Commission's QUEST model to explore the spillovers from a German spending contraction. However, there exists only a limited amount of empirical work that provides econometric estimates of such trade spillovers. A possible reason is that it is hard to disentangle the various channels through which fiscal policy can spill over to other countries, making it difficult to find significant spillover effects (e.g., see McKibbin, 1997). Nevertheless, there are some exceptions.

In a study that is closest to the current one, Giuliodori and Beetsma (2004) find a substantial number of cases of statistically and economically significant trade spillovers resulting from fiscal impulses in large EU countries. They extend recent empirical work that assesses the macroeconomic effects of fiscal impulses, by incorporating imports and exchange rates into the VARs used in this line of research. The main differences with the current paper are that here we disentangle the effects of fiscal policy on output and of output on foreign trade, use panel models, and take annual instead of quarterly data.

In a related study, Marcellino (2002) estimates VARs that include the German output gap and German fiscal policy together with the corresponding variables for other large European countries. He finds only small and insignificant effects of German fiscal shocks on the other economies. Other related work by Canzoneri et al. (2003) uses a VAR to explore the effects of changes in U.S. fiscal policy on output in France, Italy

and the United Kingdom. They find that the spillover effect of a government spending shock is quite large for all three countries. However, in contrast to our paper, these studies do not assess and quantify the specific channels through which the spillovers may take place.

Lane and Perotti (1998) explore the short-run impact of movements in different components of fiscal policy on the trade balance, exports and imports. They do so for a large panel of countries over the period 1960-1995 and find that fiscal policy exerts significant short-run effects on the trade balance. In particular, shifts in wage government consumption seem to affect the external account significantly, an effect that is stronger under flexible exchange rates. In contrast to our paper, Lane and Perotti (1998) only use aggregate trade flows and thus forego the specific advantages of using bilateral trade flows. Lane and Perotti (2003) investigate the effects of fiscal expansions for the traded sector and find that increases in wage government spending raise the real product wage and depress profitability in the traded sector, above all under a flexible exchange rate regime. While not specifically focused on the external account and spillovers, the results suggest that spending increases can have positive cross-border spillovers by making *foreign* countries' traded sector more competitive.

In a VAR analysis for the G3 countries (over the period 1975-1996), Clarida and Prendergast (1999) find that generally a fiscal expansion first leads to a real exchange rate appreciation, followed by a depreciation, during which the real exchange rate overshoots, before it returns to its original level. Kim and Roubini (2003) use a VAR analysis for the U.S. after Bretton Woods and find that an expansionary fiscal shock improves the current account and depreciates the real exchange rate. This is in contrast to what the standard Mundell-Fleming model would predict. Related empirical work by Müller (2004) shows that the U.S. trade balance improves and the nominal exchange rate depreciates after a temporary spending shock.

The estimation of the effect of fiscal impulses on foreign exports requires us to assess the consequences of fiscal impulses for economic activity. Here, we build on the recent literature that uses VAR analysis to identify fiscal shocks and to trace their effects through the economy based on impulse-response analysis. While, theoretically, the effect of public spending increases on economic activity can go both ways,⁶

⁶ For example, in the context of a real business cycle framework, Baxter and King (1993) show that a public spending increase financed by lump-sum taxes may raise GDP, while a spending increase

existing empirical evidence points to the dominance of Keynesian effects. Examples are Fatás and Mihov (2001) and Galí *et al.* (2003) for the U.S., who find that private consumption increases in response to a public spending increase. Related studies by Blanchard and Perotti (2002), Mountford and Uhlig (2002) and Perotti (2005) confirm the short-run stimulus obtained not only from government spending increases, but also from net tax reductions.⁷

3. The empirical set-up and the estimates of the fiscal and trade blocks

To estimate the overall effect of domestic fiscal impulses on exports by trading partners in Europe, in this section we first estimate a panel vector autoregression (PVAR) model in which the responses of output to discretionary fiscal shocks are traced out. To fix terminology, we will henceforth refer to this model as the *fiscal block*. Subsequently, we set up a panel trade model in which the dynamic responses of bilateral exports by the neighbouring countries to domestic output are estimated. We shall refer to this model as the *trade block*. In the next section, we combine the results of the trade block and fiscal block to obtain the full effect of fiscal impulses on bilateral exports. Finally, we translate the export impacts into changes in foreign output.

By estimating the fiscal and trade blocks separately and then combining the respective outcomes, we circumvent the difficulty that the two models have different dimensions, because the fiscal block concerns the domestic economy only, whereas the trade block deals with the interactions between pairs of countries. An additional advantage of estimating these models separately is that this allows us to disentangle the sizes of each step going from the fiscal impulse to the foreign bilateral export and the eventual foreign output effect.⁸

While the advantage of using panels is that we increase the number of observations, the disadvantage, of course, is that we have to impose certain

financed by distortionary taxes leads to a contraction of GDP. For recent surveys of the potential ways in which fiscal policy changes affect economic activity, see Hemming *et al.* (2002) or Andersen (2004).

⁷ Other relevant contributions to this expanding literature include Canova and Pappa (2002), Favero (2003), Burnside *et al.* (2000), Van Aarle *et al.* (2003), Claeys (2004) and Muscatelli *et al.* (2004). It should be noted that the aforementioned contributions mostly look at the effects of fiscal impulses under “normal” circumstances. Periods of fiscal distress may well show non-Keynesian effects of fiscal changes. In particular, Giavazzi and Pagano (1990) - followed by a large number of other papers (e.g., Perotti, 1999) - suggest that fiscal contractions can actually be expansionary.

⁸ In one experiment, we combined the fiscal and trade blocks in a single, huge panel VAR. The impulse responses were very similar to those described below. This provides another reason to keep the blocks separate.

homogeneity restrictions. By focusing on EU countries only, we intend to limit the potential heterogeneity, as the economies share many similarities. Moreover, as we describe below, we allow for extensive deterministic heterogeneity-

Finally, the specifications of the fiscal and trade blocks depend on the time horizon of the spillovers that we want to analyse. Given that we are primarily interested in assessing the potential desirability of joint fiscal responses to business cycle movements, we are mostly interested in the short- and medium-run economic effects of the fiscal impulses. Therefore, both the fiscal and trade models are dynamic instead of static.

3.1. The fiscal block

The fiscal block is captured by a PVAR model, which in its structural form is given by:

$$A_0 Z_{it} = A(L) Z_{it-1} + e_{it}, \quad (1)$$

where Z_{it} is an $(m \times 1)$ vector of endogenous variables, A_0 is an $(m \times m)$ matrix with 1's on the diagonal. It contains the structural parameters that capture the contemporaneous relations among the endogenous variables. Further, $A(L)$ is a matrix polynomial in the lag operator L , and e_{it} is the structural disturbance vector. Pre-multiplying (1) by A_0^{-1} , we obtain the reduced form as:

$$Z_{it} = B(L) Z_{it-1} + u_{it}, \quad (2)$$

where $B(L) = A_0^{-1} A(L)$ and $u_{it} = A_0^{-1} e_{it}$ is the reduced-form residual vector.

The model specification follows Blanchard and Perotti (2002) in that $Z_{it} = [g_{it}, nt_{it}, y_{it}]'$, where g_{it} is real public spending, nt_{it} is real net taxes (revenues minus transfers) and y_{it} is real total output, all in natural logarithms. We set the lag length of the system to two and estimate the PVAR for 11 EU countries over the period

1965-2002 (see the Appendix for details).⁹ To derive the impulse responses of output to the structural shocks of the system, we have to impose three identifying restrictions. Let

$$A_0 u_{it} = e_{it} \quad \text{or} \quad \begin{pmatrix} 1 & -a_{gt} & -a_{gy} \\ -a_{tg} & 1 & -a_{ty} \\ -a_{yg} & -a_{yt} & 1 \end{pmatrix} \begin{bmatrix} u_{it}^g \\ u_{it}^n \\ u_{it}^y \end{bmatrix} = \begin{bmatrix} e_{it}^g \\ e_{it}^n \\ e_{it}^y \end{bmatrix}, \quad (3)$$

where e_{it}^g , e_{it}^n , and e_{it}^y are the mutually-uncorrelated structural shocks that we want to recover, while u_{it}^g , u_{it}^n , and u_{it}^y are the reduced-form residuals.

As in Blanchard and Perotti (2002) and in Perotti (2005), in our baseline panel-VAR specification, we make use of information on the elasticities of the various components of net taxes with respect to output. Using this information, which is available on a country-by-country basis from Van den Noord (2000), we purge each component of net taxes of its cyclical component. Adding up the cyclically adjusted components then yields the cyclically adjusted net taxes (see the Appendix for more details). This variable thus takes account of the fact that the tax elasticities differ across countries. By including cyclically adjusted net taxes we can impose that the reaction of this variable to output is zero, $a_{ty} = 0$, which provides us with one identifying restriction. Another advantage of making these country-specific cyclical adjustments to net taxes is that this should enable us to more accurately identify the country-specific discretionary tax shocks. If the elasticities of net taxes to output indeed differ across countries, then imposing homogeneity by estimating a_{ty} would lead us to identify as the net tax shocks combinations of the true shock and the country-specific part of the cyclical reaction of net taxes to output.

We obtain two additional identifying restrictions with the assumption that public spending (government consumption plus government investment) does not react to contemporaneous changes in (cyclically adjusted) net taxes ($a_{gt} = 0$) and output ($a_{gy} = 0$). These assumptions seem reasonable given that spending plans are usually determined in a government budget that is presented before the new fiscal year starts.

⁹ We include country and year fixed effects as well as country-specific linear time trends. With a panel with large T, ordinary least-square (OLS) estimation with country fixed effects and country-specific linear time trends yields consistent estimates. Alesina *et al.* (2002) and Ardagna *et al.* (2004) estimate panel VARs for similar country and period samples.

(Note that while government transfers, in particular, unemployment benefits, may be sensitive to the cycle, these are not included in our measure of government expenditure). The restriction $a_{gt} = 0$ implies that public spending is “ordered first” in the VAR. An alternative orthogonalization would be to order net taxes first. However, as in Alesina *et al.* (2002), it turns out that the correlation between the reduced-form innovations of the public spending and net tax equations is very small. Hence, the specific ordering of the two fiscal variables vis-à-vis each other has no bearing on the results. In what follows, we always order public spending first.

With these restrictions imposed, the system that we estimate becomes:

$$\begin{pmatrix} 1 & 0 & 0 \\ -a_{tg} & 1 & 0 \\ -a_{yg} & -a_{yt} & 1 \end{pmatrix} \begin{bmatrix} g_{it} \\ nt_{it}^{CA} \\ y_{it} \end{bmatrix} = A(L) \begin{bmatrix} g_{it-1} \\ nt_{it-1}^{CA} \\ y_{it-1} \end{bmatrix} + \begin{bmatrix} e_{it}^g \\ e_{it}^{nt^{CA}} \\ e_{it}^y \end{bmatrix}, \quad (4)$$

where the superscript “CA” is used to denote that the variable is cyclically adjusted. For notational simplicity, we do not attach this superscript to the structural shock e_{it}^{nt} nor to the coefficients that are affected by the switch to cyclically adjusted net taxes.

Column 1 of Table 1 reports the maximum likelihood estimates of the unrestricted coefficients in (4) over the full sample period 1965-2002. We take this as the baseline case for the panel VAR. The results indicate that government spending has no contemporaneous effect on cyclically adjusted net taxes. By contrast, and as in Blanchard and Perotti (2002, Figures III and V) for the U.S., a government spending increase and a net tax cut exert a highly significant positive effect on current output. We show the corresponding impulse responses in Figure 1, where we normalize the fiscal shocks to be equal to 1% of GDP. In both instances, output rises significantly upon impact and the increase remains significant for three years after the net tax shock and for much longer after the spending impulse. In case of the latter, net taxes rise significantly, although with some lag. The positive effect on net taxes is probably best explained by the need for budgetary sustainability.

In order to assess the robustness of the baseline model, we have also estimated (4) in first differences. In addition, we have estimated a number of plausible variants on (4). Basically, all cases yield the same conclusions. In one variant, following the results of the baseline model, we impose $a_{tg} = 0$ and relax one by one the contemporaneous

zero restrictions on a_{gt} , a_{gy} and a_{ty} . Another variant replaces output (GDP) in (4) with the log of real private output py , that is, GDP minus government expenditures. The objective is to see if a spending impulse causes significant multiplier effects on output. We realize that this approach is not entirely accurate, because we subtract from output also the component of government spending that falls on foreign products. However, this component is generally small, so that our measure of private output is close to the conceptually correct one. We report the estimates in column 2 of Table 1 and the impulse responses in Figure 2. Not surprisingly, the response of private output to a spending increase is weaker than before, though it is still significant. Hence, this indicates the presence of multiplier effects.

As another variation on the baseline, we have estimated (4) for the sub-sample period 1980-2002. The reason is that Galí and Perotti (2003) and Perotti (2005) find that the effects of fiscal policy changes could have become different over time. Table 1, column 3, reports the results for this case, while Figure 3 shows the impulse responses. The effect of a net tax reduction has become much weaker (though its impact effect on output is still significantly positive), whereas the response of output to a public spending shock has slightly increased, although it now dies out more quickly.

Finally, we have extended the baseline model with the (log) price level, the short-run interest rate and (log) real multilateral exchange rate. One cannot a priori exclude the possibility that fiscal shocks influence the dynamics of economic activity by affecting these variables. In particular, it could be important to include an exchange rate, because in a large part of the sample exchange rates were not fixed. We order the price level first, because prices tend to be sticky and budgets are generally set in nominal terms. A price increase would reduce real government spending within the same year (and could affect real tax revenues through bracket creep). The real exchange rate is ordered last, because (through the nominal exchange rate) it is expected to react instantaneously to changes in other macro-economic variables. The interest rate is ordered next-to-last. The impulse responses of output (and the fiscal variables) are very similar to the baseline responses (compare Figure 4 to Figure 1), which supports our choice to proceed with the baseline specification in the remainder of the analysis. We observe that the price level and the interest rate start rising and become significant one to two years after the spending or tax shock. They reach their peaks some years later. The increase in the short interest rate most likely results from the desire of the central

banks to counteract inflationary pressures. The real exchange rate is hardly affected, except perhaps (with a depreciation) within a year after the tax shock. We also estimated a version of the model with a long-run interest rate replacing the short-run interest rate and we estimated a version in which both the short and the long interest rate were included together. The impulse responses are virtually unchanged, while the long interest rate behaves in much the same way as the short interest rate. This is not surprising given the strong empirical correlation that is usually found between the short and long end of the term structure.

3.2. The trade block

The second step is to estimate the trade block. It is based on the gravity model of trade – see Bergstrand (1989) for a description and theoretical motivation of this model. Because we are interested in the short- and medium-run effects of fiscal impulses, our baseline panel trade model extends the standard gravity model by allowing for dynamics using the following autoregressive distributed lag (ADL) specification with $n=2$ lags:

$$x_{ji,t} = \sum_{s=1}^n \beta_{1s} x_{ji,t-s} + \sum_{s=0}^n \beta_{2s} y_{i,t-s} + \sum_{s=0}^n \beta_{3s} rer_{ji,t-s} + \varepsilon_{ji,t}, \quad (5)$$

where $x_{ji,t}$ is (the log of) bilateral real exports at time t from country j (the foreign country) to i (the home country), $y_{i,t-s}$ ($y_{j,t-s}$) is (the log of) real output in the home (foreign) country, and $rer_{ji,t-s}$ is the (log of the) bilateral real exchange rate between country j and country i . It is defined such that, if $rer_{ji,t-s}$ rises, then the currency of country j (the exporting country) depreciates in real terms against the currency of country i . The model also contains – though not shown in equation (5) – fixed effects for the country-pair ji that capture the impact of all time-invariant determinants of trade (such as distance, a common border, a common language, etc., as in the gravity model). Further, we include fixed time effects to control for, among other things, the general state of the world economy, and have country-pair specific linear time trends representing potentially omitted trending determinants of exports (such as transportation costs and trade liberalization), as motivated in Bun and Klaassen (2003).

Following standard practice in the trade literature (see e.g. Rose, 2000, and Glick and Rose, 2002), we add dummies $EU_{ji,t}$ and $FTA_{ji,t}$. The former dummy scores one if at time t both j and i are members of the European Union (or the European Community, before the ratification of the Maastricht Treaty), and zero otherwise. Similarly, $FTA_{ji,t}$ is a dummy equal to one if there is a free trade agreement between j and i at time t . Finally, $\varepsilon_{ji,t}$ is a zero-mean random variable which may be heteroskedastic (over time and country pairs), but is assumed to be uncorrelated over time and country pairs.

We estimate the model by OLS (see Panopoulou and Pittis, 2004, for theoretical and empirical support). Again the data set covers the period 1965-2002. It accounts for all bilateral trade relationships between the 11 EU countries used in the fiscal block, providing us with 110 country pairs (see the Appendix for the further details).

Table 2, column 1 presents the estimates for the parameters of interest in (5). Bilateral exports are highly correlated with bilateral exports one year earlier. A real depreciation of the exporting country's currency (i.e. a rise in $rer_{ji,t}$) has a strong positive effect on bilateral exports from j to i ; the long-run effect $(\beta_{30} + \beta_{31} + \beta_{32})/(1 - \beta_{11} - \beta_{12})$ is 0.768 with a standard error of 0.077 (not reported in the table). Similarly, an increase in real GDP of country i , the importing country, exerts a strong positive effect (the long-run effect is 0.754 with standard error 0.154). Finally, in the long run, membership of a free trade area leads to 28% (standard error 4%) more trade and membership of the European Union stimulates trade by an additional 16% (standard error 3%). These effects are substantial.

To see how the long-run effects materialize over time, we plot the impulse responses of bilateral exports from the foreign to the domestic country to shocks in bilateral exports, domestic output and the real exchange rate (see Figure 5). The size of the shock is a one percent increase in the variable under consideration. As expected, the effects of an increase in domestic output on bilateral exports are positive and strongly significant on impact. A one percent real depreciation of the foreign currency leads to a statistically significant 0.5% increase in foreign exports on impact. However, these effects die out quickly. The effect of the real exchange rate impulse has disappeared after two years, while the effect of the output shock vanishes already after one year. The accumulation of the impulse responses over time thus gives the long-run estimates presented above.

Column 2 in Table 2 reports the estimates when we add as explanatory variables in the panel trade model the domestic discretionary government spending shocks that we identified from the fiscal block. It is conceivable that the government buys part of a spending increase directly from abroad, in which case the discretionary government spending shock should enter with a positive coefficient in the trade equation. However, the estimates show that the discretionary spending impulse exerts no direct effect on bilateral exports from the foreign country. This is not surprising, because by far most of government spending falls on domestic goods and services. Incidentally, we note that the government spending shock is a generated regressor in the trade model. Hence, if correctly computed, the standard errors would exceed those reported in Table 2, which would reinforce our finding that the government spending shock has no significant direct effect on foreign exports.

We have estimated a number of additional variations on the baseline, motivated by trade model specifications elsewhere in the literature. First, we add real GDP of the exporting country j . Column 3 of Table 2 shows the estimates. We conclude that there is no indication that foreign output matters for foreign exports, which motivates us to retain our baseline specification. Second, we have also estimated specifications in which we added to the baseline real GDP *per capita* of country i or country j (to control for the effect of the welfare level) or a measure of bilateral real exchange rate volatility. The estimates are not reported here, but none of these variables came out significantly. This result differs somewhat from what is usually found in the empirical trade literature. The reason is probably that we use a dynamic instead of a static model. Indeed, if we follow the usual procedure of estimating static models and not adjusting the standard errors for serial correlation in the residuals, then all the variables just mentioned have a significant impact. Because we find clear evidence of dynamics (see Table 2), we prefer to stick again with our baseline specification.

4. Combining the fiscal and the trade blocks

By combining the estimates for the trade block with those for the fiscal block, we can compute the overall effect of a domestic fiscal impulse on foreign bilateral exports to the home country. In principle, the effect can operate both through output and through the real exchange rate. However, we set the effect through the second channel to zero. The reason is that we want to assess the spillovers of a fiscal impulse under the current

regime of a monetary union in Europe. With a common currency and sticky prices, we can expect only very limited short-run movements in real exchange rates.

One can then write the impulse response function:

$$y_{it} = \Psi(L)e_{it}^f, \quad (6)$$

where $\Psi(L)$ is a lag polynomial and e_{it}^f is the discretionary fiscal shock ($e_{it}^f = e_{it}^g$ or $e_{it}^f = e_{it}^n$). The coefficients of $\Psi(L)$ are functions of the estimates of the parameters from the fiscal block. They show how a fiscal shock affects domestic output over time.

The trade model provides the link between domestic output and bilateral exports of the foreign country, where the response function is the distributed-lag function:

$$x_{ji,t} = D(L)y_{it}, \quad (7)$$

where the coefficients in the lag polynomial $D(L)$ are a function of the estimated parameters of the trade model.

Combining (6) and (7), we calculate the effects of the discretionary fiscal shock in country i on bilateral exports from country j to country i as

$$x_{ji,t} = D(L)\Psi(L)e_{it}^f. \quad (8)$$

Hence, we compute the impulse responses of bilateral exports to the fiscal shock by simply multiplying the lag polynomials $\Psi(L)$ and $D(L)$. Figure 6 shows these impulse responses. The effect of a domestic spending shock is significantly positive for several years and reaches its maximum after one year. A net-tax cut also produces a significant increase in net exports. However, the effect is smaller and shorter-lived than that of an equal-sized spending increase.

Table 3 reports the cumulative effects on foreign exports of the domestic fiscal shock. A relevant question is what is the appropriate horizon for assessing the effects of the shock. As explained earlier, we are primarily interested in the short- and medium-run consequences of fiscal impulses. Therefore, Table 3 reports impact effects and cumulative responses after two and after five years. For a one percent of GDP spending

increase, which amounts to an increase in public spending of slightly over 4 per cent, the cumulative export effect after two years is a significant increase of 7.8 per cent of one year's exports. For an equally-sized net tax reduction, the (significant) gain in exports amounts to 1.4 per cent.

A complication in assessing the gains from a fiscal impulse is that, after the shock, fiscal policy continues to deviate from its original value. It can be reasonably argued that these subsequent deviations should be added to the initial spending shock in order to obtain the total budgetary cost of the cumulative export gain. Table 3 also reports the "normalized" response, which, loosely speaking, divides the cumulative gain in exports by the cumulative deviation of government spending from its original level.¹⁰ Over a two-year horizon there is an export gain of 2.3% of a year's exports for each one-percent of GDP additional spending. The corresponding figure for a net tax reduction is 0.6%. Both figures are significant.

By combining the cumulative and normalized responses of the bilateral foreign exports to fiscal shocks with the actual shares of bilateral foreign exports in foreign output, we can calculate the effects of domestic spending and net tax shocks on foreign output. Tables 4 and 5 display the cumulative and normalized responses of EU countries' output to a spending increase or net tax reduction in the two largest economies in the Euro area (Germany and France). The computation of these responses is analogous to those for the net exports responses in Table 3. The reported figures are only indicative in that they do not account for potential multiplier effects of exports on foreign economic activity nor for further feedback effects among the economies. Hence, the figures reported here likely form only a lower bound on the actual size of the trade spillovers.¹¹ Nevertheless, Tables 4 and 5 indicate that a German fiscal expansion (especially a spending shock) has strong effects on its small neighbours. An increase in public spending (a decrease in net taxes) by 1% of GDP in Germany leads to a more than 0.4% (0.1%) normalized increase in GDP of Austria, Belgium-Luxemburg and the Netherlands after two years. In accordance with the gravity model, the effects on these countries are larger than the effects on other small countries that are further away and do not share a common border with Germany. Averaged across all partner countries, the normalized effect of a German fiscal stimulus is 0.23% (0.06%) of foreign GDP. Naturally, the spillover effects of a French fiscal impulse are smaller

¹⁰ The details of the computation are contained in the Notes to Table 3.

¹¹ Computation of the complete spillover effects is complicated and, therefore, left for future research.

(on average, roughly half of the size of the spillovers from the German shock), but they are still non-negligible. In general, and not surprisingly, the trade spillovers of fiscal shocks are larger, the stronger the bilateral trade links.

5. Conclusions

In this paper, we explored the empirical importance of trade spillovers from fiscal policy shocks in the European Union. The magnitude of these trade spillovers is important for assessing whether more fiscal coordination is desirable. On the one hand, stronger spillovers imply that a larger share of the fiscal stimulus leaks away, thus reducing the incentive to give a unilateral fiscal impulse. On the other hand, the benefit from mutually internalizing the externality associated with a concerted fiscal impulse increases. Thus, the benefit from a coordinated fiscal response to a widespread European recession becomes larger. Our estimates suggest that, measured over a two-year horizon, a domestic fiscal impulse equal to 1 per cent of GDP leads to a gain of 2.3 per cent of a year's bilateral exports by EU trading partners for a public spending shock and 0.6 per cent for a net tax shock. Averaged across EU partners, the corresponding output gain of a fiscal stimulus in Germany is 0.23 percent in case of a spending increase and 0.06 percent for a net tax cut. All these figures are significant and, as we have argued, they likely form a lower bound on the actual effects.

In order to obtain these estimates, we followed a rather unconventional two-step procedure. In the first step, we identified the discretionary fiscal shocks from a panel VAR and computed impulse responses to these shocks. The second step comprised the estimation of a panel trade model, from which we obtained the effects of changes in domestic output on foreign exports. Upon merging the responses from the two blocks, we could compute the overall effect of the fiscal impulses on bilateral exports and thereby on output of other EU countries.

The preceding analysis admits a number of extensions. For example, when estimating the consequences of the fiscal shocks, one could also take account of the multiplier effects in foreign output caused by the rise in foreign exports. Another extension would be to allow for feedback effects from the stimulation of the foreign economy onto the domestic economy.

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Appendix: data sources and description

Data sources are the Economic Outlook (EO) of the OECD Statistical Compendium; the International Financial Statistics (IFS) of the International Monetary Fund (IMF) Database; and the Direction of Trade Statistics (DOTS).

Fiscal variables

The EO provides time series at *annual* frequency for the following variables:

CGAA	=	Government Consumption
IGAA	=	Fixed Investment, Government
PCG	=	Deflator, Public Consumption (base year 1995 =100)
PIG	=	Deflator, Fixed Investment, Government (base year 1995 =100)
TIND	=	Indirect Taxes
TSUB	=	Subsidies
TY	=	Direct Taxes
SSPG	=	Social Benefits Paid by Government
TRPG	=	Other Current Transfers Paid by Government
SSRG	=	Social Security Contributions Received by Government
TRRG	=	Other Current Transfers Received by Government

Additional variables

GDP	=	Gross Domestic Product (Market Prices), Value
PGDP	=	Deflator for GDP at Market Prices (base year 1995 =100)
IRS	=	Short term interest rate

From the above series, we construct the following variables:

Y	=	Real GDP = $GDP * 100 / PGDP$
G	=	Real Public Spending = $CGAA * 100 / PCG + IGAA * 100 / PIG$
PY	=	Real Private GDP = $Y - G$
REVENUES	=	$TY + TIND + SSRG + TRRG$
TRANFERS	=	$TSUB + SSPG + TRPG$
NT	=	Real Net Taxes = $(REVENUES - TRANFERS) * 100 / PGDP$

Note that due to short data availability, for Ireland and the Netherlands TRPG and TRRG are not included in the calculation of REVENUES and TRANSFERS.

In order to cyclically adjust net taxes, we follow Alesina *et al.* (2002) and for each component of revenues and transfers at time t we compute:

$$R_{it}^{CA} = R_{it}^{NCA} (Y_t^{TR} / Y_t)^{\xi_i},$$

where superscripts CA, NCA and TR denote, respectively, “cyclically adjusted”, “non cyclically adjusted” and “trend”, and ξ is the elasticity of component i with respect to real output. The OECD does not provide the transfers elasticity. Therefore, as in Alesina *et al.* (2002), we use the total primary expenditure elasticity and scale it up by the ratio of transfers to total primary spending. Additionally, we calculate trend GDP separately for each country by regressing log real GDP on a constant, a linear and a quadratic time trend.

Trade variables

The real bilateral export flows X_{ji} from country j to country i in a given year are taken from Bun and Klaassen (2003) (updated with the year 2002). They are constructed as the sum of the monthly real exports, where the latter is the nominal value of exports in exporter’s currency divided by the exporter’s price index. The nominal value of exports in exporter’s currency is obtained by converting the original dollar denominated export values of the DOTS. The real bilateral exchange rate RER_{ji} is the average of the monthly real rates computed using nominal rates and the same exporter’s price indices as used above. The real multilateral exchange rate rer (used in the sensitivity analysis for the fiscal block) is the weighted average of the log of RER_{ji} in index form, using export shares as weights. The trade integration dummies $EU_{ji,t}$ and $FTA_{ji,t}$ are based on the dating of the membership of the EU or a free trade agreement used in Bun and Klaassen (2003).

Variables used in the panel estimation

$$p = \log(\text{PGDP})$$

$$\begin{aligned}
y &= \log(Y) \\
py &= \log(PY) \\
i &= \text{IRS} \\
rer &= \log(\text{RER}) \\
\\
g &= \log(G) \\
nt^{CA} &= \log(\text{NT}^{CA}) \\
\\
x_{ji} &= \log(X_{ji}) \\
rer_{ji} &= \log(\text{RER}_{ji})
\end{aligned}$$

Country and data samples:

The “fiscal block” is estimated for 11 EU countries: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, United Kingdom, and Sweden. Trade variables for Belgium include trade flows of Luxembourg. Denmark, Greece and Spain are excluded because the relevant fiscal variables are either missing or available only over a very short period. The estimation sample is 1965-2002. The only exceptions are the United Kingdom and Belgium (1970), Ireland (1977) and the Netherlands (1969). The “trade block” is estimated over the same period and accounts for all the bilateral trade relationships between the 11 countries above, leading to 110 country pairs.

TABLES

Table 1: Estimates of the contemporaneous coefficients of the fiscal block (4)

	<i>1</i>	<i>2</i>	<i>3</i>
	Baseline	Baseline with private output	Baseline over 1980-2002
α_{tg}	-0.068 (0.121)	-0.070 (0.122)	-0.179 (0.134)
α_{yg}	0.331*** (0.034)	0.129*** (0.045)	0.358*** (0.0371)
α_{yt}	-0.054*** (0.014)	-0.075*** (0.019)	-0.049*** (0.018)
Sample period	1965-2002	1965-2002	1980-2002
Panel size	11	11	11
Observations	370	370	231

Notes: the table shows the estimates of the coefficients (and their respective standard errors in parentheses) of the A_0 matrix of equation (4). (*), (**) and (***) indicate statistical significance at the 10%, 5% and 1% level, respectively.

Table 2: Estimates of the bilateral export panel model (5)

	<i>1</i>	<i>2</i>	<i>3</i>
$x_{ji,t-1}$	0.627*** (0.047)	0.633*** (0.052)	0.624*** (0.047)
$x_{ji,t-2}$	0.057 (0.043)	0.051 (0.049)	0.058 (0.043)
$rer_{ji,t}$	0.478*** (0.037)	0.474*** (0.038)	0.474*** (0.038)
$rer_{ji,t-1}$	-0.118** (0.052)	-0.118** (0.051)	-0.126** (0.052)
$rer_{ji,t-2}$	-0.118*** (0.038)	-0.120*** (0.038)	-0.119*** (0.038)
$y_{i,t}$	1.561*** (0.139)	1.680*** (0.160)	1.551*** (0.136)
$y_{i,t-1}$	-0.938*** (0.215)	-1.032*** (0.258)	-0.919*** (0.210)
$y_{i,t-2}$	-0.384*** (0.141)	-0.391** (0.173)	-0.416*** (0.139)
e_{it}^g		-0.096 (0.124)	
$e_{i,t-1}^g$		-0.107 (0.115)	
$e_{i,t-2}^g$		0.026 (0.102)	
$y_{j,t}$			-0.035 (0.148)
$y_{j,t-1}$			0.081 (0.245)
$y_{j,t-2}$			-0.256* (0.154)
EU	0.047*** (0.009)	0.038*** (0.0096)	0.040*** (0.009)
FTA	0.077*** (0.012)	0.073*** (0.014)	0.078*** (0.011)
Panel size	110	110	110
Observations	3960	3610	3960

Notes: the table shows the estimates of the coefficients (and their respective standard errors in parentheses) in alternative specifications of model (5). (*), (**) and (***) indicate statistical significance at the 10%, 5% and 1% level, respectively. Each model is estimated with time fixed effects, country-pair fixed effects and country-pair time trends.

**Table 3: Responses of foreign exports to domestic fiscal shocks
– cumulative and “normalized”**

Panel A: Spending increase (1% of GDP)

	<i>Cumulative</i>			<i>normalized</i>		
	Impact Effect	After 2 years	After 5 years	Impact Effect	After 2 years	After 5 years
Point estimate	2.18	7.75	11.43	2.18	2.30	1.94
Lower (5%)	1.65	5.94	7.53	1.65	1.70	1.22
Upper (95%)	2.66	9.71	15.70	2.71	2.96	2.76

Panel B: Net tax cut (1% of GDP)

	<i>Cumulative</i>			<i>Normalized</i>		
	Impact Effect	After 2 years	After 5 years	Impact Effect	After 2 years	After 5 years
Point estimate	0.40	1.37	0.81	0.40	0.57	0.26
Lower (5%)	0.18	0.48	-0.99	0.18	0.21	-0.31
Upper (95%)	0.62	2.29	2.68	0.61	0.96	0.89

Notes: Numbers are based on 1000 Monte Carlo simulations. “Point estimate” is the median value of the simulations, “Lower” is the lower bound of the 90% confidence interval and “Upper” is the upper bound of the 90% confidence interval. The fiscal shock that takes place at time 0 equals 1% of GDP. The “cumulative” effect is the sum of the percentage deviations of exports from their original value. Specifically, after t years, it is given as $100 * \sum_{\tau=0}^t (X_{\tau} - \bar{X}) / \bar{X}$, where \bar{X} is the original value of the exports. The “normalized” effect takes into account that the fiscal variable, after the initial shock, continues to deviate from its original value. Specifically, taking the case of a spending increase as an example, the normalized effect after t years is given by $\left[\sum_{\tau=0}^t (X_{\tau} - \bar{X}) / \bar{X} \right] / \left[\sum_{\tau=0}^t (G_{\tau} - \bar{G}) / \bar{Y} \right]$. Hence, this number can be interpreted as the average over the period 0 to t of additional exports per percent of output increase in public spending. For the computation we use average spending and net tax ratios of GDP over the whole sample.

Table 4: Cumulative response of foreign output to fiscal shocks in Germany and France

Panel A: Spending increase (1% of GDP)

	<i>Origin of spending increase:</i>					
	<i>Germany</i>			<i>France</i>		
	Impact Effect	After 2 years	After 5 years	Impact Effect	After 2 years	After 5 years
Austria	0.410	1.460	2.152	0.045	0.161	0.225
Belgium-Lux	0.420	1.494	2.201	0.291	1.037	1.446
Finland	0.139	0.494	0.728	0.043	0.153	0.213
France	0.103	0.368	0.542	-	-	-
Germany	-	-	-	0.076	0.270	0.376
Ireland	0.197	0.701	1.033	0.109	0.387	0.539
Italy	0.101	0.358	0.527	0.071	0.254	0.355
Netherlands	0.403	1.435	2.114	0.134	0.476	0.663
Portugal	0.161	0.574	0.845	0.084	0.301	0.419
Sweden	0.127	0.451	0.664	0.051	0.183	0.254
UK	0.095	0.338	0.498	0.065	0.230	0.321
Average	0.216	0.767	1.130	0.097	0.345	0.481

Panel B: Net tax cut (1% of GDP)

	<i>Origin of net tax cut:</i>					
	<i>Germany</i>			<i>France</i>		
	Impact Effect	After 2 years	After 5 years (*)	Impact Effect	After 2 years	After 5 years (*)
Austria	0.078	0.268	0.158	0.008	0.027	0.023
Belgium-Lux	0.080	0.274	0.162	0.050	0.172	0.146
Finland	0.026	0.091	0.053	0.007	0.025	0.022
France	0.020	0.068	0.040	-	-	-
Germany	-	-	-	0.013	0.045	0.038
Ireland	0.037	0.129	0.076	0.019	0.064	0.054
Italy	0.019	0.066	0.039	0.012	0.042	0.036
Netherlands	0.077	0.263	0.155	0.023	0.079	0.067
Portugal	0.031	0.105	0.062	0.014	0.050	0.042
Sweden	0.024	0.083	0.049	0.009	0.030	0.026
UK	0.018	0.062	0.037	0.011	0.038	0.032
Average	0.041	0.141	0.083	0.017	0.057	0.049

Notes: Panel A (Panel B) shows the cumulative effect on foreign output (in percent) of a government spending increase (net tax cut) equal to 1 percentage point of GDP. In our computations we use bilateral exports, net taxes and government spending over GDP ratios for 2002. For details on the computations, see Notes to Table 3.

Table 5: “Normalized” foreign output multipliers of fiscal shocks in Germany and France

Panel A: Spending increase (1% of GDP)

	<i>Origin of spending increase</i>					
	<i>Germany</i>			<i>France</i>		
	Impact Effect	After 2 years	After 5 years	Impact Effect	After 2 years	After 5 years
Austria	0.410	0.433	0.365	0.045	0.048	0.040
Belgium-Lux	0.420	0.443	0.373	0.291	0.309	0.260
Finland	0.139	0.147	0.123	0.043	0.046	0.038
France	0.103	0.109	0.092	-	-	-
Germany	-	-	-	0.076	0.080	0.068
Ireland	0.197	0.208	0.175	0.109	0.115	0.097
Italy	0.101	0.106	0.089	0.071	0.076	0.064
Netherlands	0.403	0.425	0.358	0.134	0.142	0.119
Portugal	0.161	0.170	0.143	0.084	0.090	0.075
Sweden	0.127	0.134	0.113	0.051	0.054	0.046
UK	0.095	0.100	0.084	0.065	0.069	0.058
Average	0.216	0.227	0.192	0.097	0.103	0.087

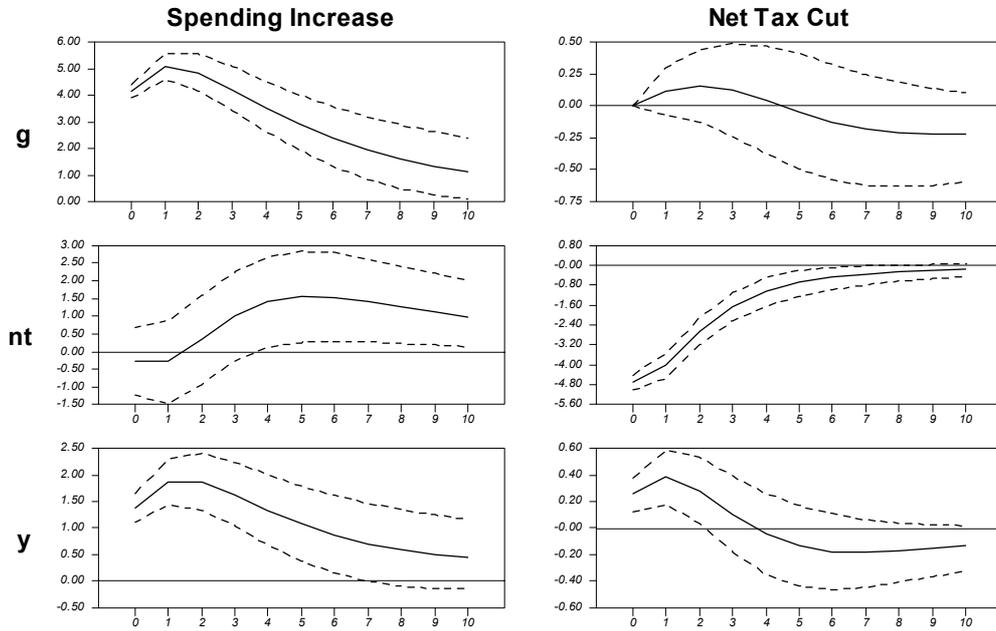
Panel B: Net tax cut (1% of GDP)

	<i>Origin of net tax cut</i>					
	<i>Germany</i>			<i>France</i>		
	Impact Effect	After 2 years	After 5 years	Impact Effect	After 2 years	After 5 years
Austria	0.078	0.111	0.051	0.008	0.011	0.005
Belgium-Lux	0.080	0.114	0.052	0.050	0.072	0.033
Finland	0.026	0.038	0.017	0.007	0.011	0.005
France	0.020	0.028	0.013	-	-	-
Germany	-	-	-	0.013	0.019	0.009
Ireland	0.037	0.053	0.025	0.019	0.027	0.012
Italy	0.019	0.027	0.013	0.012	0.018	0.008
Netherlands	0.077	0.109	0.050	0.023	0.033	0.015
Portugal	0.031	0.044	0.020	0.014	0.021	0.010
Sweden	0.024	0.034	0.016	0.009	0.013	0.006
UK	0.018	0.026	0.012	0.011	0.016	0.007
Average	0.041	0.059	0.027	0.017	0.024	0.011

Notes: Panel A (Panel B) shows the normalized multipliers of foreign output as a result of a government spending increase (net tax cut) equal to 1% of GDP. In our computations we use bilateral exports, net taxes and government spending over GDP ratios for 2002. For details on the computations, see Notes to Table 3.

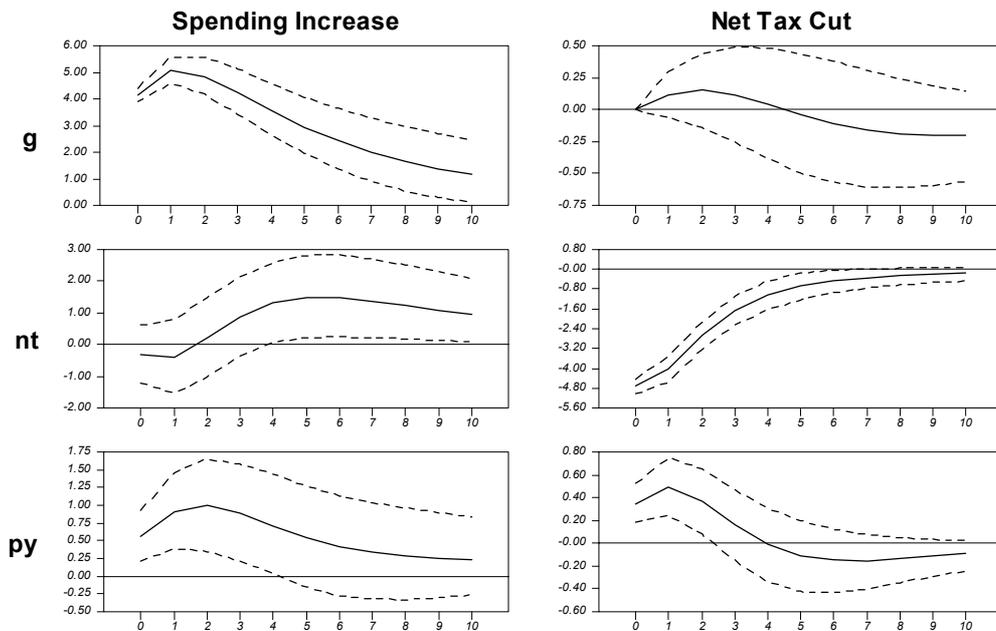
FIGURES

Figure 1: impulse responses for the fiscal block (baseline panel VAR)



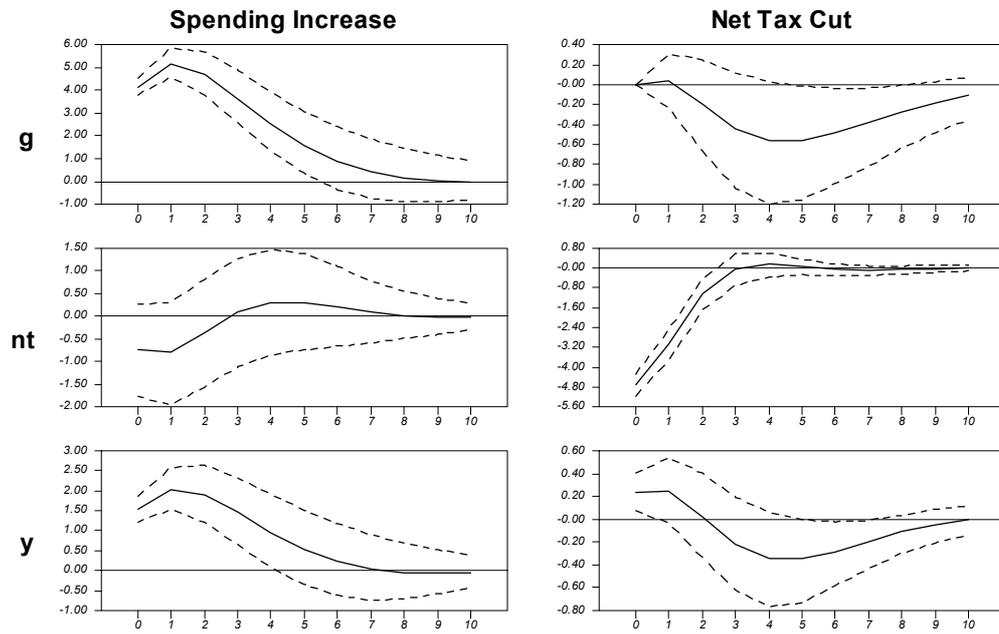
Notes: Confidence bands are the 5th and the 95th percentiles from Monte Carlo simulations based on 1,000 replications.

Figure 2: impulse responses for the fiscal block (panel VAR with private output)



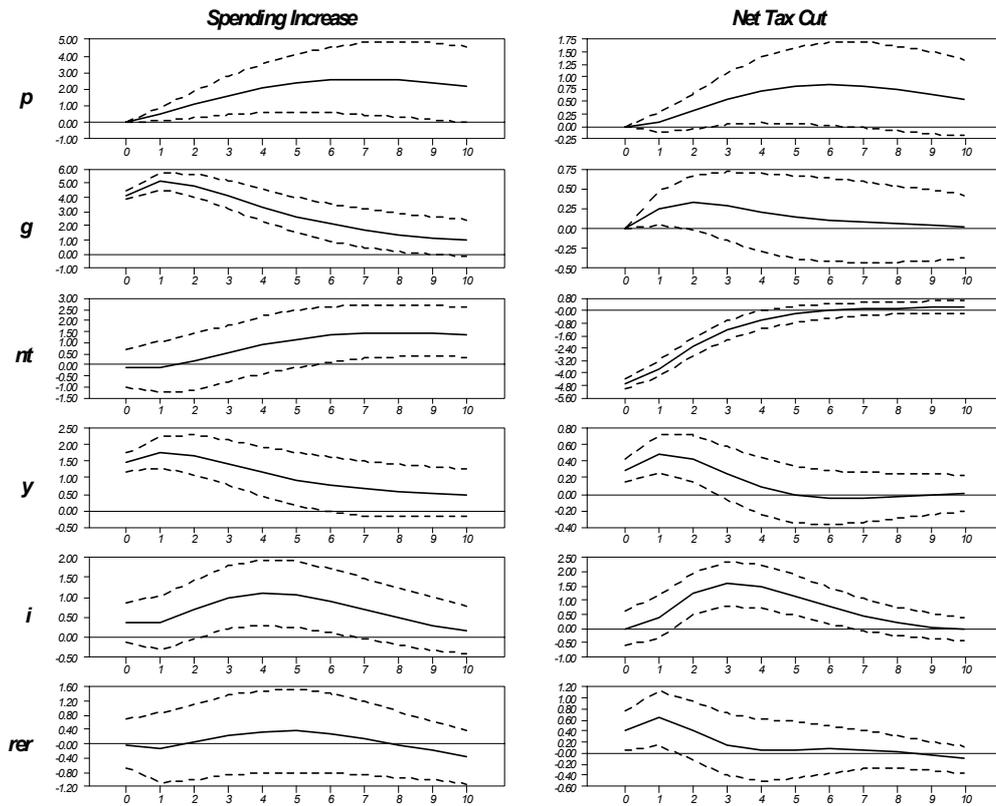
Notes: See Notes to Figure 1.

Figure 3: impulse responses for the fiscal block (panel VAR for 1980-2002)



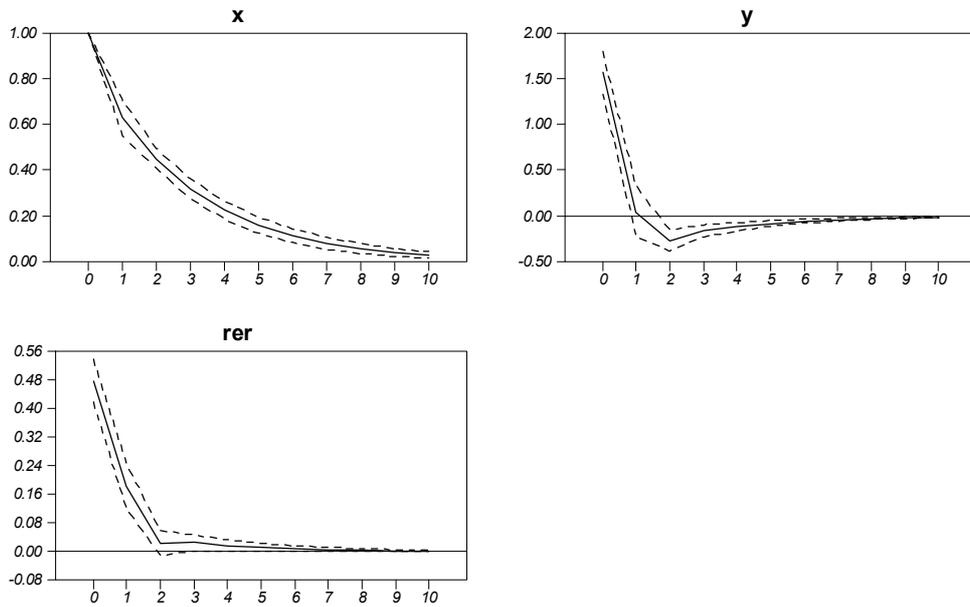
Notes: See Notes to Figure 1.

Figure 4: impulse responses for the fiscal block (extended panel VAR)



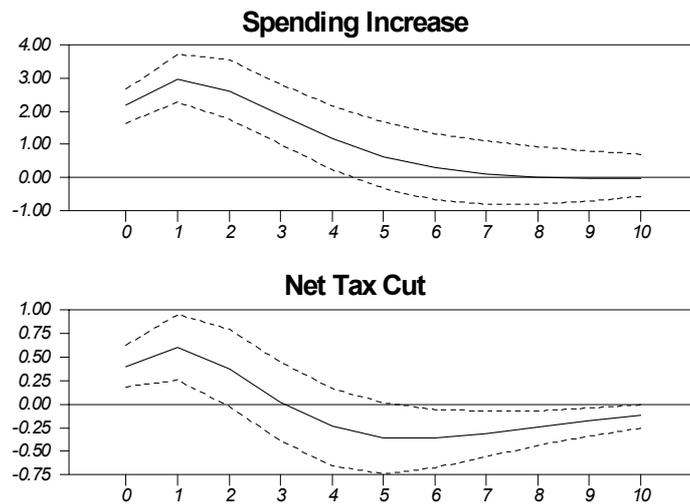
Notes: in addition to the definitions already included in the main text, we have $p = \log$ of price level, $i =$ short-run interest rate and $rer = \log$ of real multilateral exchange rate. In increase in rer corresponds to a real depreciation. Further, see Notes to Figure 1.

Figure 5: impulse responses of bilateral foreign exports (baseline model of trade block)



Notes: this figure shows the impulse responses of bilateral exports from the foreign country to the domestic country, after, respectively, a positive shock (of size 1) to exports (x), a shock to domestic GDP (y) and a depreciation of the foreign real exchange rate (rer). Further, see Notes to Figure 1.

Figure 6: impulse response of bilateral foreign exports to domestic government spending and net tax shocks after combining the fiscal and trade blocks



Notes: In each case the size of the fiscal shock equals one per cent of GDP. The estimates and the 90% confidence bands are based on Monte Carlo simulations, where we multiply 1000 draws for the impulse-response function from the fiscal model by 1000 draws for the distributed-lag function from the trade model.