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

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ABSTRACT

We use a panel model to explore the trade spillovers from fiscal policy shocks in Europe. We distinguish between a direct and an indirect effect of the fiscal shock. The direct effect amounts to a government spending increase being spent directly on foreign products or a tax reduction raising disposable income and, thereby, boosting exports by other countries. The indirect effect arises because the fiscal impulse stimulates economic activity, which in turn leads to higher imports. We find that, empirically, the direct effects are unimportant, while the indirect effects are statistically and economically significant. To evaluate the indirect effect we complement a panel trade model with a panel VAR model in GDP, net taxes, and government spending. A domestic spending impulse equal to 1% of GDP overall leads to a 1.4% cumulative increase in bilateral exports to this country, whereas an equal-size reduction in net taxes causes a 0.3% cumulated increase in bilateral exports. Further, averaged across all partner countries, the effects of a 1% of GDP fiscal stimulus in Germany are estimated at 0.12% on foreign GDP for a spending increase and 0.03% for a net tax cut.

Keywords: Fiscal shocks, trade spillovers, European Union, impulse responses.
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1. Introduction

Macroeconomic coordination of fiscal policies is a recurring theme both in the policy discussions and in the economic literature. Recent developments have given a new impulse to the study of this issue. For example, the move to a common monetary policy in Europe has quite naturally raised the question whether European fiscal policies should be more tightly coordinated. With the ongoing financial and trade integration in the world economy, spill-over effects of national fiscal policies are likely to become more important, so that the question about the need for more fiscal coordination becomes more urgent.

The practical case for fiscal coordination rests in the first place on the empirical importance of spill-overs from national fiscal policies. There exist a variety of potential fiscal spill-over effects. In particular, a debt-financed fiscal expansion in the absence of Ricardian equivalence raises the long-term interest in other countries if countries are integrated in a common capital market. Similarly, in a monetary union, a unilateral fiscal expansion exerts upward pressure on domestic prices, which forces the common central bank to contract monetary policy. The ensuing rise in the short-run interest rate affects all countries in the system. While these are negative spill-overs, fiscal expansions may also have positive spill-overs. In particular, a domestic fiscal expansion could lead to an increase in exports by other countries to this country, thereby stimulating the economies of these other countries.

In this paper, we shall explore the empirical importance of such spill-over effects of fiscal impulses via international trade for the European Union countries. Despite the relevance of the issue, to the best of our knowledge, such fiscal spill-overs 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, 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.


3 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 in the middle of the year), fiscal shocks identified in quarterly data may be hard to interpret economically.
Our results point to significant positive effects of fiscal impulses (both increases in government spending and reductions in net taxes) on exports by other countries.\footnote{Here, public spending is meant to capture government purchases, i.e. the sum of government consumption and government investment. We explicitly exclude transfers from public spending. Transfers are included in the computation of net taxes, which are defined as taxes minus transfers.} A domestic expansion of government spending equal to one percent of GDP leads to a 1.4\% cumulative increase in the bilateral exports of trading partners, whereas a reduction of net taxes of one percent of GDP causes a 0.3\% cumulated increase in the trading partner’s exports to this country. Further, averaged across all partner countries, the effects of a 1\% of GDP fiscal stimulus in Germany are estimated at 0.12\% on foreign GDP for a spending increase and 0.03\% for a net tax cut.

We estimate both the “direct” and the “indirect” effect of a domestic fiscal impulse on bilateral foreign exports. The direct effect would amount to an increase in direct government spending on foreign goods or, in the case of a net tax reduction, an increase in spending on foreign products as a result of the increase in disposable income. Of course, the latter effect would only be present if Ricardian equivalence fails to hold (perfectly). The indirect effect refers to the domestic output expansion that follows a domestic fiscal impulse and that leads to an increase in exports by trading partners. The direct effect, both of a spending increase and a net tax reduction, however, is insignificant and negligible, while the indirect effect is statistically and economically significant.

The ensuing analysis contains as a by-product of these findings other innovative elements. In particular, to compute the overall effect of a fiscal impulse on foreign exports, we need to take into account the indirect effects of the fiscal impulse running via output. To this end, we combine our panel trade model with a panel vector autoregression (PVAR) model, which allows us to identify the fiscal shocks and to compute the responses of output to these shocks. Combining these impulse responses and the estimated shocks with the coefficient estimates from the panel trade model, we can calculate the “full” effect of a fiscal impulse on bilateral foreign exports.

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. In Section 4, we estimate panel-VAR models needed for the identification of the discretionary fiscal shocks and the construction of the indirect effect of fiscal impulses on trade. In Section 5 we estimate panel trade models, after which we can construct the
complete effect of fiscal impulses on trade and on foreign output (Section 6). Finally, Section 7 concludes this paper.

2. Literature review

To the best of our knowledge, there exists only a limited amount of empirical work on the trade spill-overs from fiscal policy. A potential reason for this is that, while the theoretical literature suggests a variety of possible channels through which fiscal policy may cause cross-border spill-overs, empirically, it has proved difficult to find significant spill-over 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 spill-overs 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. Other articles dealing with trade spill-overs and based on a related empirical methodology are Marcellino (2002) and Van Aarle, Garretsen and Gobbin (2003).

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. Lane and Perotti (2002) 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 spill-overs, the results suggest that spending increases can have positive cross-border spill-overs by making foreign countries’ traded sector more competitive.

Using a VAR analysis for the G3 countries (over the period 1975-1996) of a system including the structural primary surplus to potential GDP ratio, the output gap, the actual primary surplus to actual GDP ratio and the real exchange rate, 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 (an increase in government spending or an increase in net transfers/reduction in net taxes) improves the current account and depreciates the real exchange rate. This is in contrast to what the standard Mundell-Fleming model would predict. Following Kim and Roubini (2003), Müller (2004) explores the dynamic effects of U.S. government spending on its foreign trade in the context of a structural VAR model. In particular, he finds that a temporary spending shock causes the nominal exchange rate to depreciate, the terms of trade to appreciate and the trade balance to improve.\(^5\)

In this paper we will estimate both the “direct” effects of fiscal impulses on trade and the “indirect” effect running through a stimulus of economic activity. In the case of a spending increase, the direct effect measures how much the government directly spends on foreign products, while the direct effect of a net tax reduction constitutes the increase in private spending on foreign products as a result of the increase in disposable income, holding GDP constant. The indirect effect requires us to assess the effects of fiscal impulses on 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,\(^6\) the empirical evidence points to the dominance of Keynesian effects. Examples are Fatás and Mihov (2001) and Galí \textit{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.\(^7\)

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\(^5\) He rationalizes the last two findings with a two country new-Keynesian framework, where the spending increase falls entirely on domestically produced goods and thus raises their relative price, while the degree of substitutability between domestic and foreign goods is small so that the “value effect” dominates the “volume effect” in the overall trade balance.

\(^6\) 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 financed with 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 \textit{et al.} (2002) or Andersen (2004).

\(^7\) Other relevant contributions to this expanding literature are, among others, Canova and Pappa (2002), Favero (2003), Burnside \textit{et al.} (2002) and Muscatelli \textit{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.
3. The empirical set-up

To estimate the overall effect of domestic fiscal impulses on exports by trading partners in Europe, we first estimate a panel vector autoregressive (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. Next, 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 interaction between two 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.

In the first step of our analysis we estimate the fiscal block, represented by a PVAR model, which in its reduced form is given by:

\[ Z_{it} = B(L)Z_{i,t-1} + u_{it} \]  

(1)

where \( Z_{it} \) is an \((m \times 1)\) vector of endogenous variables, \( B(L) \) is a matrix polynomial in the lag operator \( L \), \( m \) is the number of variables in the model, and \( u_{it} \) is the reduced-form residual vector. The model specification follows Blanchard and Perotti (2002) in that \( Z_{it} \) contains real public spending \( g_i \), real total output \( y_i \), and real net taxes (revenues minus transfers) \( nt_i \). Based on the estimates of this model, we obtain the structural-form model as:
\[ A_0 Z_{it} = A(L)Z_{it-1} + e_g, \]  

(2)

where \( A_0 \) is the \((m \times m)\) contemporaneous structural parameter matrix with 1’s on the diagonal, \( A(L) \) is a matrix polynomial in the lag operator \( L \), and \( e_g \) is the structural disturbance vector. The relationship between the reduced and the structural form can be seen by pre-multiplying the structural form VAR by \( A_0^{-1} \), which implies

\[ B(L) = A_0^{-1} A(L) \text{ and } u_g = A_0^{-1} e_g \text{ (or } A_0 u_g = e_g). \]

In order to recover the structural parameters and structural shocks from the estimated reduced-form model, we will make use of restrictions on the elements of matrix \( A_0 \).

In the second step, we estimate the trade block, the specification of which is an extension of Bun and Klaassen (2003). We model bilateral exports according to the following autoregressive distributed lag (ADL) specification:

\[ x_{ji,t} = \sum_{s=0}^{n} \beta_{is} x_{ji,t-s} + \sum_{s=0}^{n} \beta_{ys} y_{i,t-s} + \sum_{s=0}^{n} \beta_{rs} rer_{ji,t-s} + \sum_{s=0}^{n} \beta_{es} e^f_{i,t-s} + e_{ji,t}, \]  

(3)

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), \( y_{i,t} \) is (the log of) real total output in the home country, and \( rer_{ji,t} \) is the (log of the) bilateral real exchange rate between country \( j \) and country \( i \) expressed in units of the currency of country \( j \). In other words, if \( rer_{ji,t} \) rises, then the currency of country \( j \) (the exporting country) depreciates in real terms against the currency of country \( i \). Further, \( e^f_{i,t-s} \) is the structural fiscal impulse (a government spending shock or a net tax shock) identified from the estimation of the fiscal block. The model also contains (not shown in equation (3)): fixed effects for the country-pair \( ji \), which corrects for the impact of all time-invariant determinants of trade (such as distance, a common border, a common language, etc); fixed time effects controlling for the general state of the world economy, among other things; country-pair specific linear trends representing potentially omitted trending determinants of imports (such as transportation costs and trade liberalization) as motivated in Bun and Klaassen (2003); and the dummies \( EU_{ji,t} \) and \( FTA_{ji,t} \). The former 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, $FTA_{j,i,t}$ is a dummy equal to one if there is a free trade agreement between $j$ and $i$ at time $t$.\footnote{See the Appendix for the construction of the data and definitions of the dataset.} Finally, $\varepsilon_{j,i,t}$ 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 assume that this error term is stationary. This assumption is supported by the data.

4. **Estimates for the fiscal block**

To trace out the effects of fiscal impulses on output, we implement a three-variable specification that follows Blanchard and Perotti (2002). The vector of endogenous variables $Z_t$ comprises real public spending $g_t$, real total output $y_t$, and real net taxes $nt_t$. We set the lag length of the system to two and estimate the PVAR for 11 EU countries over the period 1960-2002 (see the Appendix for details).\footnote{We include country effects, country-specific linear time trends, and time effects, again treated as fixed parameters. With a panel with large $T$, ordinary least-square (OLS) estimation with country fixed effects.} To derive the impulse responses of output to the structural shocks of the system, we impose restrictions on the contemporaneous relationship between the reduced-form residuals of the PVAR, which, as shown above, is given by:

$$A_0 u_g = e_g \quad \text{or} \quad \begin{bmatrix} 1 & -a_{g} & -a_{g} \\ -a_{g} & 1 & -a_{g} \\ -a_{g} & -a_{g} & 1 \end{bmatrix} \begin{bmatrix} u_{g}^x \\ u_{g}^y \\ u_{g}^\varepsilon \end{bmatrix} = \begin{bmatrix} e_{g}^x \\ e_{g}^y \\ e_{g}^\varepsilon \end{bmatrix}$$

(4)

where $e_{g}^x, e_{g}^y, \text{ and } e_{g}^\varepsilon$ are the mutually-uncorrelated structural shocks that we want to recover, while $u_{g}^x, u_{g}^y, \text{ and } u_{g}^\varepsilon$ are the reduced-form residuals. In order to achieve identification, we impose three contemporaneous zero restrictions on the relationship between the reduced-form innovations.

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 output with respect to the various components of net taxes. 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. This variable thus takes account of the fact that the tax elasticities differ across countries. The Appendix provides more details.

By including cyclically adjusted net taxes we can impose that the reaction of this variable to output is zero, \( a_{yt} = 0 \), which provides us with one identifying restriction. Two more identifying restrictions are provided by 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. (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). As for the restriction \( a_{gt} = 0 \), as in Alesina et al. (2002), it turns out that the correlation between the reduced-form innovations of the public spending and the net tax equations is very small. This implies that the ordering of the two fiscal variables does not affect the results.

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

\[
\begin{pmatrix}
1 & 0 & 0 \\
-a_{gt} & 1 & 0 \\
-a_{gy} & -a_{yty} & 1
\end{pmatrix}
\begin{bmatrix}
g_{it} \\
m_{it}^{CA} \\
y_{it}
\end{bmatrix}
= A(L)
\begin{bmatrix}
g_{i,t-1} \\
m_{i,t-1}^{CA} \\
y_{i,t-1}
\end{bmatrix}
+ \begin{bmatrix}
e_{it}^{g} \\
e_{it}^{m} \\
e_{it}^{y}
\end{bmatrix}
\]

(5)

where the superscript “CA” is used to denote that the variable is cyclically adjusted.

Table 1 reports the estimates of the unrestricted coefficients in (5). The results indicate that government spending has no contemporaneous effect on cyclically adjusted net taxes. By contrast, however, government spending and net taxes exert a highly significant effect on current output. As expected, an increase in spending and a reduction in net taxes raise output spending. The corresponding impulse responses are depicted 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

and country-specific linear time trends yields consistent estimates. Panel VARs with similar country and
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.

We have estimated some plausible variants of (5). In one variant, following the results of the baseline model, we impose $a_g = 0$ and relax one by one the contemporaneous zero restrictions on $a_g$, $a_y$ and $a_t$. The results strongly indicate that none of the three coefficients is statistically different from zero. Additionally, we have estimated the baseline specification in first differences and also augmented it with the inflation rate and the long-term interest rate as in Perotti (2005). All these variants basically gave the same qualitative results and are contained in an additional appendix, which is available upon request or from the authors’ websites.

For our purposes, we report two variants here. The first one replaces output (GDP) in (5) with the log of real private output $p_y$, that is, GDP minus government expenditures. The coefficient estimates are again found in Table 1 (column 2), while Figure 2 provides the impulse responses. Not surprisingly, the response of private output to a spending increase is weaker than before, though it is still significant. The second variant we report here, concerns the basic model (5) estimated for the sub-sample 1980-2002. We can motivate this variant with the findings by Gali and Perotti (2003) and Perotti (2005). They conclude that the effects of fiscal changes may have changed over time. Table 1, column 3, reports the results for this variant and Figure 3 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 dies out more quickly.

5. **Estimates of the trade block**

We now turn to the estimation of the trade model given in equation (3). The resulting estimates can then be combined with those for the fiscal block to find the “overall” effect of fiscal impulses on trade.

_period samples are also implemented by Alesina et al. (2002) and Ardagna et al. (2004)._
In the baseline specification of the panel trade model we assume that the direct effect of the fiscal variables is zero. Because the export, GDP and real exchange rate variables may be non-stationary, and since we have many time periods in our sample, issues of non-stationarity may be relevant for inference. As expected, standard augmented Dickey-Fuller unit root tests indeed do not reject non-stationarity. As usual, we thus assume that exports and GDP are non-stationary. For the real exchange rate we leave open the possibility of stationarity, motivated by the theory of purchasing power parity. Then, we test for co-integration. Pedroni’s (1999) panel tests reveal the presence of co-integration, irrespective of the inclusion of the real exchange rate. This is in line with economic intuition. Therefore, we estimate the trade model by OLS and use standard inference. In other words, we use the panel autoregressive distributed lag (ADL) approach (see Panopoulou and Pittis, 2004, for theoretical and empirical support).

Table 2, column 1 reports the estimates for the parameters of interest. 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 $rer_{ji}$) 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. Similarly, an increase in real GDP of country $i$, the home 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 15% (standard error 3%) more trade and membership of the European Union stimulates trade by an additional 24% (standard error 4%). 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 4). The size of the shock is a one percent increase in the variable. 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 periods, while the effect of the output shock vanishes already after one year. The accumulation of the impulse responses over time gives the long-run estimates presented above.
Column 2 in Table 2 reports the estimates when we add the domestic discretionary government spending shocks that we identified from the fiscal block (as discussed in the previous section) as explanatory variables in the panel trade model. The government spending impulses exert no direct effect on bilateral exports from the foreign country, which is not surprising, since by far most of government spending increase will fall on domestic products. The impulse responses (Figure 5) confirm the absence of any significant effect of government spending shocks on bilateral exports. It should be noted in this regard that the government spending shock is a generated regressor in the trade model, so that correctly computed standard errors would exceed those reported in Table 2. Hence, with correctly computed standard errors we would simply confirm the finding of the absence of significant direct effects from a government spending shock.

In column 3 of Table 2 we report the estimates when we instead add the net tax shocks that we identified in the previous section from fiscal block. Again the direct effect of the domestic country’s fiscal shock on foreign exports is negligible. This may indicate that Ricardian equivalence has some relevance. Finally, column 4 in Table 2 includes both the government and net tax shocks of the domestic country in the model. The results are unaffected, with neither of the two types of shocks exerting any significant influence on imports. These results can be appreciated in Figure 5, in which we report the impulse responses for this case.

6. Combining the results

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. Generally, one can write the impulse response function:

\[
y_{it} = \Psi(L)e_{it}^f,
\]

where \(\Psi(L)\) is a lag polynomial and \(e_{it}^f\) is the discretionary fiscal shock (\(e_{it}^f = e_{it}^g\) or \(e_{it}^f = e_{it}^t\)). The coefficients of \(\Psi(L)\) are functions of the estimates of 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 by the foreign country, where the impulse response function is the distributed-lag function:

\[ x_{ijt} = D(L)y_{it}, \tag{7} \]

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

Combining the previous expressions, we calculate the effects of the discretionary fiscal shock in country \( i \) on bilateral exports from country \( j \) to country \( i \):

\[ x_{ijt} = D(L)\Psi(L)e^f_t, \tag{8} \]

so that we can 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 equal to one percent of GDP is significantly positive for several years and reaches its maximum after one year. A net-tax cut, again of one percent of GDP, also stimulates exports by trading partners.

To get a better idea about the total impact of fiscal shocks on trade, we sum the impulse responses over time. Since the source of this cumulated trade increase is not only the initial one percent of GDP fiscal shock but also the persistently higher level of spending or lower level of net taxes resulting from the initial shock, we normalize the trade increase by the cumulated spending increase, respectively net tax reduction. It turns out that a cumulative increase of domestic spending normalized to one percent of GDP leads to a cumulative 1.4% increase in exports from the foreign to the domestic economy. The 90% confidence interval is (0.3%, 3.6%). Likewise, a cumulative tax cut of one percent of GDP causes a 0.3% increase in bilateral exports, with a confidence interval of (-0.5%, 1.4%).

On the basis of the above cumulative response of the bilateral foreign exports to fiscal shocks and the actual shares of bilateral foreign exports in foreign output, we

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10 The estimates and confidence bands are based on a Monte Carlo analysis 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.
compute the cumulative effect of domestic spending and net tax shocks on foreign activity. Table 3 displays the cumulative effect of the EU countries’ output to a cumulative spending increase or net tax reduction of 1% of GDP in the three largest economies in the Euro area (Germany, Italy and France). The reported figures are only indicative in that they do not account for potential multiplier effects of exports on economic activity, and “second round” effects (such as the subsequent effects of increased foreign output via trade on output of other countries). Therefore, these numbers are only “conservative” measures of the trade spillovers. Despite this, Table 3 indicates that the spillovers of fiscal shocks (in particular government spending shocks) are strong in the case of Germany versus small neighbouring countries. Namely, an increase in public spending (decrease in net taxes) by 1% of GDP in Germany leads to roughly a 0.23% (0.05%) increase in GDP of Austria, Belgium-Luxemburg and the Netherlands. Averaged across all partner countries, the effects of a German fiscal stimulus is 0.12% (0.03%) on foreign GDP. Naturally, the effects of an Italian or French fiscal impulse are smaller (on average, roughly half of the size of the spillovers from a German fiscal spillover), but they are still substantial. In general, the trade spillovers of fiscal shocks are larger, the higher the bilateral trade links.

7. Conclusions

In this paper, we have focussed on the effects of a discretionary fiscal impulse (a government spending increase or a cut in net taxes) in countries in the European Union on the exports by other EU countries. The strength of such trade spill-overs from an active fiscal policy is relevant for the scope for fiscal coordination. On the one hand, stronger spillovers imply that a larger share of a fiscal stimulus leaks away, thus reducing the incentive for a unilateral fiscal impulse. On the other hand, the benefit from mutually internalising the externality associated with concerted fiscal stimulus increases. Thus, the benefit from a coordinated fiscal response to a widespread European recession becomes larger. Our estimates suggest that a domestic fiscal impulse equal to 1% of GDP leads to a cumulative increase in bilateral exports by EU trading partners of 1.4% in case of public spending shocks and 0.3% in case of net tax shocks. Averaged across all EU partner countries, we estimate that a cumulated 1% of GDP fiscal stimulus in Germany leads to a 0.12% increase in foreign GDP in case of a spending increase and a 0.03% increase for a net tax cut.
In order to obtain such estimates, we had to follow a rather unconventional route. The estimates were obtained in two steps. The first step involved the identification of the discretionary fiscal shocks, as well as the computation of the impulse response of economic activity to such shocks, from a panel VAR model involving government spending, net taxes, and GDP. The second step comprised the estimation of a panel trade model, which related bilateral exports by the foreign country to domestic output, domestic fiscal shocks and a number of other variables. Merging the estimates of the effects of output with the impulse responses obtained from the first step produced the estimated overall effect of the fiscal impulses on bilateral exports and thereby output of other EU countries.

The preceding analysis admits a number of extensions. For example, the trade block could be refined further by interacting the direct and indirect effects of fiscal impulses with variables that seem important for international trade, such as the existence of common borders, geographical distance between countries, common language, etcetera. Another extension would be to allow for feedback effects from a stimulus of foreign output (as a result of the increase in foreign exports) onto domestic output. Finally, it would be interesting to explore whether the effects of a fiscal impulse on trade depend on the exchange rate regime.\textsuperscript{11}

\textsuperscript{11} Claeys (2004) analyses the effects of fiscal impulses for different exchange rate regimes on monetary policy, using a structural VAR common trends model.
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Appendix

A. 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)

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)
- IG = Real Government Investment (IGAA*100/PIG)
- CG = Real Government Consumption (CGAA*100/PCG)
- REVENUES = TY + TIND + SSRG + TRRG
- TRANSFERS = TSUB + SSPG + TRPG
- NT = Real Net Taxes (REVENUES – TRANSFERS)*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:

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

where superscripts CA, NCA and TR denote, respectively, “cyclically adjusted”, “non cyclically adjusted” and “trend”, and $\xi_i$ 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 trend.

**Trade variables**

The real bilateral exports flows $X_{ji}$ are taken from Bun and Klaassen (2003) (updated with the year 2002) and are constructed as the sum of monthly real exports, where the latter is the nominal exporter’s currency value of exports divided by and exporter’s price index. The nominal exporter’s currency value of exports 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 price indices used above.

**Dummies**

The dummies $EU_{ji,t}$ and $FTA_{ji,t}$ control for the effects of free trade between the country pairs $j$ and $i$. $EU_{ji,t}$ is one if both $j$ and $i$ are members of the EU (or European Community, EC) at time $t$. Similarly, $FTA_{ji,t}$ is a dummy scoring one if there is a free trade agreement between country $j$ and $i$ at time $t$. Hence, when both $i$ and $j$ are in the EU, $EU_{ji,t} + FTA_{ji,t} = 2$. The precise dating of the membership of the EU or a free trade agreement is available in Bun and Klaassen (2003).

**Variables used in the panel estimation**

\[
\begin{align*}
py &= \log(PY) \\
y &= \log(Y) \\
g &= \log(G) \\
nt^{CA} &= \log(NT^{CA}) \\
x_{ji} &= \log(X_{ji}) \\
rer_{ji} &= \log(RER_{ji})
\end{align*}
\]

**Country and data samples:**

The models are 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 over a very short period.

For most countries the sample starts in 1960, with the only exception of the United Kingdom and Belgium (1970). Net Taxes for Ireland and the Netherlands are only available as of 1977 and 1969, respectively.
**TABLES**

Table 1: Estimates of contemporaneous coefficients of the fiscal block (the panel VAR model in equation (5))

<table>
<thead>
<tr>
<th></th>
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<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Baseline</td>
<td>Baseline</td>
</tr>
<tr>
<td></td>
<td>with private</td>
<td>over</td>
<td></td>
</tr>
<tr>
<td></td>
<td>output</td>
<td>1980-2002</td>
<td></td>
</tr>
<tr>
<td>$\alpha_{tq}$</td>
<td>-0.0174 (0.125)</td>
<td>-0.0198 (0.118)</td>
<td>-0.1797 (0.134)</td>
</tr>
<tr>
<td>$\alpha_{ty}$</td>
<td>0.316*** (0.0362)</td>
<td>0.109*** (0.0446)</td>
<td>0.358*** (0.0371)</td>
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<tr>
<td>$\alpha_{yt}$</td>
<td>-0.0583*** (0.0155)</td>
<td>-0.0816*** (0.0189)</td>
<td>-0.0495*** (0.0182)</td>
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<tr>
<td>Panel size</td>
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<td>11</td>
<td>11</td>
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<tr>
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<td>398</td>
<td>231</td>
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*Notes:* the table shows the estimates of the coefficients (and their respective standard errors in parentheses) of the $A_0$ matrix of equation (5). (*), (**), and (***) indicate statistical significance at 10%, 5% and 1% level, respectively.
Table 2: Estimates for the bilateral export panel model (3)

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>$x_{j,t-1}$</td>
<td>0.627***</td>
<td>0.633***</td>
<td>0.633***</td>
<td>0.634***</td>
</tr>
<tr>
<td></td>
<td>(0.047)</td>
<td>(0.052)</td>
<td>(0.052)</td>
<td>(0.052)</td>
</tr>
<tr>
<td>$x_{j,t-2}$</td>
<td>0.057</td>
<td>0.051</td>
<td>0.052</td>
<td>0.051</td>
</tr>
<tr>
<td></td>
<td>(0.043)</td>
<td>(0.049)</td>
<td>(0.048)</td>
<td>(0.048)</td>
</tr>
<tr>
<td>$rer_{j,t}$</td>
<td>0.478***</td>
<td>0.474***</td>
<td>0.480***</td>
<td>0.477***</td>
</tr>
<tr>
<td></td>
<td>(0.037)</td>
<td>(0.038)</td>
<td>(0.039)</td>
<td>(0.039)</td>
</tr>
<tr>
<td>$rer_{j,t-1}$</td>
<td>-0.118**</td>
<td>-0.118**</td>
<td>-0.117**</td>
<td>-0.113**</td>
</tr>
<tr>
<td></td>
<td>(0.052)</td>
<td>(0.051)</td>
<td>(0.052)</td>
<td>(0.052)</td>
</tr>
<tr>
<td>$rer_{j,t-2}$</td>
<td>-0.118***</td>
<td>-0.120***</td>
<td>-0.129***</td>
<td>-0.128***</td>
</tr>
<tr>
<td></td>
<td>(0.038)</td>
<td>(0.038)</td>
<td>(0.039)</td>
<td>(0.039)</td>
</tr>
<tr>
<td>$y_{i,t}$</td>
<td>1.561***</td>
<td>1.680***</td>
<td>1.601***</td>
<td>1.652***</td>
</tr>
<tr>
<td></td>
<td>(0.139)</td>
<td>(0.160)</td>
<td>(0.168)</td>
<td>(0.175)</td>
</tr>
<tr>
<td>$y_{i,t-1}$</td>
<td>-0.938***</td>
<td>-1.032***</td>
<td>-1.023***</td>
<td>-1.044***</td>
</tr>
<tr>
<td></td>
<td>(0.215)</td>
<td>(0.258)</td>
<td>(0.255)</td>
<td>(0.273)</td>
</tr>
<tr>
<td>$y_{i,t-2}$</td>
<td>-0.384***</td>
<td>-0.391**</td>
<td>-0.346**</td>
<td>-0.369**</td>
</tr>
<tr>
<td></td>
<td>(0.141)</td>
<td>(0.173)</td>
<td>(0.165)</td>
<td>(0.185)</td>
</tr>
<tr>
<td>$e^g_{it}$</td>
<td>-0.096</td>
<td>-0.097</td>
<td>-0.097</td>
<td>-0.122</td>
</tr>
<tr>
<td></td>
<td>(0.124)</td>
<td>(0.122)</td>
<td>(0.122)</td>
<td>(0.122)</td>
</tr>
<tr>
<td>$e^g_{i,t-1}$</td>
<td>-0.107</td>
<td>-0.105</td>
<td>-0.105</td>
<td>-0.116</td>
</tr>
<tr>
<td></td>
<td>(0.115)</td>
<td>(0.116)</td>
<td>(0.116)</td>
<td>(0.116)</td>
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<tr>
<td>$e^g_{i,t-2}$</td>
<td>0.026</td>
<td>0.015</td>
<td>0.015</td>
<td>0.100</td>
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<tr>
<td></td>
<td>(0.102)</td>
<td>(0.100)</td>
<td>(0.100)</td>
<td>(0.100)</td>
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<tr>
<td>$e^t_{it}$</td>
<td>-0.037</td>
<td>-0.034</td>
<td>-0.034</td>
<td>-0.058</td>
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<tr>
<td></td>
<td>(0.059)</td>
<td>(0.058)</td>
<td>(0.058)</td>
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</tr>
<tr>
<td>$e^t_{i,t-1}$</td>
<td>-0.032</td>
<td>-0.031</td>
<td>-0.031</td>
<td>-0.053</td>
</tr>
<tr>
<td></td>
<td>(0.053)</td>
<td>(0.053)</td>
<td>(0.053)</td>
<td>(0.053)</td>
</tr>
<tr>
<td>$e^t_{i,t-2}$</td>
<td>-0.035</td>
<td>-0.036</td>
<td>-0.036</td>
<td>-0.048</td>
</tr>
<tr>
<td></td>
<td>(0.048)</td>
<td>(0.048)</td>
<td>(0.048)</td>
<td>(0.048)</td>
</tr>
<tr>
<td>EU</td>
<td>0.047***</td>
<td>0.038***</td>
<td>0.039***</td>
<td>0.039***</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.0096)</td>
<td>(0.0097)</td>
<td>(0.0097)</td>
</tr>
<tr>
<td>FTA</td>
<td>0.077***</td>
<td>0.073***</td>
<td>0.073***</td>
<td>0.073***</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.014)</td>
<td>(0.014)</td>
<td>(0.014)</td>
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<tr>
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<td>3610</td>
<td>3610</td>
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</table>

Notes: the table shows the estimates of the coefficients (and their respective standard errors in parentheses) in alternative specifications of model (3). (*), (**) and (***) indicate statistical significance at 10%, 5% and 1% level, respectively. Each model is estimated with (fixed) time effects, country-pair effects and country-pair time trends. See the Appendix for variable definitions.
Table 3: Cumulative response of foreign output to fiscal shocks in Germany, Italy and France

**Panel A: Spending Shock**

<table>
<thead>
<tr>
<th></th>
<th>Germany</th>
<th>Italy</th>
<th>France</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>0.232</td>
<td>0.061</td>
<td>0.032</td>
</tr>
<tr>
<td>Belgium-Lux</td>
<td>0.237</td>
<td>0.068</td>
<td>0.206</td>
</tr>
<tr>
<td>Finland</td>
<td>0.079</td>
<td>0.022</td>
<td>0.030</td>
</tr>
<tr>
<td>France</td>
<td>0.058</td>
<td>0.036</td>
<td>-</td>
</tr>
<tr>
<td>Germany</td>
<td>-</td>
<td>0.036</td>
<td>0.054</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.111</td>
<td>0.059</td>
<td>0.077</td>
</tr>
<tr>
<td>Italy</td>
<td>0.057</td>
<td>-</td>
<td>0.050</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.228</td>
<td>0.057</td>
<td>0.094</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.091</td>
<td>0.023</td>
<td>0.060</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.072</td>
<td>0.025</td>
<td>0.036</td>
</tr>
<tr>
<td>UK</td>
<td>0.054</td>
<td>0.021</td>
<td>0.046</td>
</tr>
<tr>
<td>Average</td>
<td>0.122</td>
<td>0.041</td>
<td>0.069</td>
</tr>
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</table>

**Panel B: Net Tax Shock**

<table>
<thead>
<tr>
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<th>Italy</th>
<th>France</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>0.050</td>
<td>0.013</td>
<td>0.007</td>
</tr>
<tr>
<td>Belgium-Lux</td>
<td>0.051</td>
<td>0.015</td>
<td>0.044</td>
</tr>
<tr>
<td>Finland</td>
<td>0.017</td>
<td>0.005</td>
<td>0.007</td>
</tr>
<tr>
<td>France</td>
<td>0.013</td>
<td>0.008</td>
<td>-</td>
</tr>
<tr>
<td>Germany</td>
<td>-</td>
<td>0.008</td>
<td>0.011</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.024</td>
<td>0.013</td>
<td>0.016</td>
</tr>
<tr>
<td>Italy</td>
<td>0.012</td>
<td>-</td>
<td>0.011</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.049</td>
<td>0.012</td>
<td>0.020</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.020</td>
<td>0.005</td>
<td>0.013</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.015</td>
<td>0.005</td>
<td>0.008</td>
</tr>
<tr>
<td>UK</td>
<td>0.012</td>
<td>0.004</td>
<td>0.010</td>
</tr>
<tr>
<td>Average</td>
<td>0.026</td>
<td>0.009</td>
<td>0.015</td>
</tr>
</tbody>
</table>

Notes: Panel A (Panel B) shows the cumulated response of foreign output (in %) to a cumulated domestic public spending increase (net tax reduction) of 1% of GDP in Germany, Italy and France.
FIGURES

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

Figure 2: impulse responses for the fiscal block (panel VAR with private output)
Figure 3: impulse responses for the fiscal block (panel VAR for 1980-2002)

Figure 4: impulse responses of bilateral foreign exports (basic 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 to exports (x), a shock to domestic GDP (y) and a depreciation of the foreign real exchange rate (rer)
Figure 5: responses of bilateral exports to changes in explanatory variables in the trade block

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

Notes: the figures shows the responses over time of bilateral exports as a result of one-unit increases in the indicated explanatory variables in the trade block