FISCAL POLICIES IN THE EURO AREA: REVISITING THE SIZE OF SPILLOVERS

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FISCAL POLICIES IN THE EURO AREA: REVISITING THE SIZE OF SPILLOVERS [(*)]

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Abstract

The issue of the size of fiscal spillovers in the euro area has gained prominence recently, given proposals to coordinate fiscal policies that aim at achieving an appropriate "aggregate fiscal stance", consistent with economic and monetary policy conditions. Given the heterogeneous fiscal positions of member states, such stance would be achieved by fine-tuning policies of countries with enough fiscal space. Appealing as they are, such proposals have so far been based on limited empirical evidence. On the one hand, the literature based on calibrated/ estimated general equilibrium models tends to find that fiscal spillovers within the euro area are small once all channels are considered (trade channel vs. monetary policy reaction, exchange rate, and risk premium). On the other hand, the available empirical studies hinge on pools of countries, given data limitations, and do not provide robust country-specific estimates. In our paper we revisit the issue at hand. To do so, first, we compile quarterly datasets of fiscal policy variables for the four major euro area economies (1980q1-2016q4), based on consistent and comparable criteria and sources. This rich dataset allows us to effectively exploit exclusion restrictions within a structural VAR framework to identify country-specific government spending shocks. We use these shocks to explore the dynamic effects of fiscal changes in one country on neighbor countries (spillovers), finding significant and economically-relevant effects. We document that these spillover effects are notably heterogeneous in euro area countries and are particularly powerful when the fiscal actions are based on public investment expansions. We find that trade is a key transmission mechanism in explaining our results.

Keywords: fiscal policy; fiscal spillovers; euro area; vector autoregressions.

JEL classification: E62, E32, C32.

Resumen

El tamaño de los efectos desbordamiento *(spillovers)* de la política fiscal en el área del euro se ha convertido en un tema de particular relevancia en la actualidad, habida cuenta de las propuestas sobre la coordinación de políticas fiscales que persiguen encontrar un tono agregado de política fiscal, coherente con las condiciones económicas y monetarias. Dada la heterogeneidad de las posiciones fiscales de los Estados miembros, este tono se conseguiría a través de un ajuste preciso en las políticas de los países con suficiente espacio fiscal. A pesar de su atractivo, estas propuestas se han basado, por el momento, en escasa evidencia empírica. Por un lado, la literatura basada en modelos de equilibrio general calibrados o estimados tiende a encontrar que los efectos desbordamiento de la política fiscal en el área del euro son pequeños una vez que se tienen en cuenta otros canales (canal comercial *versus* reacción de la política monetaria, tipo de cambio, prima de riesgo). Por otro lado, los estudios empíricos disponibles se basan en grandes conjuntos de países, debido a las restricciones impuestas por la disponibilidad de datos, y no ofrecen estimaciones robustas específicas para cada país. Para resolver estas limitaciones, en primer lugar, construimos una base de datos de variables relativas a la política fiscal para los cuatro grandes países del área del euro (I TR 1980-IV TR 2016), basada en criterios y fuentes consistentes y comparables. Esta detallada base de datos nos permite explotar de forma efectiva restricciones de exclusión en un vector autorregresivo (VAR) para identificar variación exógena en el gasto público, específica a cada país. Utilizamos esta variación para explorar los efectos dinámicos de cambios fiscales en un país en la actividad económica de países vecinos *(spillovers),* encontrando efectos significativos y relevantes desde un punto de vista económico. Documentamos que estos efectos de desbordamiento son notablemente heterogéneos en los países del área del euro y son particularmente fuertes cuando las acciones fiscales se basan en expansiones de la inversión pública. También encontramos que el comercio es un canal de transmisión clave para explicar nuestros resultados.

Palabras clave: política fiscal, efectos desbordamiento, área del euro, vectores autorregresivos.

Códigos JEL: E62, E32, C32.

1 Introduction

Contrary to the US or Japan, in the euro area the use of fiscal policy as a area-wide stabilization tool can only be achieved through a coordination of national (country-specific) fiscal policies, given that no area-wide fiscal authority or centralised fiscal capacity do exist. In the euro area, the fiscal policy stance is the result of aggregating the member countries fiscal policies which are designed, nevertheless, under the constraint of having to fulfil the EUs common budgetary rules framework, defined in the Stability and Growth Pact (SGP). The implementation of such coordinated policies might become particularly relevant when the common monetary policy is constrained or limited in its ability to react to area-wide symmetric shocks. Accordingly, joint fiscal policy responses have to be based on ad hoc initiatives coordinated by the European Commission or via ad hoc inter-governmental agreements. This was the case, for instance, of the November 2008 "European Economic Recovery Plan" (EERP), the European Investment Plan (the so-called Juncker Plan), which was approved in late 2014, or, more recently, the European Commission Communication on the need for a more expansionary fiscal policy stance in the euro area, formulated in November 2016.[1]

To make a proper assessment on the usefulness of such policy actions it is essential to understand what are the economic effects of fiscal policy shocks in a member country on neighbouring countries. Nevertheless, euro area wide discussions about this matter have typically been based on limited empirical evidence. On the one hand, the literature based on calibrated/estimated general equilibrium models tends to find that fiscal spillovers within the euro area are small once all channels are considered (trade channel vs. monetary policy reaction, exchange rate, and risk premium).[2] On the other hand, the available empirical studies hinge on pools of countries, given data limitations, and do not usually provide country-specific estimates or, when provided, tend to hinge on relatively short time periods.[3]

In our paper we revisit the issue at hand. In order to estimate fiscal spillovers effects among euro area countries, we first assemble a novel country-level fiscal dataset for the four largest EA countries (Germany, France, Italy and Spain) and the region-wise aggregate for the period 1980q1-2016q4, given the scarcity of publicly available detailed historical fiscal data. Such database is built to some extent on the basis of interpolation methods, but the raw indicators we use to do so are closely linked to the ones employed by national statistical agencies to provide their best estimates (i.e. monthly fiscal data, mostly on a public accounts basis), and the unobserved components, mixed-frequencies time series method we use preserves full coherence with official, annual and quarterly fiscal data when available.[4] Next, we employ

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[1] See European Commission (2016).

[2] In general, structural models find small or even negative spillovers (see for example Gadatsch et al. (2016) or Stähler and Thomas (2012)). However, Blanchard et al. (2017) show that spillovers can be positive and large during prolonged liquidity traps in New Keynesian model of a currency union.

[3] See for example Auerbach and Gorodnichenko (2013) or International Monetary Fund (2017).

[4] This dataset updates already existing data elaborated with the same methodology proposed here, for the cases of Spain and the EA aggregate, see Paredes et al. (2014), and merges it with newly created data for Germany and Italy. For France we use the same type of models to seasonally-adjust official quarterly National Accounts data. Our dataset includes detailed information on both public revenues (total revenues, direct and indirect taxes and social security contributions) and expenditures (total expenditures, social transfers, government consumption and investment, among others).

this dataset to estimate a vector autorregresion (VAR) for each of the six major euro area countries. We then impose restrictions on the contemporaneous response of the variables following Blanchard and Perotti (2002) to identify government spending shocks. Finally, we use these shocks to explore the dynamic effects of fiscal changes in the major euro area countries both on the country undertaking this policy (i.e. the conventional fiscal multiplier) and on neighbour countries (fiscal spillovers).

To analyze *fiscal spillovers* (defined as the cross-border effects of domestic fiscal policies), our empirical strategy employs local projections (Jordá (2005)) to relate the dynamic response of economic activity in a country to a government spending shock in a different country. We propose two statistics that allow us to quantify the degree of spillovers present in the euro area, while preserving the potentially heterogeneous effects that they may exhibit. First, we construct a measure of how much an economy benefits from changes in fiscal policy abroad and, second, we estimate how large are the effects that each individual country is able to generate on the economic activity of other countries. We refer to these two measures as spillovers by destination and spillovers by origin, respectively. Overall, our results suggest that the fiscal spillovers are positive and large. This is particularly so, for fiscal actions that are based on public investment policies. Ours results also point to a notable degree of heterogeneity, with some countries benefiting more than others from fiscal policies abroad (e.g. Germany). We investigate a potential channel explaining our results and find evidence that support the hypothesis that government expansions increase both domestic and external demand, fostering exports in neighbour countries and enhancing their economic activity.

In order to compare our work with previous literature, we follow Auerbach and Gorod-nichenko (2013), and construct a trade-weighted measure of spillovers. Our results corroborate our previous findings. Particularly, we find that an average increase of one euro in the rest of countries, can increase economic activity in the average country by as much as 0.6 euros by the third year. Again, we find that a substantial degree of heterogeneity is hidden behind these average figures. Our results point to important policy implications for the design of fiscal policies. First, countries that may not have enough fiscal space to execute fiscal expansions to support a contracting domestic demand may benefit from similar actions taken by their neighbours. However, despite the fact that these spillover effects are relatively large for the average economy, not all the countries benefit from these action to the same extent. And lastly, the composition of fiscal plans is also an important determinant of the size of potential cross border effects. Euro area-wide policies based on public investment are likely to generate higher spillovers.

This paper is structured as follows. In Section 2 we discuss the relation of our paper to the relevant literature of reference. Then in Section 3 we describe the new dataset and the methodology used for its production, while in Section 4 we explain our empirical strategy to

identify exogenous fiscal shocks and to estimate their effects. Next, in Section 5 we present our main results on the impact of fiscal shocks on neighbour countries in the EU, and investigate a potential mechanism to understand them. In Section 6 we test the robustness of these results to different specifications. Lastly, Section 7 concludes an offers future avenues of research.

2   Related Literature

Our paper relates to different strands of the literature on fiscal policy. First, our study relates to an incipient literature that aims to analyse the effects of fiscal spillovers. Beetsma et al. (2006) employ a yearly panel of European countries and estimates the effects of fiscal shocks on other countries via trade. The shocks are identified in the spirit of Blanchard and Perotti (2002), and in a second step, the authors investigate the impact of these shocks on exports activity using a trade gravitational panel. A limitation of this approach is that the use of annual data makes the restrictions needed to identify the fiscal shocks less plausible. More recently, Hebous and Zimmermann (2013) develop a global VAR to explore the effects of an area-wide shock to European countries. They identify shocks as the unanticipated variation in the deficit-to-GDP ratio and find that the impact of area-wide shocks of similar size to domestic shocks tends to be larger than the latter, suggesting that coordinated fiscal actions are particularly important in the euro area. Auerbach and Gorodnichenko (2013) use bi-annual OECD data and identify government spending shocks using forecast errors in the Survey of Professional Forecasters. They also allow for nonlinearities driven by business cycles as in Auerbach and Gorodnichenko (2012). Their results suggest that the average three-year multiplier from fiscal spillovers in OECD economies is close to 2, and as large as 6.7 during recessions. Following a similar methodology, Goujard (2017) employs a yearly panel of OECD countries but identifies fiscal shocks using the Devries et al. (2011) measure of action-based fiscal consolidations. Their results suggest that a reduction in the fiscal balance by a 1 percentage point of GDP in an average country's export markets can contract its domestic GDP growth by 1.5 percentage points on impact. More recently, International Monetary Fund (2017) provide a similar analysis for a large pool of countries during 2000q1-2016q4, finding that an expansion of government spending by one percent of GDP in an average major advanced economy has an effect of 0.15 on an average recipient country within the first year.[5]

All these studies, however, face two important limitations. First, the identification of government spending shocks rely on time variation that can only be found in long fiscal time series, which, as we argue in Section 3 are not generally available in major European

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[5]Additionally, Poghosyan (2017) gauge the size of spillovers in 10 Euro Area countries by augmenting an otherwise standard local projection as in Auerbach and Gorodnichenko (2013) or Goujard (2017) with distance-weighted lags of output from neighbour countries. Under the assumptions that the coefficients of these lags capture exclusively an increase in output resulting from the fiscal action originated in the recipients country and that potential spillovers effects take longer than a year to materialize, the author finds significant spillovers from fiscal consolidations in the euro area.

countries. Second, these studies estimate an average response from an average fiscal shock, ignoring potential heterogeneity that may arise from both the country originating the shock and from the country receiving it.[6] In our paper, we overcome these empirical limitations by producing a novel dataset and highlighting the role of heterogeneity in the transmission of spillovers.

Our paper also relates to a classic literature that has estimated the effect of fiscal shocks on domestic economies. Our identification of fiscal shocks follows Blanchard and Perotti (2002). Other examples of this literature include Romer and Romer (2010), Barro and Redlick (2011), Ramey (2011) for the case of the US and Burriel et al. (2010) for a comparison of fiscal multipliers in the US and the EU. In particular, our paper updates new estimates of *domestic* fiscal multipliers in light of our novel dataset.

Lastly, our paper relates to works that have produced databases suitable for the empirical analysis of fiscal policies, such as Ilzetzki et al. (2013). In particular, the methodology used in this paper follows that of Paredes et al. (2014).

We consider that our work presents relevant contributions to the different strands of literature mentioned above. Our first contribution is the production of a new long, coherent and quarterly dataset of fiscal variables which we believe can be particularly helpful in analysing empirical questions with identification strategies that require detailed datasets as the one we present here. Secondly, we provide new evidence on fiscal spillovers in the EU based on this dataset and propose a new procedure to uncover potential heterogeneity in the degree of spillovers between countries. Lastly, as a byproduct of our estimations, we produce new updated and comparable evidence on (domestic) fiscal multipliers in Germany, France, Italy, Spain and the euro area aggregate, distinguishing between government consumption and public investment shocks.

3   Data

Most of the empirical exercises on the effects of fiscal policies in the US rely on the existence of long quarterly datasets,[7] with official NIPA data being available since 1948q1. On the contrary, in the case of most euro area countries, the fiscal variables necessary for these empirical exercises are only available since the mid and late 90's at a quarterly frequency.

To address this issue we assemble a new dataset for Germany, France, Italy, Spain and the EU aggregate from 1980q1 to 2016q4 at a quarterly frequency. This dataset is consistent with Eurostat's figures in their newest accounting framework (ESA2010). For the cases of Germany and Italy we combine official information from the quarterly non-financial accounts for general government statistics (ESA2010 and ESA95) and extend it backwards by combining intra-annual information and annual official statistics using the methodology from Paredes et al.

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[6]A recent exception is Georgiadis and Hollmayr (2016), which analyzes the heterogeneity of spillovers in the euro area using an identification strategy based on sign-restrictions.

[7]See Blanchard and Perotti (2002) and Ramey (2011), for example.

(2014), explained in Appendix A. Data for Spain and the euro area as a whole is obtained from an updated version of de Castro et al. (2017) and Paredes et al. (2014), respectively, which are produced using the same methodology described below and also consistent with the system of national accounts. Lastly, data for France is directly obtained from Eurostat.

The resulting dataset contains disaggregated measures of fiscal revenues and spending for each of the four countries (and the aggregate), shown in Table 1. From a revenues point of view, the database includes an aggregate measure of total revenues, and separates between direct and indirect taxation and social security contributions. Likewise, the variables pertaining to the spending side include a broad category of total expenditures and measures of government consumption (disaggregated into compensation of employees and other government consumption), government investment, social payments, subsidies and interest payments.[8] The deficit can be computed as the difference between total revenues and total expenditure.

Our new dataset presents three important advantages. First, it is comparatively longer (and in quarterly frequency) than existing data. Second, it is consistent with official European statistics, allowing for cross-country comparisons (a feature particularly important in this context). And lastly, the data is detailed enough to allow for an implementation of an identification strategy based on a particular definition of government spending and tax revenues (see Blanchard and Perotti (2002)).

For our analysis in the rest of the paper, in line with Blanchard and Perotti (2002), we define government spending as total purchases of goods and services (the sum of government consumption -GCN, and government investment -GIN). Net tax revenues are defined as the sum of total revenues (TOR) minus total transfers, which are defined as the sum of social payments (THN) and subsidies (SIN). Additional variables used in the analysis are real output, the output deflator, the 10-year interest rate, real exports and imports. Further details and sources of these data are described in Appendix A.[9]

4 Empirical Strategy

In this section we first describe how we identify domestic government spending shocks and then we propose a method to measure their effect on the economic activity of other countries in the euro area.

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[8]The categories of other revenues and other expenditure are computed as the difference between the main aggregate and all the chapter, that is: $TOR - DTC - TIN - SCT$ for the case of fiscal revenues, and $TOE - GCN - GIN - THN - SIN - INP$ for the fiscal expenditures.

[9]Nominal variables are converted into real terms using the GDP deflator. All series (with the exception of the interest rate) are seasonally adjusted.

4.1 Identifying Government Spending Shocks

For each country in our sample, we separately estimate the following VAR:

$$\boldsymbol{x}_t = \boldsymbol{B}_L(L)\boldsymbol{x}_{t-1} + \boldsymbol{e}_t \tag{1}$$

where $\boldsymbol{x}_t = [tr_t, g_t, y_t, p_t, r_t]'$ is a vector containing the logs of real net tax revenues (tr_t), government spending (g_t), output (y_t), gdp deflator (p_t) and the level of the 10-year interest rate (r_t). $\boldsymbol{B}(L) = (\boldsymbol{I} - \boldsymbol{B}_1 L - \boldsymbol{B}_2 L^2 \ldots \boldsymbol{B}_p L^p)$ is a lag polynomial of order $P = 4$. Equation 1 also includes a constant and a quadratic trend, omitted here for simplicity.[10] We assume that the vector of residuals $\boldsymbol{e}_t$ contains a linear combination of structural shocks:

$$\boldsymbol{A}_0 \boldsymbol{e}_t = \boldsymbol{C}\boldsymbol{\varepsilon}_t \tag{2}$$

where A_0 and C are contemporaneous-response matrices that map reduced-form residuals into structural shocks $\boldsymbol{\varepsilon}_t$. Following the description in Perotti (2005), the reduced-form shocks of the tax revenues and government spending equations (e_t^T and e_t^G, respectively) can be considered linear combinations of three objects: i) the automatic response of fiscal variables to unexpected changes in the rest of the system (e.g. automatic stabilizers), ii) systematic discretionary responses of policy makers to unexpected changes in output, prices and interest rates (e.g. for instance increases in government spending or reductions in tax liabilities that authorities implement in the wake of a recession), and iii) random discretionary shocks, which represent the structural, economically-meaningful shocks that we are interested in (denoted by ε_t^T and ε_t^G for the tax and government spending equations, respectively). The role of the identification strategy, is to impose sufficient conditions so that these objects (ε_t^T and ε_t^G) can be recovered. In this section, we describe how we identify structural shocks to government spending.

To see the assumptions that are required to recover the structural government spending shocks, consider the second equation forming the system in Equation 2:

$$e_t^G = \alpha_{g,y} e_t^Y + \alpha_{g,p} e_t^P + \alpha_{g,r} e_t^R + \beta_{g,t}\varepsilon_t^T + \varepsilon_t^G \tag{3}$$

Following Blanchard and Perotti (2002), the main identifying assumption imposed is that it takes longer than a quarter to implement fiscal policies in response to innovation in the economic environment. Hence, the use of quarterly data eliminates the possibility of contemporaneous discretionary responses and the α coefficients in Equation 3 only reflect the automatic response of government spending to the rest of the variables.[11]

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[10]When estimating Equation 1 for Germany and France, we include dummy variables for the reunification period (1991q1-2016q4) and during the 90s crisis period (1992q1-1995q4), respectively.

[11]In the case of government spending, the output elasticity is assumed to be 0 ($\alpha_{g,y} = 0$), the price elasticity is assumed to be -0.5 for all countries ($\alpha_{g,p} = -0.5$), following Perotti (2005), with the exception of France, where $\alpha_{g,p} = 0$, as in Cleaud et al. (2014), while the interest rate elasticity is assumed to be 0 ($\alpha_{g,R} = 0$).

We can now construct the cyclically adjusted government spending shocks (Blanchard and Perotti (2002)) as:

$$e_t^{G,CA} = e_t^G - \left(\alpha_{g,y}e_t^Y + \alpha_{g,p}e_t^P + \alpha_{g,r}e_t^R\right) = \beta_{g,t}\varepsilon_t^T + \varepsilon_t^G \tag{4}$$

Finally we impose the restriction that $\beta_{g,t} = 0$, as in Blanchard and Perotti (2002), in order to separate government and net tax revenues shocks.

With these restrictions we are able to identify and estimate the structural shocks to government spending, ε_t^G, for each country considered in our sample individually (Germany, France, Italy, Spain and the euro area). Note that in our benchmark estimation in the next section, we do not construct the impulse responses to the structural shocks using the VAR representation in Equation 1, but we use instead a local projections approach. Therefore we do not need to estimate further elements in the contemporaneous impact matrix $\boldsymbol{A}$ in Equation 2. However, if we want to compute the impulses responses using the moving average representation of Equation 1 (as we do in Table B1), we can recover the necessary elements in matrix $\boldsymbol{A}$ by using ε_t^T and ε_t^G as instruments for e_t^T and e_t^G in the rest of equations in system 2 as described by Blanchard and Perotti (2002) and Perotti (2005).

An important aspect to notice is that in the identification of a structural shock ε_t^G we have not explicitly incorporated variables from other countries. Implicitly, our approach relies on the assumption that Equation 1 contains sufficient information about the economic environment to identify the shocks which do not impact on the contemporaneous exclusion restriction embedded in Equation 2. We relax this by controlling for fiscal shocks in countries $j \neq i$ when analysing the effect of a fiscal shock in country i in our estimation of spillovers. Additionally, we find that the covariance matrix of country shocks ε_t^G is close to diagonal, implying that our recovered structural shocks are not correlated and, therefore, Equations 1-3 represent an adequate approach to the identification of shocks.[12]

4.2 Estimation of Spillovers

In this section we describe how we estimate the effects of government spending shocks abroad (fiscal spillovers) and on the domestic economics (the traditional government spending multiplier) and propose two statistics that can quantify the degree of spillover effects in the euro area.

In our estimations of the effect of fiscal shocks we compute impulse response functions following the local projections method of Jordá (2005). This approach presents some advantages with respect to impulse response functions constructed using the moving average

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[12]All non-diagonal entries in the covariance matrix formed by combining the structural shocks ε_t^G estimated by each country-specific VAR are close to zero, with the cross-correlations not being significant. The only exception is the correlation between the structural shocks in Spain and Italy, which presents a coefficient of 0.21. As our estimations below include the shocks to other countries as controls, this means that the potentially common information in the shocks of Spain and Italy is accounted for. However, as we show in the robustness section, even failing to control for other countries' shocks has little effect on our results.

representation of Equation 1.[13] First, this simple method is more resilient to model misspecification (Ramey (2016)) and, second, it allows us to compute spillovers in terms of cumulative multipliers in a convenient and transparent way, without the need to use sample averages for its construction.[14]

We start by estimating how much each of the EU countries considered here (Germany, France, Italy and Spain) benefit form a fiscal action in each one of the rest of countries. In particular, we estimate the individual effect of fiscal shocks in country j to output in country i regressing the following equations for each pair countries (i, j) over the horizon h:

Following Owyang et al. (2013) and Ramey and Zubairy (2018), we estimate a series of single equations over the horizon h using:

$$\frac{y_{i,t+h} - y_{i,t-1}}{y_{i,t-1}} = \alpha_{i,h} + \beta_{i,j,h}\frac{shock_{j,t}}{y_{i,t-1}} + \boldsymbol{\delta}_{i,h}(L)\boldsymbol{x}_{i,t-1} + \xi_{i,t+h} \qquad (5)$$

$$\frac{g_{j,t+h} - g_{j,t-1}}{y_{i,t-1}} = \lambda_{i,h} + \gamma_{i,j,h}\frac{shock_{j,t}}{y_{i,t-1}} + \boldsymbol{\rho}_{i,h}(L)\boldsymbol{x}_{j,t-1} + \zeta_{i,t+h} \qquad (6)$$

where y and g represent output and government spending in real terms, $shock_{i,t}$ is the structural government spending ε_t^G uncovered in Equation 4 for country i. $x_{i,t-1}$ are controls specific for country i which also include other structural government spending shocks from countries $i \neq j$.[15] Note that given its iterative nature, the local projections method introduces serial correlation in the residual $\xi_{i,t}$, we use the Newey-West (HAC) correction method to compute the standard errors. The spillover effect of an one-euro increase in government spending in country j on the output of country i is measured by a cross-country multiplier. The multiplier of a government spending increase in country j on output of country i in period h, $M_{i,j,h}$, is computed as the ratio of the cumulative sum of coefficients $\beta_{i,j,h}$ in the output equation and the $\gamma_{i,j,h}$ coefficients in the government spending equation:[16]

[13]There are however, disadvantages of local projections: compared to the impulse responses computed from an inversion of a moving average representation, local projection generates a more inefficient estimation of the impulse response conditionally on the VAR correctly capturing the underlying data generating process.

[14]This is particularly useful in our context, since constructing fiscal multipliers as in Blanchard and Perotti (2002) (i.e. evaluating the elasticities using the sample average) could potentially be misleading when the sample means of government spending and output significantly vary over item. As explained in Ramey and Zubairy (2018) and Fieldhouse et al. (2018), the use of local projections mitigates this problem by effectively using the ratio of output and government spending for each point in the sample, rather than its average.

[15]Additionally, the results are invariant to the inclusion of controls specific to country j in the output equation. With the exception of interest rates and debt-to-GDP, controls are included in logs and also include tax revenues, government spending and output. Note that by definition there is no need to include additional controls for country j in Equation 6, since $shock_{j,t}$ already incorporates this information. However, the coefficient $\boldsymbol{\rho}_{i,h}$ may not be exactly 0 since $y_{i,t}$ is also present in the left-hand side of the equation and hence, despite the results do not show quantitatively or qualitatively negligible changes, we decide to include them.

[16]Note that there is no need to rescale the responses by the sample average of nominal government spending to output, since the approach described in Equations 5 and 6 effectively does this re-scaling for every period t (see Owyang et al. (2013) for further details).

$$M_{i,j,h} = \sum_{r=1}^{h} \frac{\beta_{i,j,r}}{\gamma_{i,j,r}} \qquad (7)$$

Next, in order to estimate the aggregate degree of fiscal spillovers that is present in the euro area, we propose two alternative methodologies to summarise the information contained in Equations 5 and 6. First, we compute a measure of how much a country benefits from simultaneous fiscal policies in the rest of the countries (we refer to this statistic as the spillovers *by destination* or *spillover^D*). And, second, we estimate how big are the spillovers that each individual country is able to generate (we refer to this as the spillovers *by origin*, or *spillover^O*).

The spillover effect by destination, measures the impact on the output of country i from shocks originated in the rest of considered countries $j \neq i$. This statistic is our preferred specification to determine the existence of spillovers in the euro area. We construct it as the ratio of the sum of the total impact of the fiscal actions in countries $j \neq i$ on the output of country i, and the sum of the effect of the same policies in the government spending of all countries $j \neq i$:

$$spillover_{i,h}^{D} = \frac{\sum_{j\neq i}\sum_{r=0}^{h}\beta_{i,j,r}}{\sum_{j\neq i}\sum_{r=0}^{h}\gamma_{i,j,r}} = \sum_{j\neq i} M_{i,j,h}\frac{\Gamma_{i,j,h}}{\sum_{j\neq i}\Gamma_{i,j,h}} \qquad (8)$$

where $M_{i,j,h}$ is our definition of the cumulative multiplier of government spending spillover of country j on country i in time horizon h and $\Gamma_{i,j,h} = \sum_{r=0}^{h}\gamma_{i,j,r}$. Intuitively, Equation 8 weights the cross-country multipliers $M_{i,j,h}$ by the size of the increase in government spending in country j as a share of the total increase in government spending from countries $j \neq i$. Given that the object measured by Equation 8 is the response to a simultaneous increase of one euro in the rest of the considered countries, our results are likely to represent an upper bound. The advantage of this approach, as compared with the literature (see discussion in the next subsection), is that Equations 5 to 8 require minimal restrictions beyond those necessary for identification of the fiscal shocks.

The spillover effect by origin, *spillover^O*, traces the impact of an exogenous government spending shock originated in country j on the output of the rest of countries $i \neq j$. We construct this object by taking an output-weighted average of the cross-country spillovers that country j generates on countries $i \neq j$, employing the coefficients estimated in Equations 5 and 6:

$$spillover_{j,h}^{O} = \sum_{i\neq j} \frac{\sum_{r=0}^{h}\beta_{i,j,r}}{\sum_{r=0}^{h}\gamma_{j,r}}w_j = \sum_{i\neq j} M_{i,j,h}w_j \qquad (9)$$

where $w_j = \frac{Y_j}{\sum_{i\neq j}Y_i}$ represents the GDP weights. Basically, *spillover$_{j,h}^O$* represents an average effect of a shock in country j on countries $i \neq j$, with the weights determined by relative size of the economy receiving the shock.

5 Results

This section presents our main results on the estimated effects of spillovers, it explores a potential mechanism of transmission and the heterogeneity of the results by components of spending, and describes an alternative specification for the measurement of spillovers. In order to set a benchmark, we first start by exploring the implications of our methodology and new data for the estimation of domestic multipliers.

5.1 The Domestic Effects of Government Spending Shocks

This subsection describes the dynamic effects of government spending shocks on their own economies, summarized by the government spending multiplier defined in Equation 7. For this particular case, we estimate Equations 5 and 6 and set $j = i$ and $\rho = 0$. Panel A of Table 2 reports the cumulative multipliers for changes in total government spending at different horizons. Figure B1 shows the response of output and government spending to an exogenous increase in government spending, as well as the cumulative multiplier (as defined above).[17]

In the case of Germany, an increase in government spending triggers a positive and significant (at confidence levels of 95%) response of output throughout all the periods considered. Particularly, the dynamic effects of the shock exhibit the largest impact multiplier amongst the countries considered: about 1 on impact and up to 1.8 by the third year.

The effect of a government spending shock for the case of France is measured with very high uncertainty. The impact multiplier of 0.37 is significant at levels of 95%, but the effect at longer horizons is not significant at levels of 68% (although the cumulative multiplier for the first year is significant at 67%).

When considering Italy, the impact of the same fiscal action is associated with an effect close to 0 on the quarter of impact, although it quickly rises up. The 1-year cumulative multiplier is measured to be around 0.6, reaching a peak value of about 1.24 by the third year (with significant levels above 95%).

Spain also shows a similar dynamic pattern to Italy, although in this case the increase in government spending does affect the economy on impact in a positive and significant way (the impact multiplier is close to 0.5). The effect of this policy remains positive and significant at

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[17]Throughout the paper, all the graphs show confidence bands computed using the heteroskedasticiy and autocorrelation robust (Newey-West) standard errors (as, for example, in Owyang et al. (2013)). We use the impulse response graphs (e.g. Figure B1 orFigure 1) as evidence of the existence of significant macroeconomic effects (domestic or spillovers) derived from fiscal shocks. Additionally, to translate these (normalised) percentage effects into comparable figures, we calculate cumulative multipliers (e.g. Table 2). We have estimated the significance of these multipliers using Equation 7 (i.e as the ratio of the estimated Newey-West confidence bands in the output and government equation). This computation method is only approximate and becomes asymptotically true with (among other aspects) a sufficiently low correlation of the standard errors of the coefficients β and γ in Equation 5 and 6 (an assumption seemingly plausible according to our calculations). For the case of domestic multipliers, we have found that this methods yields very similar results to those obtained from a bootstrap procedure that constructs endogenous variables $\mathbf{x_t}$ by randomly sampling (with replacement) the residuals $\mathbf{e_t}$ in Equation 1.

levels of 95% for the rest of the period considered, with a peak effect reached at the end of the second year (the multiplier rises to about 1.4).

Lastly, an area-wide fiscal expansion also shows a positive effect on economic activity. The impact multiplier of an increase in government spending is measured to be slightly above 0.3. Over the course of the first year, this effect is large (multiplier of 1) and significant (at levels of 95%). The peak is reached during the second year, with a somewhat higher multiplier of 1.1.

To sum up, we find government spending multipliers close or above 1 by the second year for the countries considered (although imprecisely measured in the case of France).

We now turn our attention to the dynamic effects of changes in the subcomponents of government spending (i.e. public consumption and investment). We identify these shocks using the same methodology as described in Section 4. Panel B and C of Table 2 show the cumulative multipliers of these two components. When considering the impact of public consumption on economic activity we observe that the associated multipliers tend to be roughly similar with those reported for total government spending in Panel A, although with some differential aspects.

When exploring the output effects of exogenous shocks in public investment (Panel C of Table 2) we obtain a more homogeneous picture: these fiscal actions are positive and more significant in almost all countries and periods considered. In a similar way to what is found in the literature, the magnitude of the effects of shocks to public investment are comparatively higher to other components of total spending. In our sample of countries, the 2-year cumulative multiplier is close or above 2 in France, Italy ans Spain (2.6, 1.8 and 2.3 respectively) and much higher in the case of Germany (a multiplier of 2.9 is reached by the end of the first year and increases to 4.9 in the second year). This results on an area-wide cumulative multiplier slightly higher than 3 in the second year.

In the Appendix B, we compare ours results with those found in previous literature. To make this comparison, we use as a benchmark a recent survey undertaken by the European Commission in the 2012 Public Finance Report (European Commission (2012)) which includes a replication of estimates of government spending multipliers for Germany, Italy, Spain and the euro area with a common methodology.[18] The left panel of Table B1 shows the multipliers estimated in (European Commission (2012) for these countries over the sample 1985q1-2010q4, while the middle panel includes our estimated multipliers for a similar sample obtained from the impulse responses of a VAR as in Equation 1[19] and through local projections, as described in Equations 5-6. Reassuringly, the multipliers for total government spending estimated in this section for the four largest countries and the euro area similar in magnitude to those

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[18]Spanish data comes from de Castro et al. (2017), German data is obtained from Tenhofen et al. (2010), Italian data is taken from Giordano et al. (2007), while euro area data is explained in Burriel et al. (2010). For the case of France, we use the results from Cleaud et al. (2014) (absent in European Commission (2012)).

[19]The responses y_t are converted to multipliers by dividing the area below the response function of y_t by the area below the response function of g_t and then re-scaled by the sample average ratio of nominal government spending to nominal output.

found in previous studies. The results are also robust to changes in the construction of the impulse response (i.e. using the moving average representation of a VAR or local projection methods). The multipliers estimated over our full sample (1980q1-2016q4), as in Panel A of Table 2, are slightly smaller in size to the ones obtained when restricting the sample to 1985q1-2010q4 as in European Commission (2012).

5.2 Fiscal Spillovers in the Euro Area

In this subsection, we estimate Equations 5-6 for all pairs of countries, and obtain our measures of spillovers using Equations 8-9 mentioned above.[20]

Figure 1 shows the output effects (in normalized percentage terms) on each of the four considered countries after a simultaneous increase in government spending in the rest of neighbour countries (i.e. $spillover^D$ in Equation 8). The results suggest that there exist positive spillovers in Germany, France and Spain, although with differences in the dynamics of these effects and their magnitude. Additionally, in Panel A in Table 3 we report the associated cumulative multipliers from this exercise. France and Spain show a similar pattern, with the spillover becoming positive and significant by the end of the first year, with a cumulative effect peaking in the third year, with a multiplier of approximately 1. Germany also shows an increasing positive pattern of the fiscal spillover, but with significant values at 68% only in the third year (the spillover in the second year of 1.7 is significant at the 67% level, not shown in the table). The magnitude of the effect in Germany seems to be bigger than in the rest of considered countries, suggesting a special sensitivity of this country to foreign fiscal actions.[21] If we take the output-weighted average of the results in Panel A we have an approximate measure of an average spillover effect of a simultaneous increase in government spending in the euro area, which would amount to 0.36, 0.97 and 1.46 in the first, second and third year, respectively.

Next, in Figure 2 and Panel B in Table 3 we explore the average effect of a fiscal action in one country over the economic activity of the rest of countries (the spillover by origin $spillover^O$ defined in Equation 9). The results suggest that all countries generate large and positive spillovers after the second year, although the estimates for the case of France are not significant. In all cases, the effect takes at least one quarter to build in. Germany shows a positive and significant capacity to generate fiscal spillovers over the rest of countries, with average multipliers of 0.21 in the first year and rising up to 0.6 in the third year.[22] Italy and Spain also show significant spillover effects and larger in magnitude: the multiplier is estimated to be around 0.9 and 1.6 in the second year and up to 1.3 and 2.1 in the third year, respectively. All in all, we take the results summarised in Panels A and B of Table 3 as evidence of positive fiscal spillovers among the major euro area economies.

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[20]Additionally, Figure B2 shows the output response of each country to a fiscal shock originated in each of the other countries. Even though results are quite heterogeneous, the impact on output of fiscal spillovers tends to be significant, although often only at 68%.

[21]However, the uncertainty surrounding the estimation does not support the existence of significantly different spillovers across countries.

[22]Goujard (2017) reports similar numbers for Germany, with a multiplier of fiscal consolidations in Germany of 0.23 in the first year.

Figure 1: Fiscal spillovers, by country of destination
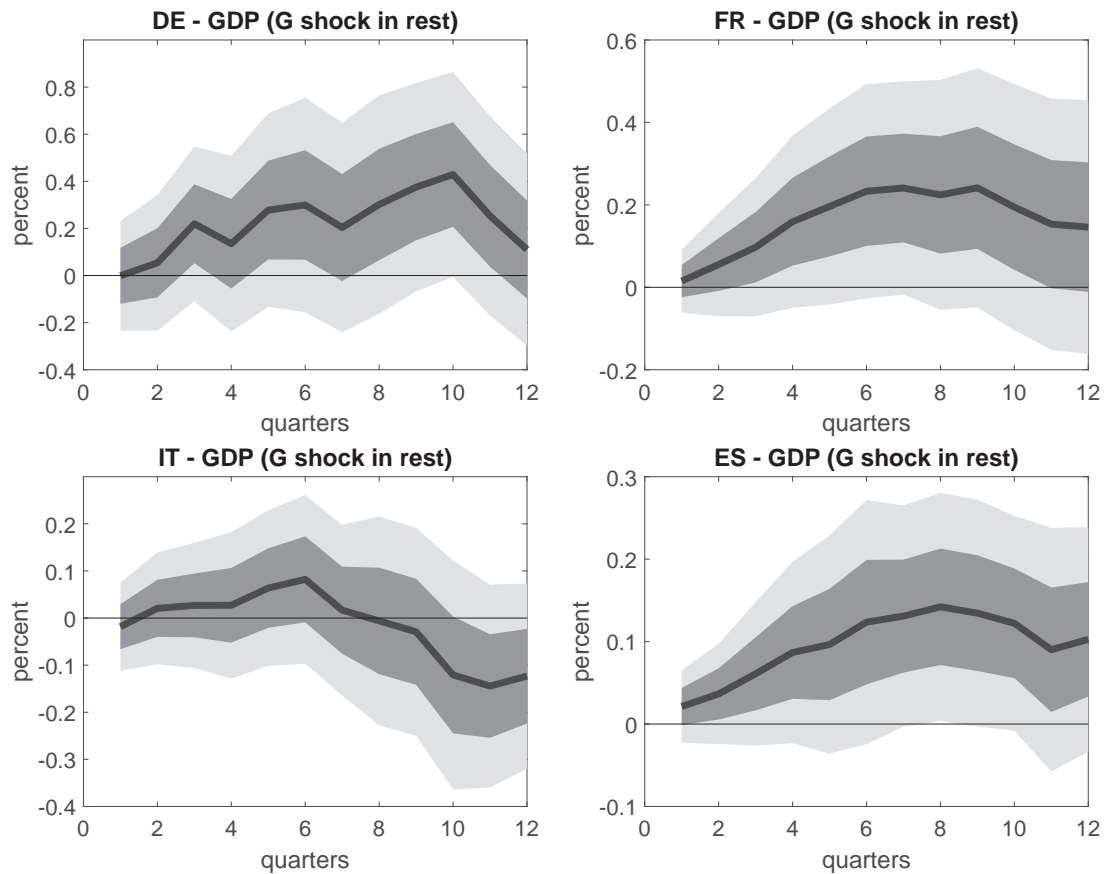
Note: 68 and 95% confidence bands computed using Newey-West standard errors.

Figure 2: Fiscal spillovers, by country of origin
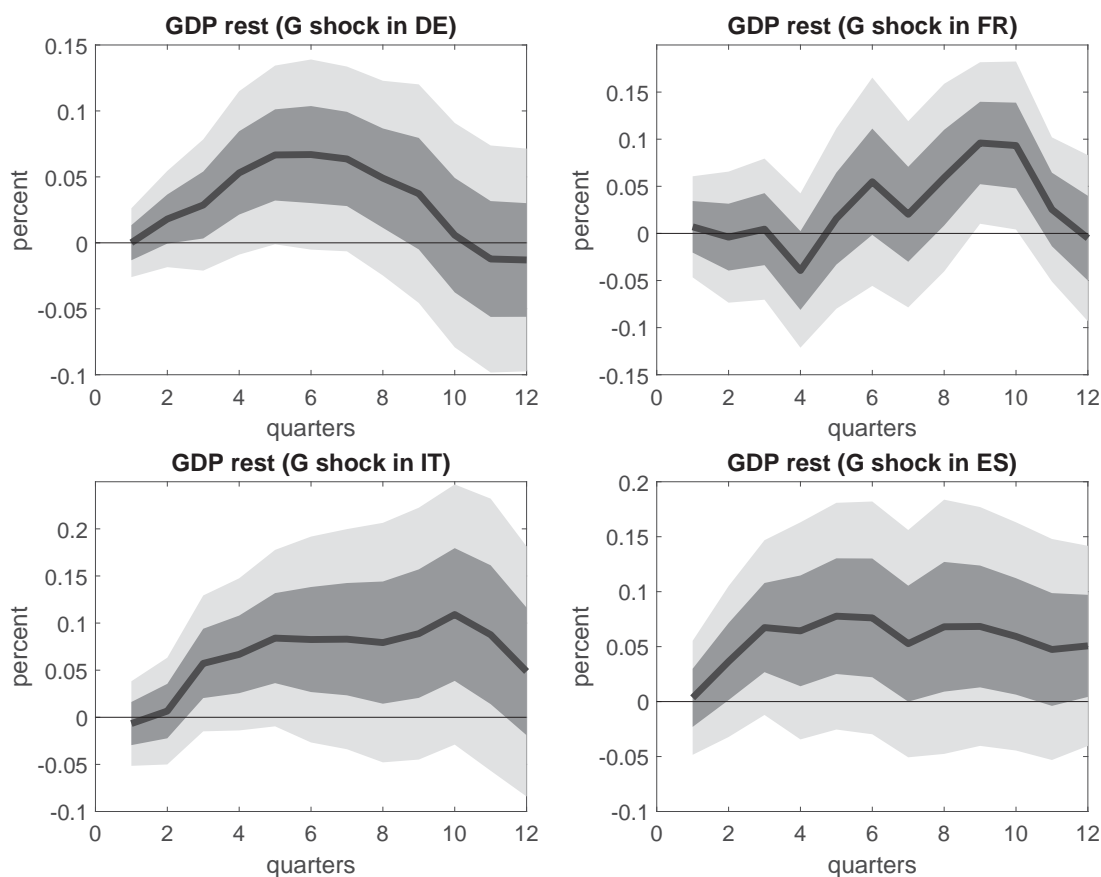
Note: 68 and 95% confidence bands computed using Newey-West standard errors.

5.3 Exploring a Potential Mechanism: the Importance of Trade

What is the economic mechanism behind the existence of the positive fiscal spillovers commented above? A potential explanation for domestic economic responses to foreign fiscal policies may be related to the trade relationship between countries. In this case, an increase in government spending in one country may stimulate the domestic demand and hence, trigger the exports of trading partners.[23] We evaluate how much this channel could help in explaining the above results. To this extent we carry out three experiments. First we use Equations 5-6

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[23]A more direct channel would be related to the import content of government spending in countries that originate fiscal shocks. In this case, increases in public consumption or investment reflect reflect direct increases in imports from neighbour countries. For example, this could be the case of a public infrastructure project that requires equipment imported from another euro area country. Evidence of this direct channel is shown in Figure B3, which plots the relationship between the degree of import content of government spending and the size of the spillover effects.

and compute the response of imports in a given country to a domestic government spending shock (i.e. a fiscal expansion in the same country). Second, we compute the destination $spillover^D$, defined in Equation 8, for exports (i.e.: the dependent variable in Equation 5 is substituted by exports). This statistic shows if a country experiences an increase in its exports after a simultaneous expansionary fiscal policy by its neighbors. Third, we estimate the origin $spillover^O$, defined in Equation 9 in country j, for exports (the dependent variable in Equation 5 represents the sum of exports in the rest of countries $i \neq j$). This allows us to explore the capacity of a country implementing a fiscal expansion to stimulate the trade amongst its partners. The results of these experiments are described in Panels A, B and C of Table 4, respectively.

Figure 3 shows the behavior of total imports to a domestic shock in the same country. The multiplier effect is shown in Panel A in Table 4. In all cases countries experience an increase in imports as a result of a government spending expansion.[24] These evidence suggests that increases in government spending spills over to the trade sector by increasing the imports of the country, either as a result of a more buoyant national demand or because of the import-content of government spending.

As the next piece of evidence on the importance of the trade sector as a transmission channel of fiscal spillovers, Panel B of Table 4 shows the export multipliers in one country when the rest of countries have embarked in simultaneous expansionary policies. The results support the trade channel described above, since countries experiencing positive spillovers also benefit from positive, large and significant increases in exports. For example, we observe a large and significant increase in exports in Germany from the first year onwards, which according to Panel A in Table 3 seems to be a country that experiences large fiscal spillovers from its neighbours. France and Spain also show positive increases in exports as a result of foreign fiscal policies, peaking in the third year. Italy, for which we could not find a significant evidence of benefiting from fiscal spillovers, does not seem to experience positive increases in exports.

In Panel C of Table 4 we analyse the effects of an expansionary policy in one country on the average exports of the rest of countries considered. Again, the results are supportive of the evidence gathered in Panel B in Table 3: countries which generate spillovers on the rest of countries also trigger a rise in their exports. In all cases, the effect on exports is positive after the first quarter. While the results are significant at levels of 68% for most countries, Spain shows large and positive results which are subjected to high uncertainty, and therefore not statistically significant. In the case of Germany, a domestic fiscal expansion generates an effect on the exports of the rest of countries of a similar magnitude to that on output (around 0.5 in the second year and 0.6-0.7 in the third year). Taken together, the evidence in Table 4 suggests that the trade channel is important in explaining the fiscal spillovers in the euro area.

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[24]The results, although positive, are not significantly different from 0 in the case of France, which corroborates the evidence from Panel B in Table 3 suggesting that this country does not tend to generate significant spillovers.

Figure 3: Response of domestic imports to (domestic) government spending shocks

DE - IMP (Country G shock)

FR - IMP (Country G shock)

IT - IMP (Country G shock)

ES - IMP (Country G shock)
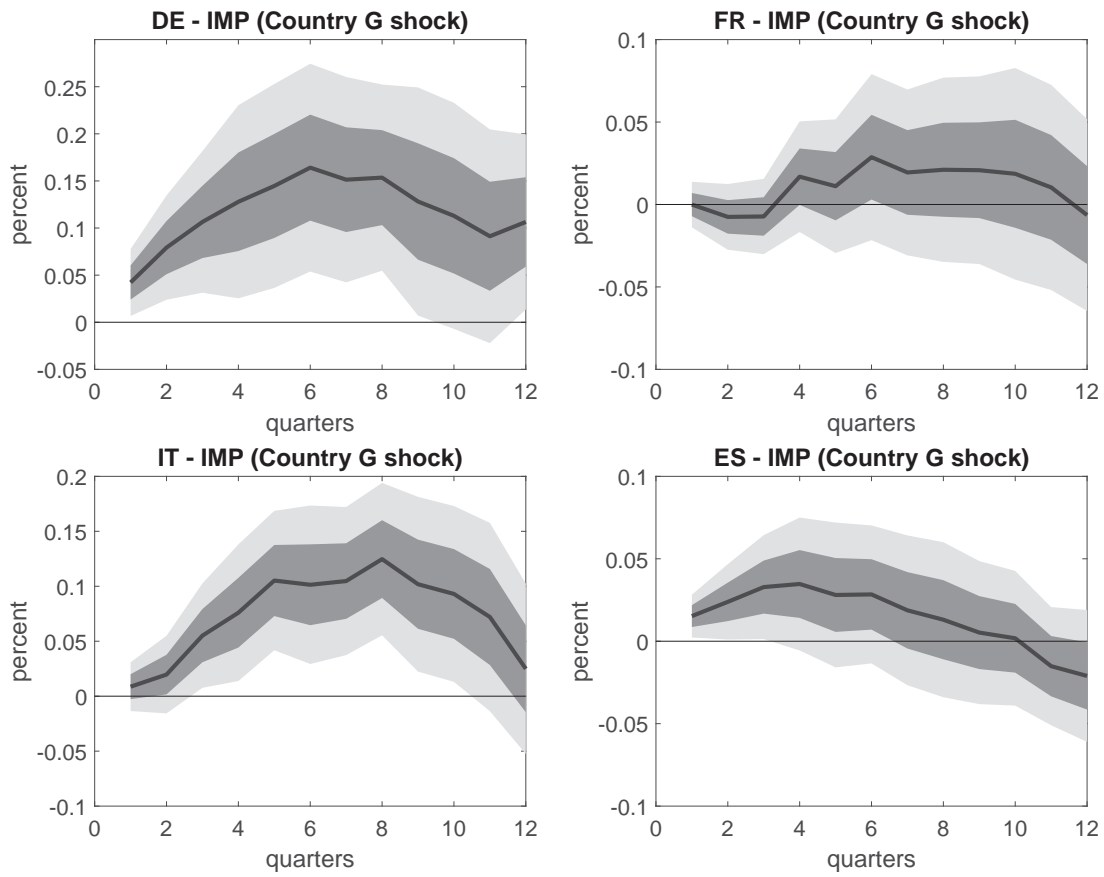
5.4 The Heterogeneous Effects of Government Spending Composition

Next, we separately analyze the effect of the two chapters that form our definition of government spending: public expenditure and public investment. To do so, we separately identify these shocks using the methods described in Section 4, and substitute this new shock in Equations 5 and 6 (as well as the government spending measure g). Starting with the spillovers generated by increases of public consumption in the rest of the countries (i.e. $spillover^D$), Panel A in Table 5 shows that these effects are large and positive for all countries except Italy (consistent with the results in Panel A in Table 3). However, only Spain receives spillovers from public spending increases in the rest of the country that can be considered significant at levels of 68%. Turning to the origin of the spillover effects (i.e. $spillover^O$), Panel B in Table 5 shows estimates of $spillover^O$ in Equation 9 for the case of public spending shocks. The results are heterogeneous: some countries such as Germany and Italy, seem to generate public spending spillovers which are only significant at some horizons (1 or 2 years). Spain and France do not generate significant public spending spillovers, with the former having large and positive sign and the latter being negative. The evidence suggests that the spillovers based on public spending are much less precisely estimated and with more heterogeneous effects than those reported in Panels A and B in Table 3.

Finally, we explore the fiscal spillovers effects derived from exogenous changes in public investment. Panel C in Table 5 shows the cumulative multipliers in one country as a response of simultaneous increases in this component of spending. The results are similar to those reported in Panel A in Table 3 but noticeable larger in size (and in some cases more significant). Germany shows a response that is positive, large and significant since the first year. This is in line with the idea that investment spending multipliers have larger effects and that such fiscal action in a foreign country may have a greater import content that can benefit exports from Germany. France and Spain also exhibit positive and large spillovers which are as well significant during the first three years after the expansion. As observed before, output in Italy does not seem to react significantly to foreign fiscal expansions. When looking at the countries originating the public investment spillover effect ($spillover^O$, shown in Panel D in Table 5), all the countries seem to generate a large and positive spillover effect since the first year. In the case of Spain, despite its large magnitude, the associated standard errors are large and the spillover effect is not statistically significant.[25] Interestingly, all countries seem to generate a large and homogeneous cumulative spillover effect by the second year of about 2 (somewhat larger in the case of France).

To summarise, we find important spillovers of fiscal policies within the major euro area countries. The evidence suggest that this is the result of a more dynamic behaviour of the exports in countries receiving a foreign fiscal shock. The fiscal spillovers are particularly large when analysing separately the public investment component of the overall expenditure.

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[25]We find that Spain actually generates large and significant public investment spillovers to some countries (particularly Germany), however, the estimates for other countries have large standard errors, resulting in an average estimate which is rather imprecise. The 1-year spillover effect of Spain (1.36) is however significant at just marginally smaller levels of confidence (67%).

5.5 Alternative Estimation of Government Spending Spillovers by Destination and Relationship to Previous Literature

In this subsection, we measure the degree of spillovers by destination using the methodology from Auerbach and Gorodnichenko (2013). Their goal is to estimate the effects on output of country i of a fiscal shock originated in the rest of the countries $j \neq i$. These authors propose an aggregation of individual shocks to government spending into a *spillover variable* using trade intensity as weights. Following a similar procedure, we construct our spillover variable as:

$$shock_{i,t} = \sum_{j \neq i} \omega_{ij} \varepsilon_{j,t}^{G} G_{j,t-1} \tag{10}$$

where ω_{ij} represent the trade weights between countries i and j,[26] $\varepsilon_{j,t}^{G}$ is the government spending shock identified in Section 4, and $G_{j,t}$ is the real government spending in country j in time t, expressed in levels.

Next, we plug this new aggregated variable in Equations 5 and 6 to estimate the fiscal spillovers effects. Note that our two measures of spillovers *by destination*, described in the previous subsection in Equation 8 and Equation 10 above, identify different objects. The former explores the effect of output in country j to a *simultaneous* increase in government spending in countries $j \neq i$, while the latter analyses the response of country i to an *average* increase in government spending in countries $j \neq i$. Therefore, we expect the latter results to be similar to those described in Panel A of Table 3, but smaller in magnitude.

The results of this estimation are shown in Figure 4 and Panel A of Table 6. In line with our main results, the responses of output in Figure 4 show a positive and significant expansion in Spain, France, and, with a slightly longer delay, in Germany. In the case of Italy, the response of output is not statistically different from 0 in the first two years and becomes negative in the medium and long run.[27]

Panel A of Table 6 shows the spillover effects expressed as cumulative multipliers. As expected, the magnitude of the results are noticeable smaller than those observed in Panel A of Table 3, with the size of the multipliers being around half the size. Reassuringly, the dynamic patterns and relative size across countries remain similar between both specifications. Spain and France show a significant positive response of output to an increase in government spending in their neighbor countries, with multipliers as big as about 0.4 or 0.6 in the third year, respectively. Germany shows a positive response to a trade-weighted shock in government spending which is higher in magnitude compared to the rest of the countries, but not

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[26]The weights are constructed using the averages of shares of exports and imports over the period 2008-2011 (source: World Input-Output Database).

[27]Figure B4 plots the weighted response of government spending to the shock defined in 10. The results show that our identified shock does indeed generate a positive and significant movement in government spending.

Figure 4: Fiscal spillovers using alternative method, by country of destination
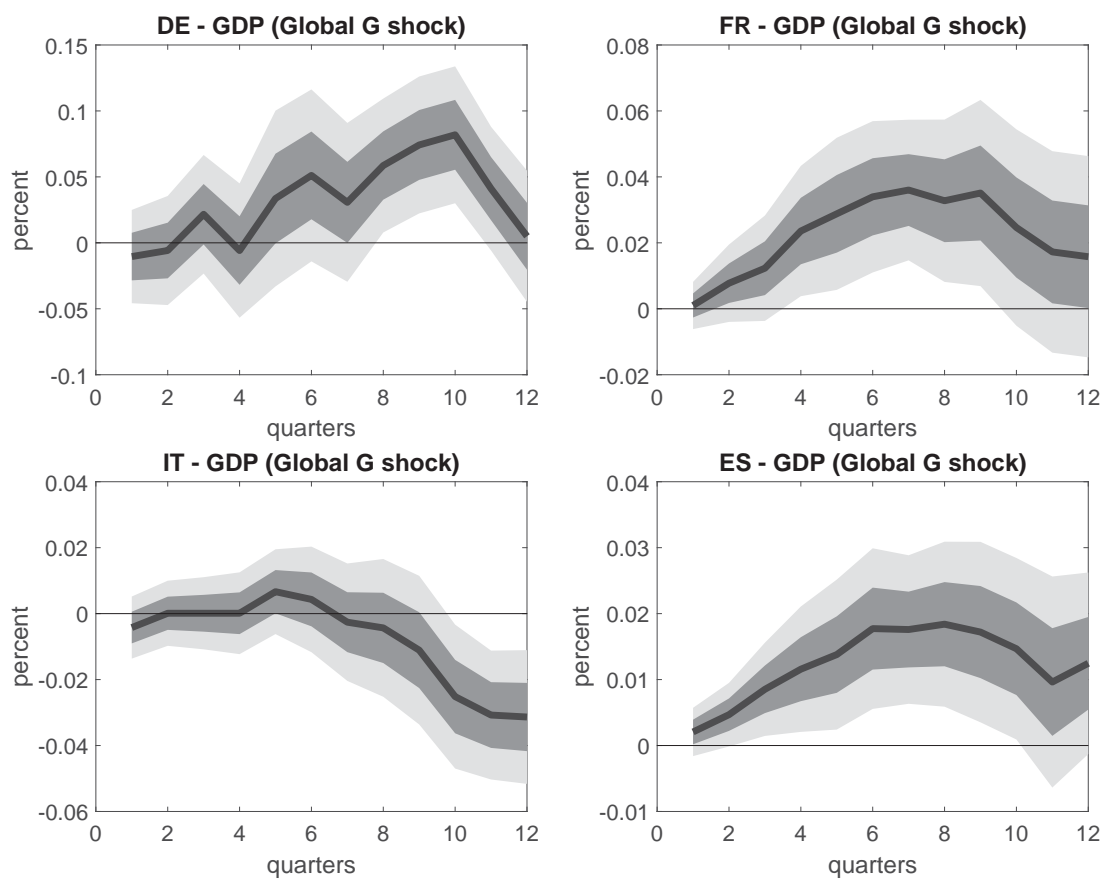
Note: 68 and 95% confidence bands computed using Newey-West standard errors.

significant at levels of 68% until the third year.[28] Taking into account the relative size of each economy considered here, the average effect (in terms of the cumulative multiplier) of a trade-weighted shock in the these countries would be of around 0.09, 0.46, and 0.60 in the first, second and third year respectively.

These results sit at the lower range of some previous empirical work. For example, our average multiplier for the third year of 0.6 is methodologically comparable to Auerbach and Gorodnichenko (2013). In this study, the authors found this figure to be between 1.6-2.0, depending on the precise specification (with standard errors of 1 or higher), for a sample of OECD countries.[29] Goujard (2017) finds larger effects: the average impact in the first year of a trade-weighted fiscal consolidation based on spending cuts of 1% of GDP, reduces output growth in the destination of an average OECD country by around 3-3.4 percentage points. The differences between our results and those in Auerbach and Gorodnichenko (2013) and Goujard (2017) can potentially be explained by differences in the data (Auerbach and Gorodnichenko (2013) employs a sample of OECD countries with an average shorter time length) or in the definition of shocks (Goujard (2017) uses fiscal consolidations which may show larger effects than fiscal expansions, as in Barnichon and Matthes (2017)). However, we cannot conclude that our results are significantly lower than those in Auerbach and Gorodnichenko (2013) or Goujard (2017), given the levels of uncertainty that these authors report.[30]

6 Robustness

In this section we test the robustness of our results to changes in the main specification.[31] All the results are shown in Figure 5.

Changes to the definition of real variables. To account for potential changes in population trends, we redefine the real variables contained in vector $\mathbf{x_t}$ in Equation 1 (i.e. output, net tax rates and government spending) in per capita terms, by dividing by total population.[32] The point estimations of Equation 1 with these new variables are shown in dotted lines in Figure 5 (together with benchmark results shown in solid thick lines). In all cases the results are not significantly different. In the cases of Germany, France and Italy, the new results stay within one standard deviation of our benchmark estimates in Figure 1. In the case of

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[28]The response of output in Germany to the trade-weighted shock is only significant in the second year at levels of 58%, i.e. about 0.8 standard errors.

[29]Auerbach and Gorodnichenko (2013) find that spillovers tend to be negative but insignificant during expansions (of about -1 to -2) and large and significant during recessions (between 4.6 and 6.7) in a specification where the regime is determined by the growth rate of output.

[30]Additionally, our results are comparable in magnitude to those estimated by International Monetary Fund (2017) for a large pool of countries during 2000q1-2016q4. The authors report only a first-year average spillover after a 1% increase in government spending (0.15), which is in line with our results when using the trade-weighted shock (0.09).

[31]We show the results of our robustness tests using Equation 8 and Figure 1 as our benchmark specification.

[32]Given the lack of comparable quarterly figures, we employ the official yearly data from Eurostat (Population on January 1st) and convert it to quarterly frequency by means of a lineal interpolation.

Spain, the new definition of the variables suggests somewhat higher spillovers, although the results stay within two standard deviations of the benchmark estimates throughout most of the response horizon.

Alternative specification of endogenous variables.   In our benchmark results, the identification of the structural shocks in equations 1-2 follows Perotti (2005) and includes prices and interest rates in $\mathbf{x_t}$ in Equation 1, in addition to output, net tax revenues and government spending. In an alternative test, we opt for a more parsimonious specification as in Blanchard and Perotti (2002) where only the real variables are included (i.e. without accounting for inflation or monetary policy). The results are shown in lines with square markers in Figure 1. The point estimates from this alternative specification are quantitatively very close to the benchmark scenario, suggesting that our main results do not critically hinge on a particular selection of endogenous variables.

Longer dynamic structure.   Our identification of structural shocks assumes that the specification in Equation 1 sufficiently captures the dynamic structure of the endogenous variables when setting the number of lags to $P = 4$. In an alternative setting we increase the length of the lag polynomial to $P = 8$ to assess whether allowing for richer dynamics uncovers potential problems due to an omitted variable bias. These results are shown in lines with round markers in Figure 5. Both the benchmark and alternative estimates are very similar, increasing only slightly in the case of Italy (but staying withing one standard deviation confidence bands). This seems to indicate that the benchmark specification includes a dynamic structure that is rich enough to identify the fiscal shocks.

Changes to sample size.   In an alternative test, we noticeably shorten the sample to 1995q1-2016q4 instead of 1980q1-2016q4. The results are shown in dashed lines in Figure 5. While they remain relatively similar to the benchmark specifications for the cases of Germany and Spain, they indicate somewhat higher spillovers in the case of Italy and smaller (and close to 0 by the first year) in the case of France. The uncertainty surrounding this estimates is high (not shown) and highlights the importance of using a sufficiently large sample.

Specification in differences.   The variables in $\mathbf{x_t}$ in Equation 1 are expressed in logarithms (with the exception of the interest rate). In an alternative specification, we transform these variables by taking first differences of the vector $\mathbf{x_t}$ and implicitely allowing the shocks to have permanent effects. The new results are shown in lines with cross markers in Figure 5. The alternative and benchmark specifications yield remarkably similar results in all countries, with the only exception of Spain, which are somewhat smaller after the first year. In all cases, this alternative specification suggests that the spillover effects seem to have a temporary nature.

Figure 5: Fiscal spillovers, by country of destination, robustness
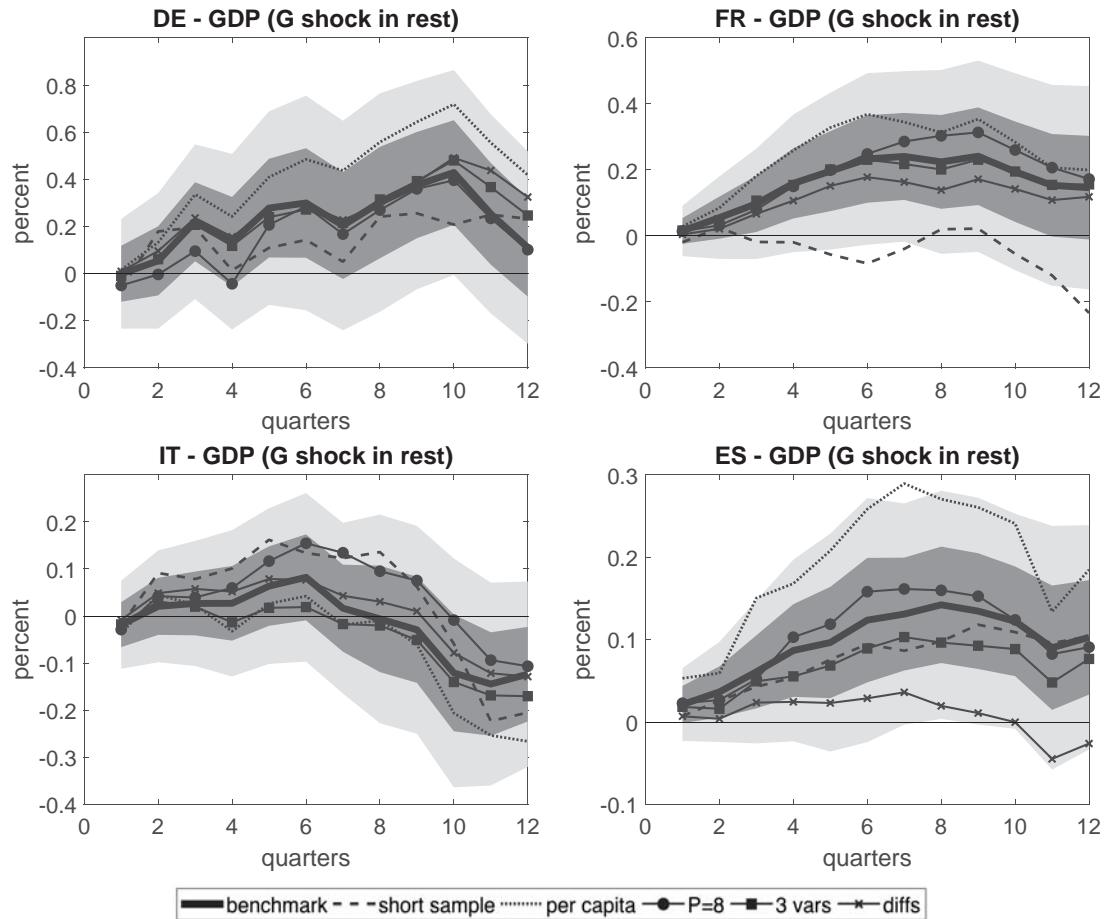
Note: The *solid thick lines* represent the benchmark point estimations as in 1. The *dotted lines* show the results of an specification with all real variables expressed in per capita terms. The *dashed lines* show the results when using a shorter sample from 1995q1 to 2016q4. The lines with *round markers* show the results when using a longer dynamic structure in Equation 1 (setting the number of lags to $P = 8$ instead of $P = 4$). The lines with *square markers* show the results when the vector $\mathbf{x_t}$ in Equation 1 only includes output, net tax revenues and government spending as endogenous variables. The lines with *cross markers* show the results when all the variables in $\mathbf{x_t}$ in Equation 1 are expressed in differences rather than in (log) levels. The grey areas represent the 68 and 95% confidence bands computed using Newey-West standard errors for the benchmark specification.

7 Conclusions

This paper finds that fiscal spillovers in the euro area are positive and relatively large. These results suggest that countries are likely to benefit (in terms of an increase in economic activity) from government spending actions implemented by their neighbors. We find evidence that supports the hypothesis that trade is a key mechanism in bringing about these results and that expansions based on investments are more likely to generate higher spillovers.

However, it is worth noting that these effects are heterogeneous across countries. Potential coordinated fiscals policies that aim at exploiting the existence of the spillovers effects should take this heterogeneity into account.

Our work highlights potential areas of future research. First while the present paper has focused on the cross-border effects of government spending, it would also be interesting to extend our analysis to the case of taxation. However, as highlighted in the text, there are empirical challenges to the identification of the tax shocks that should be carefully addressed.

It would also be interesting to investigate what class of theoretical models can yield estimates of spillovers of a similar magnitude to what is found in the empirical literature. Then, such framework could be used to get a deeper knowledge of the transmission mechanism while at the same time, allowing the possibility to explore and quantify the effects of different policy experiments. These and other questions are left for future research.

References

Auerbach, A. and Gorodnichenko, Y. (2012). Measuring the Output Responses to Fiscal Policy. *American Economic Journal: Economic Policy*, 4(2):1–27.

Auerbach, A. J. and Gorodnichenko, Y. (2013). Output Spillovers from Fiscal Policy. *American Economic Review*, 103(3):141–46.

Barnichon, R. and Matthes, C. (2017). Understanding the Size of the Government Spending Multiplier: It's in the Sign. Working paper, Mimeo.

Barro, R. J. and Redlick, C. J. (2011). Macroeconomic Effects from Government Purchases and Taxes. *Quarterly Journal of Economics*, 126(1):51–102.

Beetsma, R., Giuliodori, M., and Klaassen, F. (2006). Trade spill-overs of fiscal policy in the European Union: a panel analysis. *Economic policy*, 21(48):640–687.

Blanchard, O., Erceg, C. J., and Lindé, J. (2017). Jump-starting the euro-area recovery: would a rise in core fiscal spending help the periphery? *NBER Macroeconomics Annual*, 31(1):103–182.

Blanchard, O. and Perotti, R. (2002). An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output. *Quarterly Journal of Economics*, 117(4):1329–1368.

Burriel, P., De Castro, F., Garrote, D., Gordo, E., Paredes, J., and Pérez, J. J. (2010). Fiscal policy shocks in the euro area and the US: an empirical assessment. *Fiscal Studies*, 31(2):251–285.

Cleaud, G., Lemoine, M., and Pionnier, P.-A. (2014). Which size and evolution of the government expenditure multiplier in France (1980-2010)? *Working paper Banque de France*, (G2013/15).

de Castro, F., Martí, F., Montesinos, A., Pérez, J. J., and Sánchez-Fuentes, A. J. (2017). A quarterly fiscal database fit for macroeconomic analysis. *Hacienda Pública Española - Review of Public Economics*.

Devries, P., Guajardo, J., Leigh, D., and Pescatori, A. (2011). A new action-based dataset of fiscal consolidation. *IMF Working Papers*.

European Commission (2012). Report on Public finances in EMU.

European Commission (2016). Towards a positive euro area fiscal stance.

Fagan, G., Henry, J., and Mestre, R. (2005). An area-wide model for the euro area. *Economic Modelling*, 22(1):39–59.

Fieldhouse, A., Mertens, K., and Ravn, M. O. (2018). The Macroeconomic Effects of Government Asset Purchases: Evidence from Postwar us Housing Credit Policy. *Forthcoming in Quarterly Journal of Economics.*

Gadatsch, N., Hauzenberger, K., and Sthler, N. (2016). Fiscal policy during the crisis: A look on Germany and the Euro area with GEAR. *Economic Modelling*, 52:997 – 1016.

Georgiadis, G. and Hollmayr, J. (2016). Fiscal spillovers in the Euro area: sign, size and determinants. Working paper, Mimeo.

Giordano, R., Momigliano, S., Neri, S., and Perotti, R. (2007). The effects of fiscal policy in Italy: Evidence from a VAR model. *European Journal of Political Economy*, 23(3):707–733.

Goujard, A. (2017). Cross-Country Spillovers from Fiscal Consolidations. *Fiscal studies*, 38(2):219–267.

Harvey, A. C. (1990). *Forecasting, structural time series models and the Kalman filter.* Cambridge university press.

Hebous, S. and Zimmermann, T. (2013). Estimating the effects of coordinated fiscal actions in the euro area. *European Economic Review*, 58(C):110–121.

Ilzetzki, E., Mendoza, E. G., and Végh, C. A. (2013). How big (small?) are fiscal multipliers? *Journal of Monetary Economics*, 60(2):239–254.

International Monetary Fund (2017). World Economic Outlook.

Jordá, O. (2005). Estimation and Inference of Impulse Responses by Local Projections. *American Economic Review*, pages 161–182.

Owyang, M. T., Ramey, V. A., and Zubairy, S. (2013). Are Government Spending Multipliers Greater during Periods of Slack? Evidence from Twentieth-Century Historical Data. *American Economic Review*, 103(3):129–34.

Paredes, J., Pedregal, D. J., and Pérez, J. J. (2014). Fiscal policy analysis in the euro area: Expanding the toolkit. *Journal of Policy Modeling*, 36(5):800–823.

Pedregal, D. J. and Young, P. C. (2002). Statistical approaches to modelling and forecasting time series. *Companion to economic forecasting*, pages 69–104.

Perotti, R. (2005). Estimating the Effects of Fiscal Policy in OECD Countries. Working paper, CEPR Discussion Papers.

Poghosyan, M. T. (2017). Cross-Country Spillovers of Fiscal Consolidations in the Euro Area.

Ramey, V. (2011). Identifying Government Spending Shocks: It's All in the Timing. *Quarterly Journal of Economics*, 126(1):1.

Ramey, V. (2016). Chapter 2 - Macroeconomic Shocks and Their Propagation. volume 2 of *Handbook of Macroeconomics*, pages 71 – 162. Elsevier.

Ramey, V. A. and Zubairy, S. (2018). Government spending multipliers in good times and in bad: evidence from US historical data. *Journal of Political Economy*, 126(2).

Romer, C. and Romer, D. (2010). The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks. *American Economic Review*, 100(3):763–801.

Stähler, N. and Thomas, C. (2012). FiMod A DSGE model for fiscal policy simulations. *Economic Modelling*, 29(2):239–261.

Tenhofen, J., Wolff, G. B., and Heppke-Falk, K. H. (2010). The macroeconomic effects of exogenous fiscal policy shocks in Germany: a disaggregated SVAR analysis. *Jahrbücher für Nationalökonomie und Statistik*, 230(3):328–355.

8 Tables

Table 1: Structure of the database and its components.

Total Revenues (TOR)	Total Expenditure (TOE)
Direct Taxes (DTX)	Government Consumption(GCN)
Indirect Taxes (TIN)	Compensation of Employees (COE)
Social Security Contributions (SCT)	Government Investment (GIN)
Other revenues	Social Payments (THN)
	Subsidies (SIN)
	Interest Payments (INP)
	Other expenditure

Table 2: Government Spending Multipliers

	DE	FR	IT	ES	EA
Panel A: total G					
impact	0.97**	0.37**	-0.09	0.47**	0.33*
1 year	0.89**	0.43	0.60**	1.06**	1.01**
2 years	1.39**	1.14	1.09**	1.36**	1.09*
3 years	1.79**	1.69	1.24**	1.23**	0.64
Panel B: gov. cons.					
impact	1.15**	0.08	-0.13	0.55**	0.77*
1 year	1.00*	-0.22	0.89**	0.79**	1.66**
2 years	1.74**	0.33	1.43**	-0.02	1.02
3 years	2.46**	1.42	1.51*	-1.51*	0.09
Panel C: gov. inv.					
impact	1.25*	1.31**	0.04	0.27*	0.41*
1 year	2.91**	1.87**	0.66*	1.10**	1.91**
2 years	4.90**	2.59**	1.76**	2.29**	3.17**
3 years	5.19**	2.52*	2.32**	3.67*	2.76*

Note: One and two stars denote significance at 68% and 95% levels respectively (computed using Newey-West standard errors).

Table 3: Government Spending Spillovers

	DE	FR	IT	ES
Panel A: by destination (total)				
impact	0.00	0.05	-0.07	0.07
1 year	0.63	0.31*	0.07	0.24*
2 years	1.72	0.72*	0.16	0.61*
3 years	2.80*	1.03*	-0.13	1.00*
Panel B: by origin (total)				
impact	0.00	0.11	-0.06	0.05
1 year	0.21*	-0.22	0.40	0.83*
2 years	0.47*	0.97	0.89*	1.57*
3 years	0.58**	3.62	1.31*	2.11*

Note: One and two stars denote significance at 68% and 95% levels respectively (computed using Newey-West standard errors).

Table 4: Import and Export Effects

	DE	FR	IT	ES
Panel A: domestic imports:				
impact	0.37**	0.00	0.07	0.25**
1 year	0.68**	0.01	0.46*	0.52*
2 years	0.94**	0.60	0.95**	0.63*
3 years	1.07**	0.98	1.08**	0.43
Panel B: By destination (exports):				
impact	0.12	0.01	-0.02	-0.01
1 year	0.90*	0.28*	0.04	0.09
2 years	2.31*	0.62*	0.12	0.31*
3 years	3.68*	0.80*	0.13	0.44*
Panel C: By origin (exports):				
impact	0.02	0.47*	0.06	-0.32
1 year	0.22*	0.62	0.61*	0.24
2 years	0.46*	3.16*	1.06*	0.99
3 years	0.70*	7.55	1.41*	1.51

Note: One and two stars denote significance at 68% and 95% levels respectively (computed using Newey-West standard errors).

Table 5: Government Spending Spillovers by Composition of Spending

	DE	FR	IT	ES
Panel A: by destination (public cons.)				
impact	0.08	0.02	0.02	0.07
1 year	0.43	0.27	0.12	0.24*
2 years	0.81	0.67	0.19	0.60*
3 years	1.41	1.21	-0.16	0.84*
Panel B: by origin (public cons.)				
impact	0.01	-0.07	0.10	0.16
1 year	0.25*	-0.86	0.67*	0.65
2 years	0.58*	-1.39	0.98	1.23
3 years	0.77	-1.00	1.42	2.12
Panel C: by destination (public inv.)				
impact	0.31	0.17	0.04	0.11
1 year	1.76*	1.02*	0.18	0.42*
2 years	3.79*	2.26*	0.00	1.16*
3 years	5.57*	3.08*	-2.09	1.65*
Panel D: by origin (public inv.)				
impact	0.18	1.23*	-0.01	-0.25
1 year	0.90*	0.99	0.92*	1.36
2 years	1.94*	2.62*	2.19*	1.93
3 years	1.85*	3.37*	3.06*	7.67

Note: One and two stars denote significance at 68% and 95% levels respectively (computed using Newey-West standard errors).

Table 6: Government Spending Spillovers, alternative specifications

	DE	FR	IT	ES
Panel A: by destination				
impact	-0.19	0.02	-0.11	0.04*
1 year	0.00	0.25*	-0.03	0.17**
2 years	0.73	0.50**	0.00	0.32**
3 years	1.16*	0.59**	-0.28	0.40**

Note: One and two stars denote significance at 68% and 95% levels respectively (computed using Newey-West standard errors).

Appendix A: Database Description

In this section we briefly describe the methodology used to produce the new data drawn from Pedregal and Young (2002), as implemented in Paredes et al. (2014). Following Harvey (1990) we set up an unobserved components model:

$$\begin{pmatrix} z_t \\ \boldsymbol{u}_t \end{pmatrix} = \boldsymbol{T}_t + \boldsymbol{S}_t + \boldsymbol{e}_t \tag{11}$$

where z_t is the object of interest: a scalar representing the t-th observation of an aggregate that is coherent with ESA2010. $\boldsymbol{u}_t$ is either a scalar or a matrix of indicators that contain useful information to construct z_t. Both series are decomposed in a trend $\boldsymbol{T}_t$, seasonal $\boldsymbol{S}_t$ and irregular components $\boldsymbol{e}_t$. Equation 11 is the observation equation within a State Space system. The evolution of both the trend $\boldsymbol{T}_t$ and seasonal $\boldsymbol{S}_t$ components are governed by transition equations of Local Linear Trend and Trigonometric Seasonal models respectively (Pedregal and Young (2002)).

The model described in Equation 11 allows to combine series with different frequencies. For example, a variable might be available at quarterly frequency since a given date and only at annual frequency before then (the so-called time aggregation problem). The model then employs information from one or more indicators $\boldsymbol{u}_t$ to interpolate the behaviour of the target variable z_t when the quarterly information is not available.[33] Note that the model produces an output series z_t that takes the value of the ESA2010 figures when these are available at quarterly frequency. For the rest of the sample, it generates data that preserve the coherence with the official annual ESA2010 figures (i.e. an observation of the annual ESA2010 series is the sum of the 4 quarters of a year of variable z_t).

An important issue to take into account is that both the aggregate z_t and potential indicator u_t may have a different seasonal behaviour (e.g. cash variables may have a different seasonal pattern than national accounts). Equation 11 effectively deals with this issue by extracting the seasonal component of both series and then aggregate a seasonal component pattern that is consistent with the official quarterly figures.[34]

Quarterly and annual figures for z_t (for each chapter listed in Table 1) are obtained from Eurostat's non-financial accounts for general government statistics, using ESA2010 figures extended backwards with the growth rates of ESA95 figures. Indicators $\boldsymbol{u}_t$ are taken from national sources, the Bank of International Settlements and other institutions (as described below).[35] The impact of proceeds from the allocation of mobile licenses (UMTS) and other one-off events, which are shown to heavily distort the figures during selected years, have been removed from the series (as described below).

Figures C1-C5 show the behaviour of the variables listed in Table 1 for the six major economies in the euro area and the region-wise aggregate.

In the rest of this section, we describe the variables and sources employed to construct the objects z_t and $\boldsymbol{u}_t$ described in Section 3 for each country and revenue/spending chapter.[36] We also explain how we remove some one-off events (such us allocations of mobile licenses) that could otherwise distort the data.

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[33]Equation 11 and its associated transition equations are estimated using the Kalman filter.

[34]All the output series z_t are seasonally adjusted using the TRAMO-SEATS filter.

[35]In cases where we have not been able to find a suitable indicator we have relied on combinations of estimates of z_t or linear interpolations. We have however not used macroeconomic aggregates to interpolate the variables z_t, since it would create an important problem of endogeneity that would bias the results of the types of empirical analysis that we perform in this paper.

[36]Please refer to Table 1 for the description and full name of each revenues and spending category.

To construct z_t we employ both quarterly and annual data. Our main source is the *quarterly non-financial accounts for general government (ESA2010)* from Eurostat. When available, we extend these data backwards using the growth rates of the *quarterly non-financial accounts for general government (ESA95)* from the same source.[37] We refer to these data as *official quarterly data*. When no quarterly data is available, our methodology explained in Section 3 requires both annual data (to maintain coherence with official data) and monthly/quarterly indicators u_t to extend the series backwards. In the case of annual data, we follow the same approach described before and extend the ESA2010 annual figures using the growth rate of the ESA1995 figures. We refer to the the resulting series as *official annual data*.

To construct the indicators we employ different national and international sources such as the Bank of International Settlements (BIS) or the OECD. When no indicator has been available we rely on other procedures such as employing the output from other fiscal variables as indicators or, as a last resort, a linear interpolation of the official annual figures. All the details are described below.

Finally, all nominal variables are converted in real terms using the GDP deflator, constructed as the ratio of nominal to real output. The fiscal variables for all countries are seasonally adjusted using the TRAMO-SEATS filter.

Germany

We have availability of official quarterly data since 1995q (ESA2010 figures start in 2002q1). However, for selected categories (DTX, TIN and THN) official quarterly data starts in 1991q1. Official annual data is available since 1980 (since 1995 in the case of ESA2010).

- TOR. Sources of indicators: Total Public Sector Revenues (BIS) from 1980q1-1990q4 and General Government Budgetary Position - Total Revenues (Bundesbank) from 1991q1 onwards. We correct one-off events in the level of the variable for the quarters 1995q1, 2000q3 and 2010q3 by imposing them to have the same growth rate as the sum of the TOR components (DTX+TIN+SCT).

- DTX. Sources of indicators: Central Government Income Tax Revenues (Ministry of Finance, cash data) from 1980q1-1990q4.

- SCT. Sources of indicators: Households Income - Contributions to Social Security in West Germany (BIS), from 1980q1-1990q4 and Households Income - Contributions to Social Security in West and East Germany (BIS, cash data) from 1991q1 onwards.

- TIN. Sources of indicators: Indirect Taxes Net of Subsidies (BIS) from 1980q1 onwards.

- TOE. Sources of indicators: Total Public Sector Expenditure (BIS) from 1980q1-1990q4 and from 1991q1 onwards.

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[37]The definition of our variables is as follows. Total Revenues (TOR): Total general government Revenue. Direct Taxes (DTX): Current taxes on income, wealth, etc., receivable. Social Security Contributions (SCT): Net social contributions, receivable. Indirect Taxes (TIN): Taxes on production and import, receivable. Total Expenditures (TOE): Total general government expenditure. Social Payments (THN): Social benefits other than social transfers in kind, payable. Government Consumption (GCN): Final consumption expenditure. Compensation of Employees (COE): Compensation of employees, payable. Subsidies (SIN): Subsidies, payable. Government Investment (GIN): Gross capital formation and acquisitions less disposals of non-financial non-produced assets. Interest Payments (INP): Interest, payable.

- THN. We construct an artificial indicator for THN using the estimates of other categories of spending. We first estimate the rest of the spending variables and then use those estimates to construct the indicator for THN defined as TOE-GCN-SIN-GIN-INP. In a second stage we use the newly created indicator to obtain estimates of THN.

- GCN. Sources of indicators: Government Consumption - West Germany (BIS) from 1980q1-1990q4, Government consumption expenditure (OECD) from 1991q1 onwards and Government Final Consumption Expenditure ESA95 (Eurostat) from 1991q1 onwards.

- COE. Sources of indicators: Personnel Expenditure (Ministry of Finance, cash data) from 1980q1-1990q4 and Quarterly Personnel Expenditure (Bundesbank) from 1991q1.

- SIN. We create an auxiliary spending category (TIN-SIN) using the same indicator mentioned above (Indirect Taxes Net of Subsidies). Then we use the joint estimation of (TIN-SIN) and that of TIN to back out the estimate of SIN.

- GIN. Sources of indicators: Investment Expenditure - Central Government (Ministry of Finance, cash data) from 1980q1-1990q4 and Investment Expenditure (Bundesbank) from 1991q1 onwards. We correct one-off events in the level of the variable for the quarters 2000q3 and 2010q2 by imposing them to have the same growth rate as the variable gross capital formation (Eurostat).

- INP. Sources of indicators: Interest Expenditure - Federal Government (Ministry of Finance, cash data) from 1980q1 onwards.

Other variables. Nominal and real GDP are obtained from the Bundesbank, while Interest Rates (defined as the 10-year bonds) are obtained from Eurostat. Imports and exports are obtained from Eurostat for the period 1991q-2016q4 and extended backwards using the growth rates of these variables obtained from OECD. All variables are available for the 1980q1-2016 period.

France

Data for all fiscal variables is directly obtained from Eurostat, since there is availability of official quarterly data since 1980q1 (from ESA2010).

Other variables. Nominal and real GDP, Interest Rates (10-year bonds), real imports and exports are obtained from Eurostat. All variables are available for the 1980q1-2016 period.

Italy

We have availability of official quarterly data since 1999q1 (from ESA2010). There is also official data from ESA95 for three categories (DTX, TIN and THN), but ultimately we decided not to include it due to concerns about its reliability (see comments below). Official annual data is available since 1980 (since 1995 in the case of ESA2010). There is however a concern with the quality of annual and quarterly data during the period 1992-1995 (which mostly affect ESA1995 figures). This potential problem affects the fiscal variables (and GDP) from the *quarterly non-financial accounts for general government* (Eurostat). For example we compare the series GCN and GDP from Eurostat with other sources such as the OECD and World Bank and find significant differences for this particular period. To address this, we

correct our annual official figures from 1992-1995 using the growth rates from the annual average figures of the indicators described below.

- TOR. Sources of indicators: State budget, total revenue, excluding the proceeds of loans (Bank of Italy, cash data), from 1980q1 onwards.

- DTX. Sources of indicators: Government Financial Statistics, vintage of ESA95 figures (Eurostat) from 1991q1. We construct an additional indicator from 1980q1 onwards, by subtracting the estimates of TIN from those of TOE. This indicator contains information about DTX, SCT and other revenues.

- SCT. We construct and indicator by combining the estimates of other revenue categories as TOE-DTX-TIN.

- TIN. Sources of indicators: Indirect Taxes Net of Subsidies (BIS) from 1980q1 onwards and Government Financial Statistics, vintage of ESA95 figures (Eurostat) from 1991q1.

- TOE. Sources of indicators: State budget, total expenditure, excluding redemptions of loans (Bank of Italy, cash data), from 1980q1 onwards. We correct one-off events in the level of the variable for the quarters 2000q4 and 2006q4 by imposing them to have the same growth rate as the sum of the TOR components (DTX+TIN+SCT).

- THN. We construct an artificial indicator for THN using the estimates of other categories of spending. We first estimate the rest of the spending variables and then use those estimates to construct the indicator for THN defined as TOE-GCN-SIN-GIN-INP. In a second stage we use the newly created indicator to obtain estimates of THN.

- GCN. Sources of indicators: Government Final Consumption Expenditure ESA95 (Eurostat) from 1980q1 onwards and Government Final Consumption Expenditure, value, GDP expenditure approach (OECD) from 1980q1 onwards.

- COE. Sources of indicators: Public wages (from Giordano et al. (2007)) since 1980q1 onwards and Government Financial Statistics, vintage of ESA95 figures (Eurostat) from 1991q1.

- SIN. We create an auxiliary spending category (TIN-SIN) using the same indicator mentioned above (Indirect Taxes Net of Subsidies). Then we use the joint estimation of (TIN-SIN) and that of TIN to back out the estimate of SIN.

- GIN. Sources of indicators: State budget, investment (Bank of Italy, cash data) since 1981q1 Government Financial Statistics, vintage of ESA95 figures (Eurostat) from 1991q1. There is no indicator for the first year of the sample (1980q1 to 1980q4), so we use a linear trend to interpolate the annual figure of 1980 and extend back the data for these four data points. We correct one-off events in the level of the variable for the quarters 2000q4 and 2011q4 by imposing them to have the same growth rate as the variable gross capital formation (Eurostat). We also correct the value of 2002q4 imposing the average value of the preceding and following quarters.

- INP. Sources of indicators: Sources of indicators: State budget, interest payments (Bank of Italy, cash data) since 1980q1 and Government Financial Statistics, vintage of ESA95 figures (Eurostat) from 1991q1.

Other variables. Nominal and real GDP are obtained from the Bank of Italy since 1995q1. The series are extended backwards using the series from the OECD (series name $CARSA$ for nominal GDP, and $VOBARSA$ for real GDP).[38] Interest Rates (defined as the 10-year bonds) are obtained from Eurostat. Imports and exports are obtained from Eurostat for the period 1991q-2016q4 and extended backwards using the growth rates of these variables obtained from OECD. All variables are available for the 1980q1-2016 period.

Spain

All fiscal variables are obtained from de Castro et al. (2017).

Other variables.Nominal and real GDP are obtained from de Castro et al. (2017), while Interest Rates (defined as the 10-year bonds) are obtained from Eurostat. Imports and exports are obtained from Eurostat for the period 1991q-2016q4 and extended backwards using the growth rates of these variables obtained from OECD. All variables are available for the 1980q1-2016 period.

Euro Area

All fiscal variables are obtained from Paredes et al. (2014), for the EU15.

Other variables. Nominal and real GDP, Interest Rates (defined as the 10-year bonds), imports and exports are obtained from the latest update of the database developed by Fagan et al. (2005). All variables are available for the 1980q1-2016 period.

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[38]Although available from 1990q1, nominal GDP series from Eurostat show a very volatile behaviour during the period 1992-1995. This erratic behaviour is also observed in the annual series. However, it is not found in other sources such us the OECD, World Bank or Bank of Italy.

Appendix B: Additional Tables and Figures

Figure B1: Government spending shock: responses of output, gov. spending & multiplier
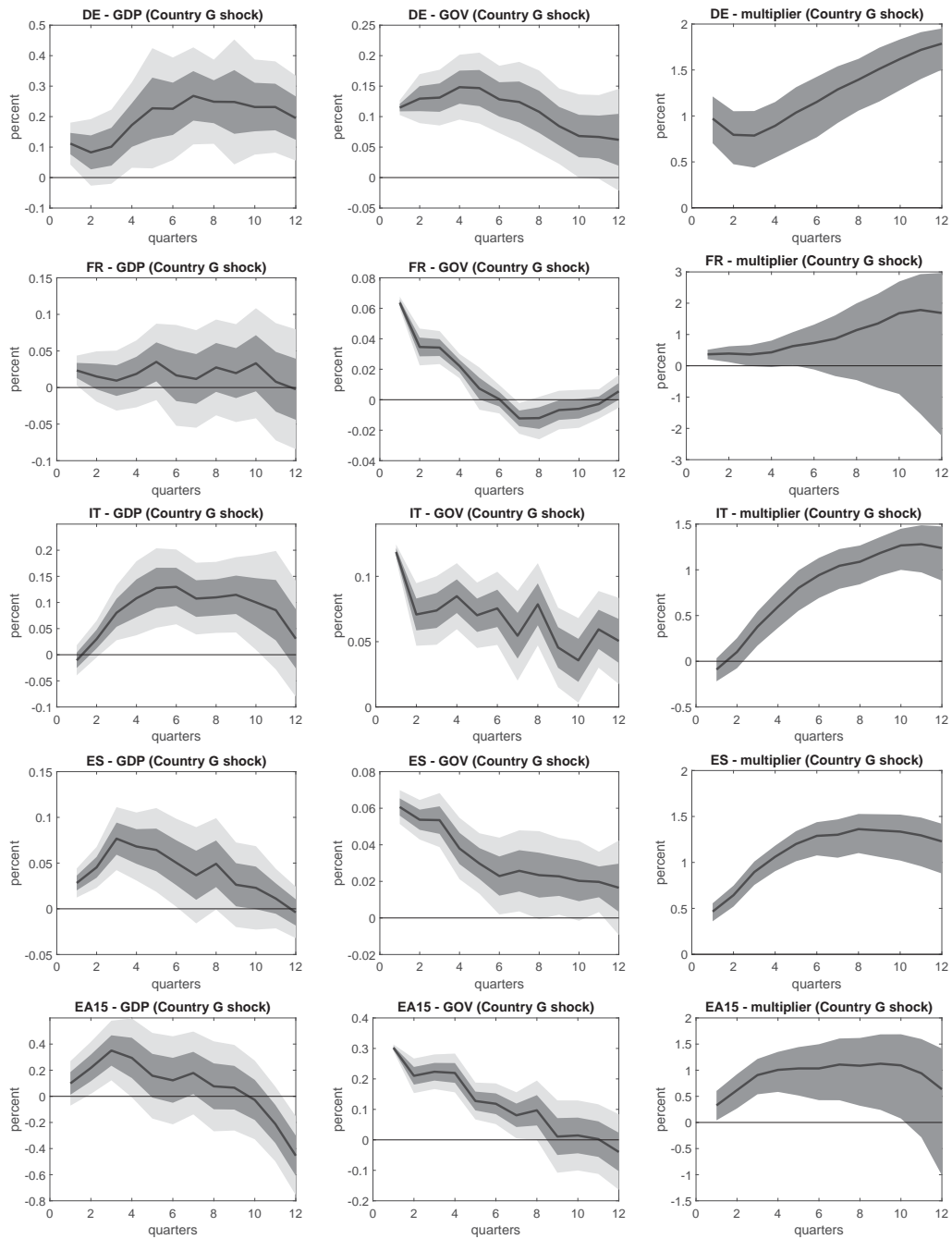
Note: 68 and 95% confidence bands computed using Newey-West Standard errors.

Figure B2: Government spending spillovers, effect on output and government spending by pairs of countries.
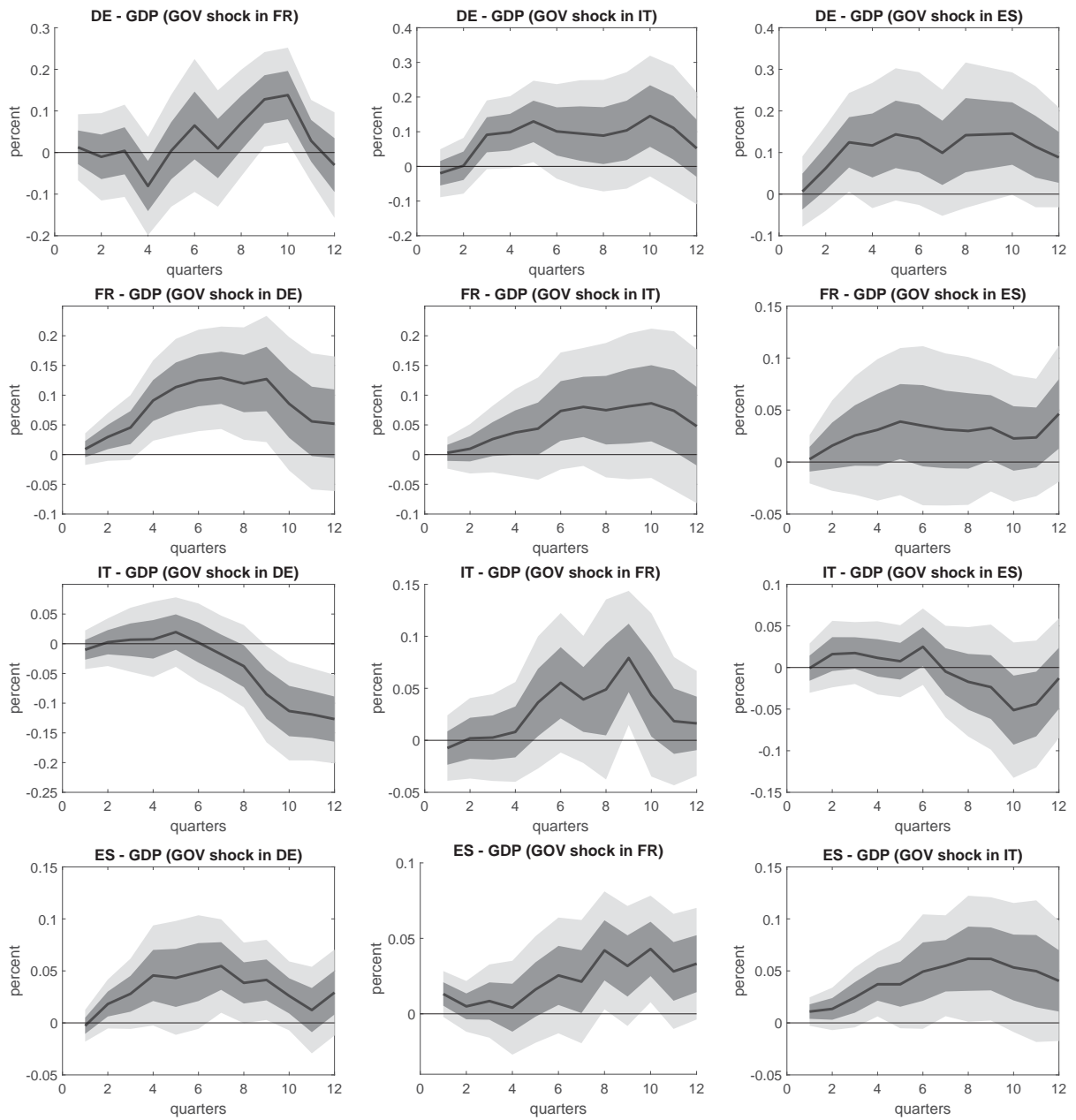
Note: 68 and 95% confidence bands computed using Newey-West standard errors.

Figure B3: Relationship between import content and spillovers
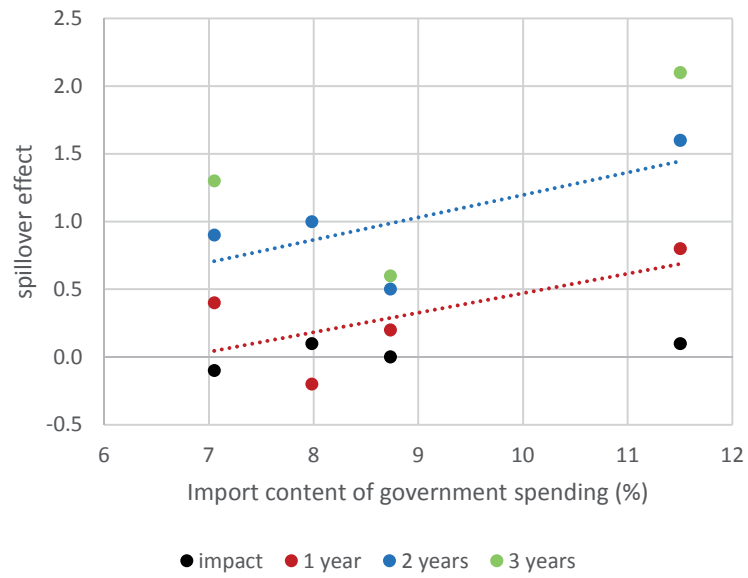
Figure B4: Response of government spending using alternative method, by country of destination
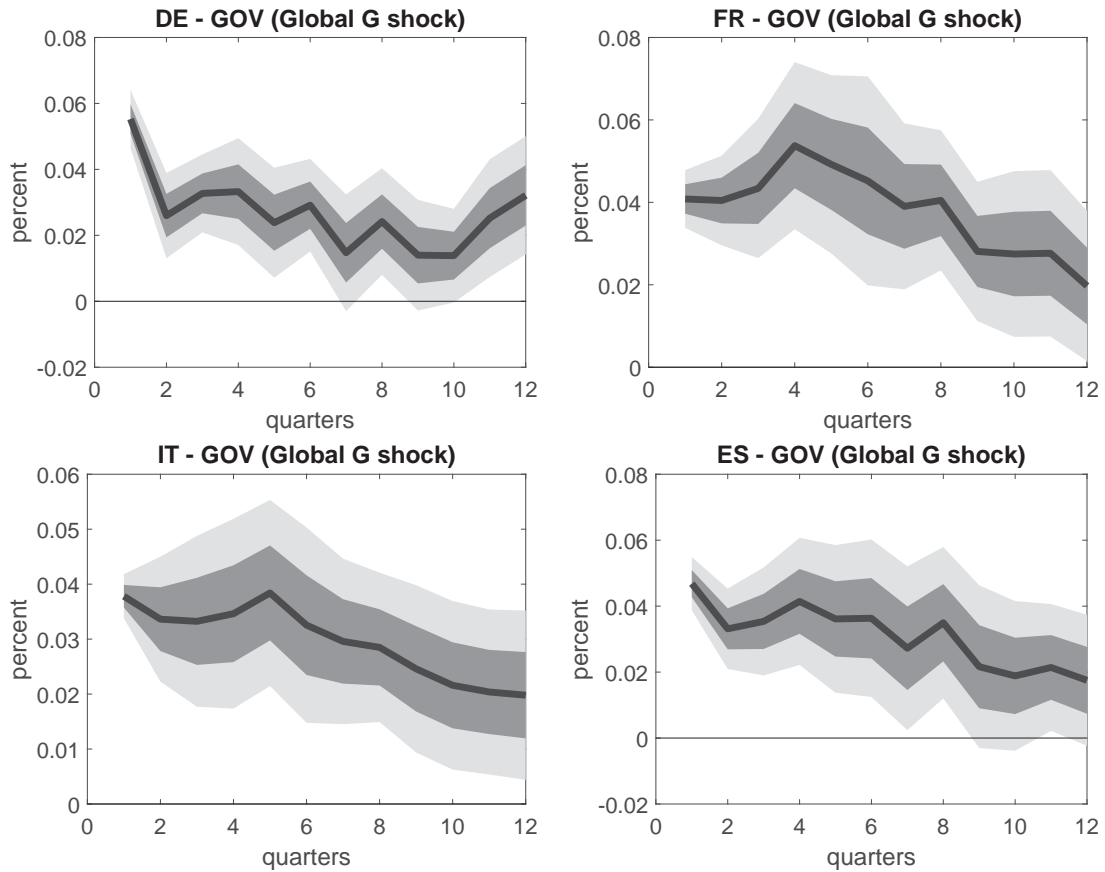
Note: 68 and 95% confidence bands computed using Newey-West standard errors.

Table B1: Government Spending Multipliers: Comparison with the Literature

	Literature* 1985-2010					This paper 1985-2010				
	DE	FR	IT	ES	EA	DE	FR	IT	ES	EA
impact	0.4	1.6	0.1	0.3	0.6	1.0	0.5	0.0	0.5	0.5
1 year	1.2	1.5	0.3	1.2	1.4	0.9	0.9	0.6	1.3	1.5
2 years	1.8	1.2	0.8	1.8	1.7	1.9	1.7	1.3	1.3	2.3

Source: European Commission Public Finance Report (2012), for France see Cleaud et al (2013).

Appendix C: Fiscal Variables in the New Dataset

Figure C1: Germany: fiscal variables
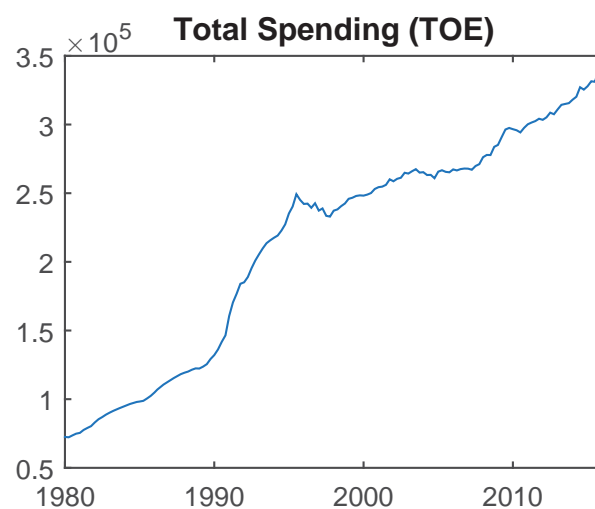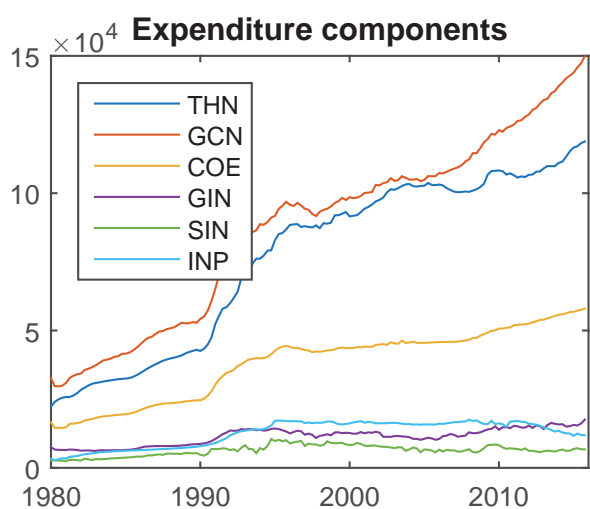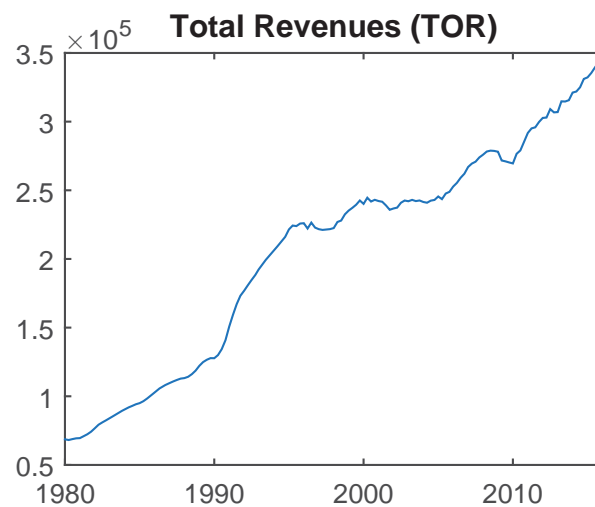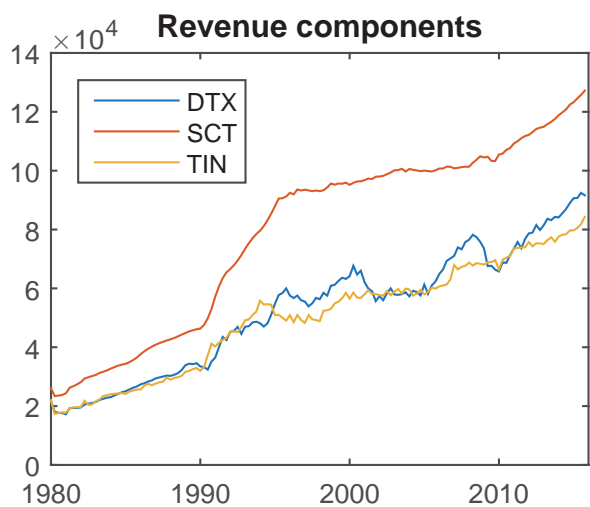
Figure C2: France: fiscal variables

Revenue components

Total Revenues (TOR)

Expenditure components

Total Spending (TOE)
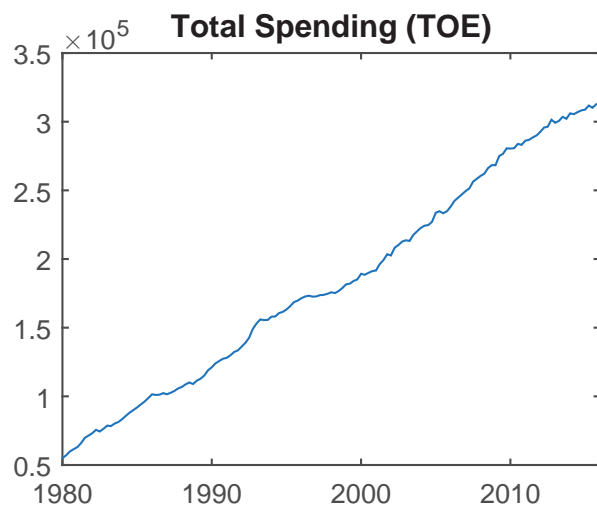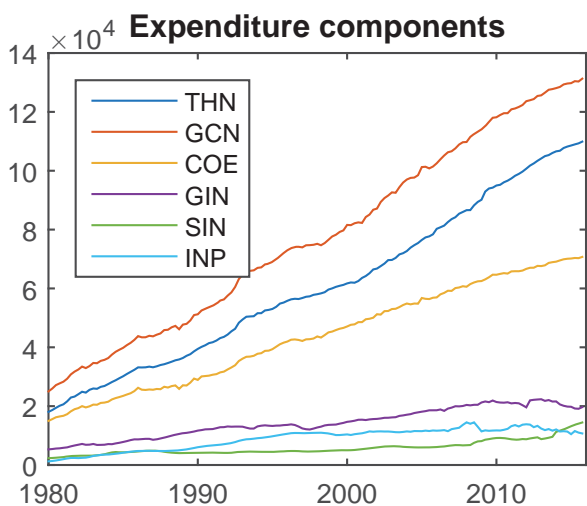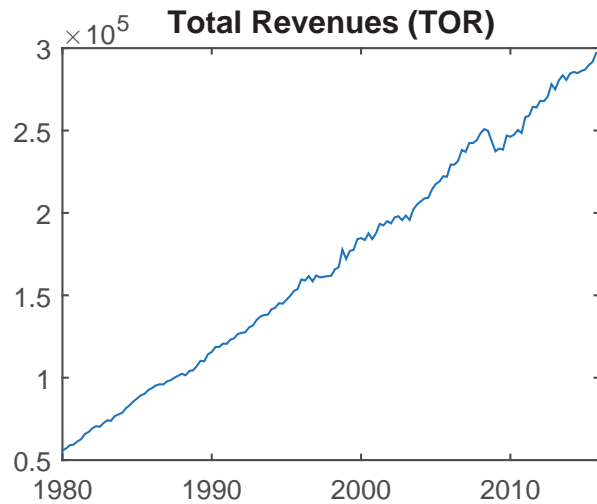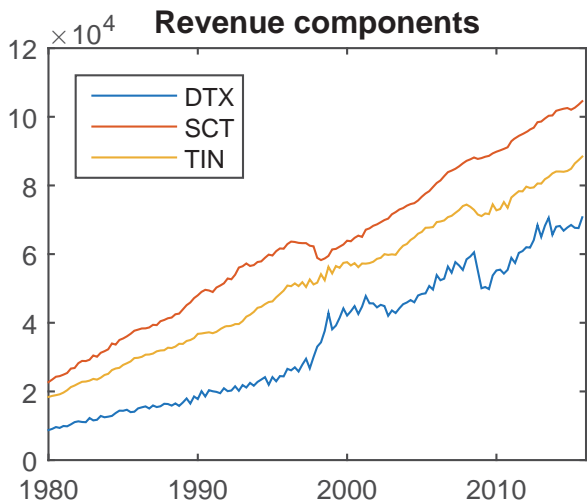
Figure C3: Italy: fiscal variables
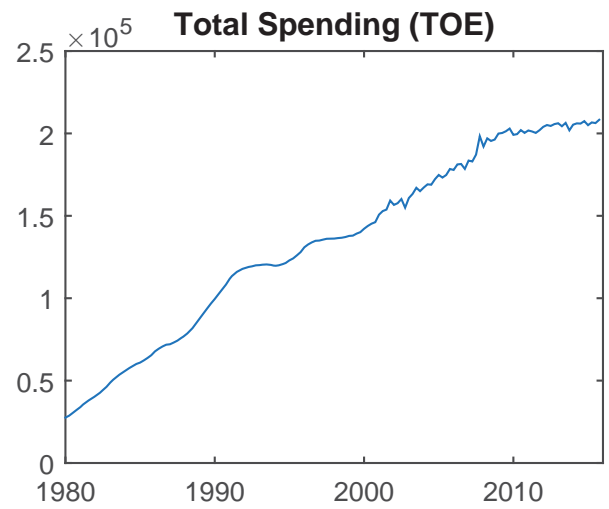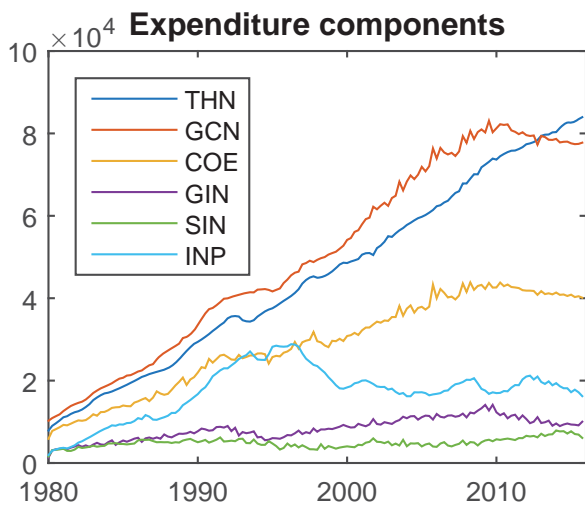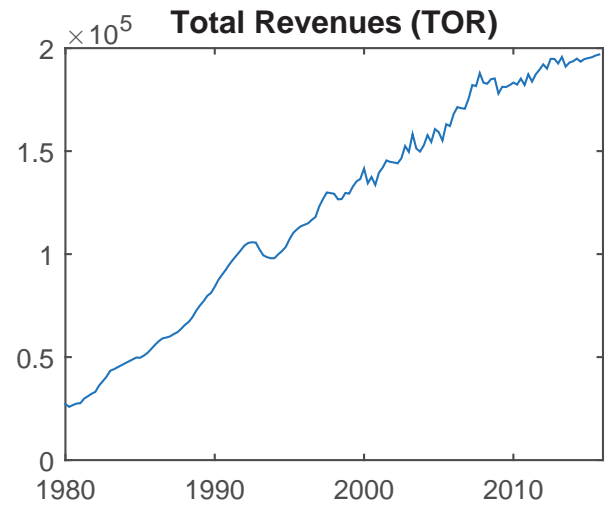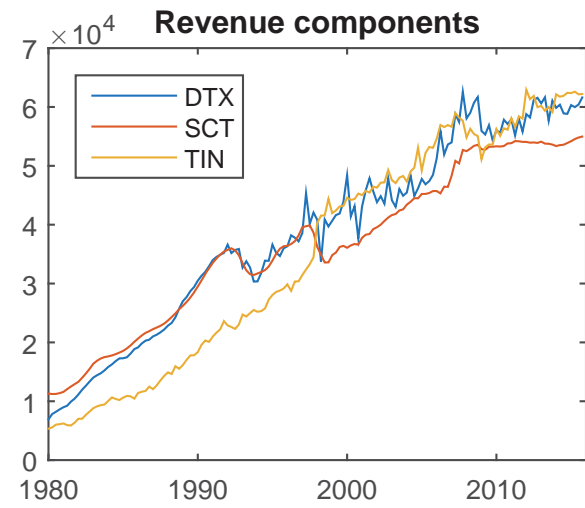
Figure C4: Spain: fiscal variables
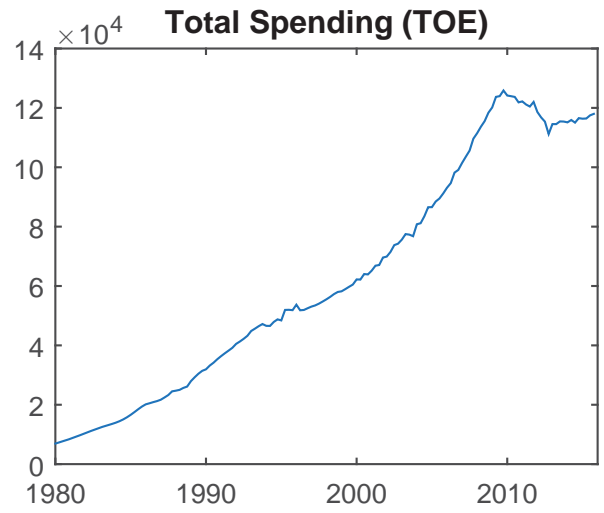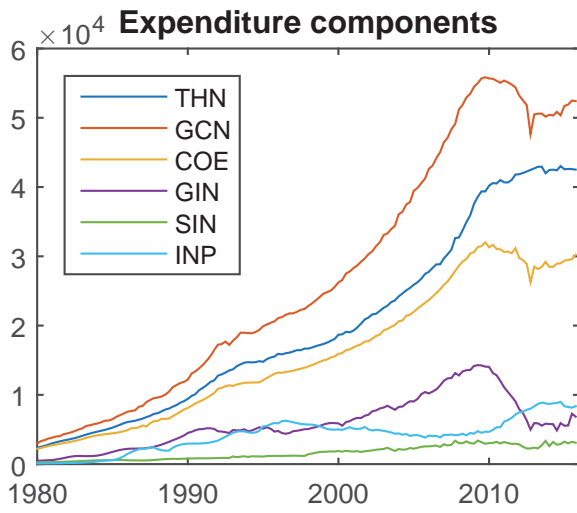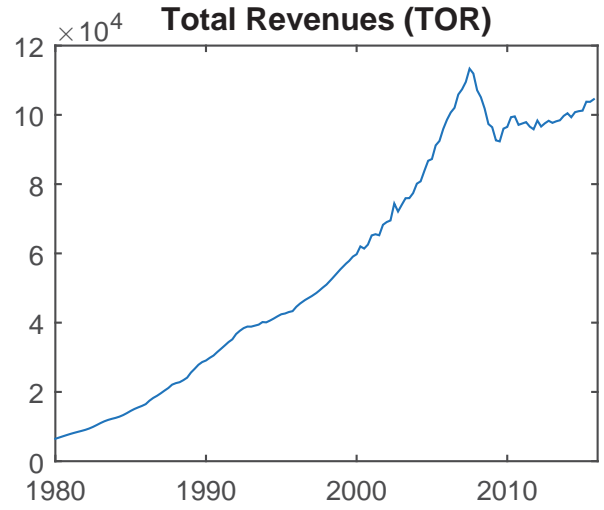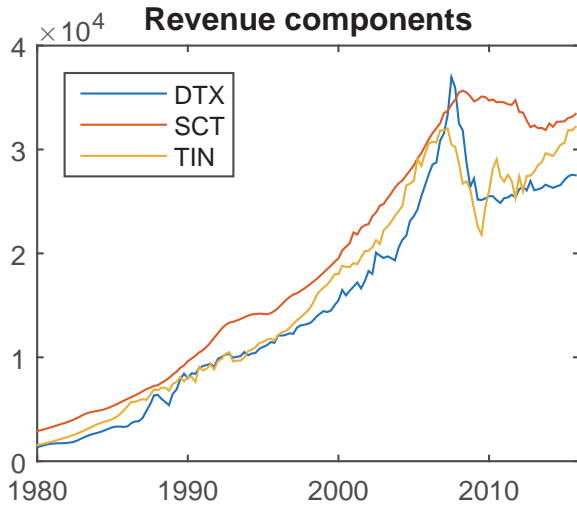
Figure C5: Euro area: fiscal variables
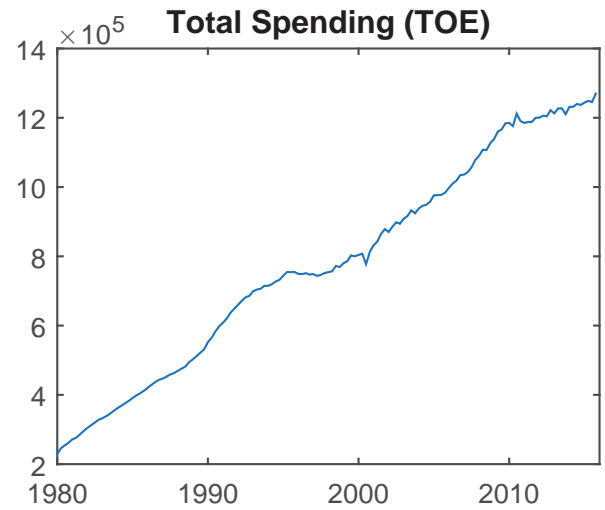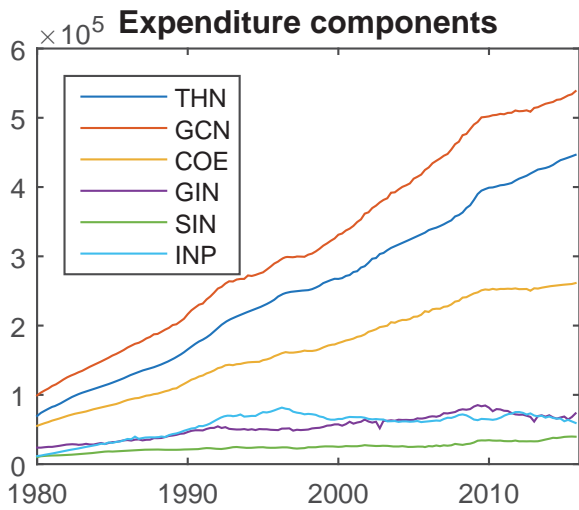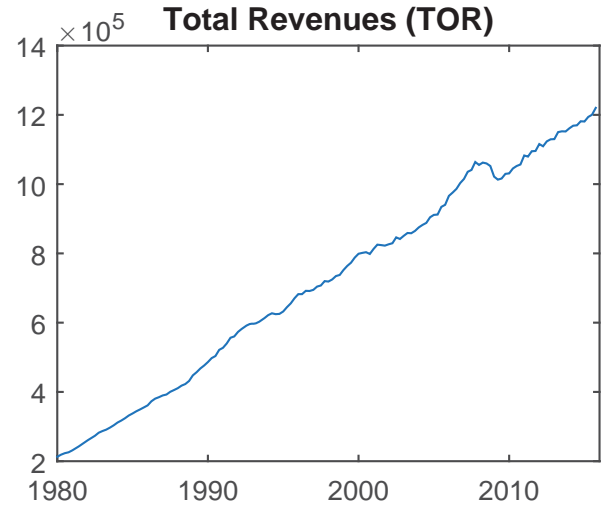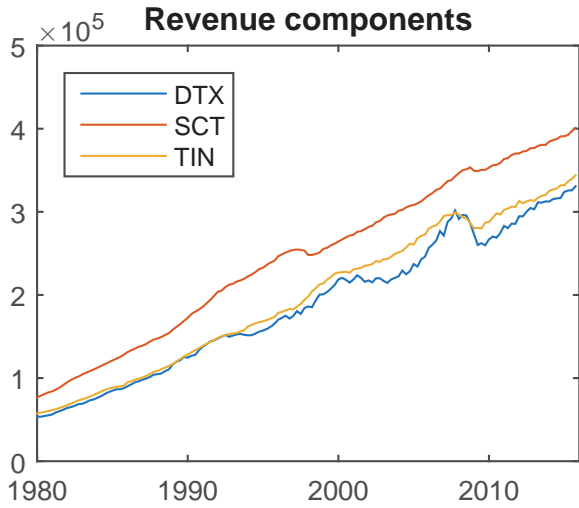
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