Fiscal Policies in the euro area: Revisiting the Size of Spillovers

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Abstract

This paper investigates the empirical effects of fiscal policies within the euro area and estimates the size of fiscal spillovers. We first use an unobserved components methodology to produce a detailed dataset of fiscal variables at quarterly frequency between 1980q1 and 2015q4 for the six major euro area countries. This rich and long dataset allows us to effectively exploit exclusions restrictions within a structural vector autorregression to identify country-specific government and tax revenue shocks. 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). We find that fiscal spillovers have positive effects on the economic activity in the euro area. Additionally, we show that the new dataset has relevant implications for the analysis of fiscal multipliers.

Keywords: fiscal policy, spillovers, vector autorregressions.
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1 Introduction

In a monetary union like the euro area, with a common monetary policy but no area-wide fiscal authority, when monetary policy is constrained the only stabilization tool available is a coordinated fiscal stimulus. 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. We estimate these fiscal spillovers effects, employing a novel country-level fiscal dataset.

Given the scarcity of publicly available detailed historical fiscal data, we assemble a quarterly dataset for the six largest EA countries (Germany, France, Italy, Spain, Netherlands and Belgium) and the region-wise aggregate for the period 1980q1-2015q4. 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, Italy, Netherlands and Belgium.[1]. We use an unobserved components methodology to extend backwards quarterly National Accounts (ESA2010) fiscal data combining annual national accounts and monthly cash time series. This 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).

We employ this data 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 and tax revenue shocks.

Next, 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). We compare our results to the previous literature and conclude that, although results are similar when restricting our sample, using our extended dataset has implications for the impact fiscal policies in the EU.

In a second application of our dataset, we explore the role of fiscal spillovers in the EU. For that purpose, we estimate the destination effect of a fiscal spillover as the increase in output in one country resulting from increases in government spending in the rest of the countries. We also explore the degree of spillovers that each major economy is able to produce. Lastly, to compare our results to some previous work in the literature,

[1] France is the only major EA country with official National Accounts data from 1980q1 (available in Eurostat).

we aggregate the identified country-specific shocks into a trade-weighted fiscal shocks for the rest of the area, and estimate its impact on the output of its members. In our estimations, we use Local Projections (Jordá (2005)) to compute the responses to the shocks and allow for potential nonlinearities driven by the state of the business cycles or the level of debt.The results suggest that fiscal spillovers have positive effects on the economic activity in the euro area, which has important implication for the design of coordinated fiscal policies.

Related Literature Our paper relates to different literatures on fiscal policy. First, our study relates to an incipient literature that aims to analyse the effects of fiscal spillovers. Beetsma et al. (2006) employs 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 is the deficit-to-GDP ratio and find that area-wide shocks of similar size to domestic shocks tend to be larger than the latter, suggesting that coordinate fiscal actions are particularly important in the euro area. Auerbach and Gorodnichenko (2013) use bi-annual OECD data and identifies government spending shocks using forecast errors in the Survey of Professional Forecasters. They authors also allow for nonlinearities driven by business cycles as in Auerbach and Gorodnichenko (2012). Their results suggest that the average multiplier for three years in OECD economies is close to 2, and as large as 6.7 during recessions. Following a similar methodology, Goujard (2016) 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 reductions in the fiscal balance of the size of 1 percentage point of GDP in the export markets can contract the GDP of average domestic economy by 1.5 percentage points on impact.

Our paper also relates to a classic literature that has estimated the effect of fiscal shocks on domestic economies. Our identification of fiscal shocks follow 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.

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

This paper is structured as follows. Section 2 describes the new dataset and the methodology used for its production. Section 3 explains the approach to identify exogenous fiscal shocks. The effects of domestic government spending and net-tax revenues shocks are described in Section 4. Section 5 analyses how fiscal shocks may also have an effect on neighbour countries in the EU. Lastly, Section 6 concludes an offers future avenues of research.

2 Data

Most of the empirical exercises of fiscal policies in the US rely on the existence of long and quarterly datasets.[2] While NIPA aggregates in the US are available officially since 1948q1. However many fiscal variables necessary for these empirical exercises are only available in the mid and late 90's for several EU countries at a quarterly frequency.

To address this issue we assemble a new dataset for Germany, France, Italy, Spain, Netherlands, Belgium and the EU aggregate from 1980q1 to 2015q4 at a quarterly frequency. This dataset is consistent with Eurostat's in their newest accounting framework (ESA2010). For the cases of Germany, Italy, Netherlands an Belgium we combine official information from the quarterly non-financial accounts for general government statistics (ESA2010 and ESA95) and extend it backwards using intra-annual information and annual official statistics in combination with the methodology described below. Data from Spain and EU 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 from France is directly obtained from Eurostat.

The resulting dataset contains disaggregated measures of fiscal revenues and spending for each of the six countries (and the aggregate), shown in Table 7. 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 in compensation of employees and other government consumption), government investment, social payments, subsidies and interest payments.[3] The deficit can be computed as the difference

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

[3]The categories of other revenues and other expenditure are computed as the difference between

between total revenues and total expenditure.

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

$$\begin{pmatrix} z_t \\ \boldsymbol{u}_t \end{pmatrix} = \boldsymbol{T}_t + \boldsymbol{S}_t + \boldsymbol{e}_t \tag{1}$$

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 1 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 1 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.[4] 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 summation of 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 1 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.[5]

Quarterly and annual figures for z_t (for each chapter listed in Table 7) 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 institu-

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.

[4]Equation 1 and its associated transition equations are estimated using the Kalman filter.

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

tions (see Appendix).[6] 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 in the Appendix).

Figures D1-D7 show the behaviour of the variables listed in Table 7 for the six major economies in the EU and the region-wise aggregate.

For our analysis in the rest of the paper we follow Blanchard and Perotti (2002) and 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 included in the analysis are real output, the output deflator and the 10-year interest rate. Further details and sources of these data are described in Appendix A.[7]

3 Identification of Fiscal Shocks

In this section we describe how we identify the fiscal shocks that we will later use to analyse the empirical effects of fiscal policies in the euro area.

For each country, we separately estimate the following VAR:

$$\boldsymbol{x}_t = \boldsymbol{B}_L(L)\boldsymbol{x}_{t-1} + \boldsymbol{e}_t \tag{2}$$

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 2 also includes a constant and a quadratic trend, omitted here for simplicity.[8] We assume that the vector of residuals $\boldsymbol{e}_t$ contains a linear combination of structural shocks:

$$\boldsymbol{A}_0\boldsymbol{e}_t = \boldsymbol{C}\boldsymbol{\varepsilon}_t \tag{3}$$

where A_0 and bmC are contemporaneous-response matrix that map reduced-form residuals into structural shocks $\boldsymbol{\varepsilon}_t$. Following the description in Perotti et al. (2005), the

[6] 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.

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

[8] When estimating 2 for Germany and France, we include dummy variables since the reunification (1991q1-2015q4) and during the period 1992q1-1995q4, respectively.

reduced-form shocks of the 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 the rest of the system (e.g. automatic stabilizers), ii) systematic discretionary responses of policy makers to unexpected changes in oputput, 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 want 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.

To see the assumptions that are required to recover the structural shocks, consider the first two equations forming the systme in 3::

$$\begin{aligned} e_t^T &= \alpha_{t,y} e_t^Y + \alpha_{t,p} e_t^P + \alpha_{t,r} e_t^R + \beta_{t,g} \varepsilon_t^G + \varepsilon_t^T \\ e_t^G &= \alpha_{g,y} e_t^Y + \alpha_{g,p} e_t^P + \alpha_{g,r} e_t^R + \beta_{g,t} \varepsilon_t^T + \varepsilon_t^G \end{aligned} \tag{4}$$

Following Blanchard and Perotti (2002), the main identifying assumption 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 the equations described in 4 only reflect the automatic response of taxes and government spending to the rest of the variables. In Appendix B we describe how we use external information (regarding the elasticities of taxes and government spending to out) to compute the contemporaneous elasticities α.[9]

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

$$\begin{aligned} e_t^{T,CA} &= e_t^T - \left(\alpha_{t,y} e_t^Y + \alpha_{t,p} e_t^P + \alpha_{t,r} e_t^R\right) = \beta_{t,g} \varepsilon_t^G + \varepsilon_t^T \\ e_t^{G,CA} &= e_t^G \left(\alpha_{g,y} e_t^Y + \alpha_{g,p} e_t^P + \alpha_{g,r} e_t^R\right) = \beta_{g,t} \varepsilon_t^T + \varepsilon_t^G \end{aligned} \tag{5}$$

[9]For example, for the case of the elasticity of tax revenues to output, we compute the elasticity of taxes of type i to their tax base η_{T_i,B_i} , and the elasticity of the tax base to output $\eta_{B_i,X}$, for each category of taxes T_i:

$$\alpha_t, y = \sum_i \eta_{T_i,B_i} \eta_{B_i,Y} \frac{T_i}{T}$$

Hence, we obtain the elasticity of tax revenues to output α_t, y as the weighted average of the elasticities of each tax component. The values of all the constructed α elsaticities are shown in Table B1.

Finally we need to impose the restriction that either $\beta_{g,t} = 0$ or $\beta_{t,g} = 0$ in order to recover the structural fiscal shocks. Following Blanchard and Perotti (2002), we assume $\beta_{g,t} = 0$ as the benchmark and test the robustness of our results to other orthogonalization.

With these restrictions we are able to identify and estimate the structural shocks to tax revenues, ε_t^T, and government spending, ε_t^G for each country considered (Germany, France, Italy, Spain, Netherlands, Belgium 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 2, 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 3. However, if we want to compute the impulses responses using the moving average representation of 2 (as in we do in Table C1), 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 3 as described by Blanchard and Perotti (2002) and Perotti et al. (2005).

4 The Dynamic Effects of Fiscal Policies

In order to estimate the impact of government spending and tax shocks on the domestic activity we compute impulse response functions following the local projections method of Jordá (2005). This approach presents some advantages with respect to to impulse response functions constructed using the moving average representation of Equation 2. First, this simple method is more resilient to model misspecification and second, it is particularly suitable to the analysis of potential non-linearities, since it does not assume that a given regime is held fixed during the horizon of the response analysis.[10]

Following Owyang et al. (2013) and Ramey and Zubairy (2017), we estimate a series of single equations over the horizon h using:

$$\frac{z_{i,t+h} - z_{i,t-1}}{y_{i,t-1}} = \alpha_{i,h} + \beta_{i,h} \frac{shock_{i,t}}{y_{i,t-1}} + \boldsymbol{\delta}_{i,h}(L)\boldsymbol{x}_{i,t-1} + \xi_{i,t+h} \tag{6}$$

where $z_{i,t}$ represents either output, government spending or tax revenues in country i, $shock_{i,t}$ is the structural government spending ε_t^G or tax revenues shock ε_t^T uncovered

[10] 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. However the robustness of this method makes it a particularly useful tool for estimating response functionsRamey (2016)).

in Equation 5 for country i and $\boldsymbol{x}_t = [tr_t, g_t, y_t, p_t, r_t]'$.[11] [12] The cumulative sequence of $\beta_{i,h}$ for different time horizons h represents the response of the variable of interest $z_{i,t}$ to the shock. We compute the government spending (tax revenues) multipliers as the ratio of the sum of coefficients $\beta_{i,h}$ in the output equation by the same coefficients in the government spending (tax revenues) equation.[13] Note that the iterative nature of 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.

4.1 Government Spending Shocks

This subsection describes the dynamic effects of government spending shocks. Figure 1 shows the response of output and government spending to an exogenous increase in government spending (as described in Equation 6), as well as the cumulative multiplier (as defined above). Panel A of Table 2 reports the cumulative multipliers for changes in total government spending at different horizons. 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 levels of 95% for the rest of the period considered, with a peak effect

[11] The inclusion of controls $\boldsymbol{x}_t$ is not strictly necessary since the shock is exogenous to these variables by construction, but due to minor changes in the specification of Equation 6 (namely the rescaling) we decide to include them. Their effect on the results in both quantitatively and qualitatively negligible.

[12] Equation 6 also includes a linear and quadratic trends.

[13] 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 Equation 6 effectively does this re-scalling for every period t (see Owyang et al. (2013) for further details).

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 peaked is reached during the second year, with a somewhat higher multiplier of 1.1.[14]

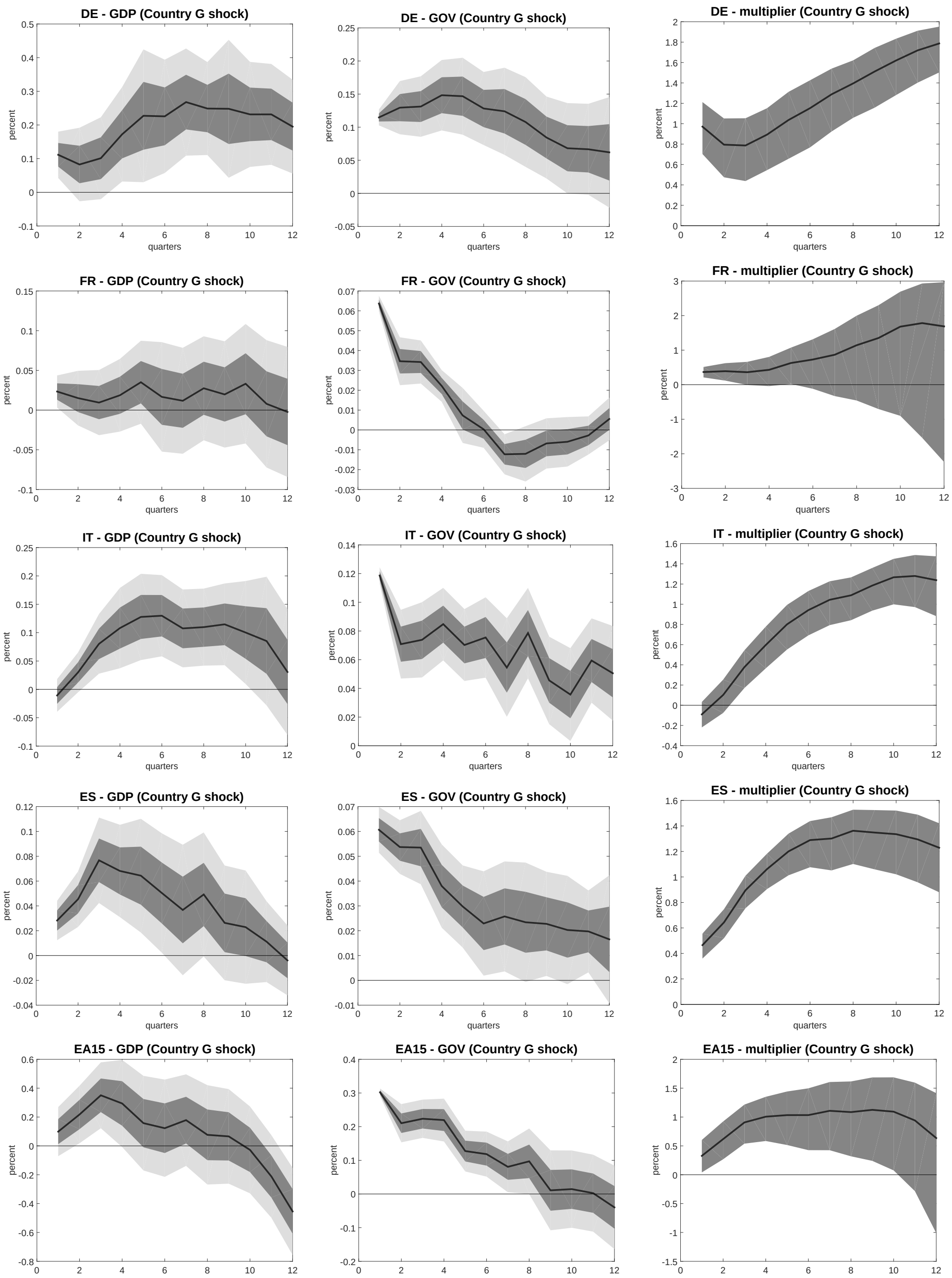
To sum up, we find government spending multipliers close or above 1 for the countries considered by the second year (although imprecisely measured in the case of France).

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 3. 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 to be roughly similar with those reported for total government spending in Panel A, although with some differential aspects. Germany, Italy, and the Euro Area have public consumption multipliers that display a very similar dynamic pattern to those of total government spending (although their magnitude is slightly higher, these differences are not statistically significant). In the case of Spain, the effect of increases in public consumption during the first year is similar in magnitude to a shock in total government spending (the main difference is that at longer horizons, the effect of higher government consumption becomes close to 0 or, after three years, even negative). Some differences are observed in the case of France where, although the magnitude of the effect is very similar after three years), the short and medium term dynamics are quite different, probably a result of the higher imprecision of the estimates.

When exploring the output effects of exogenous shocks in public investment (Panel C of Table 2) we obtain a more homogeneous picture: this 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

[14]We also investigate the effect of government spending shocks in Netherlands and Belgium. we obtain, however, puzzling results with negative multipliers which are very imprecisely measured. Up to the best of our best knowledge, we have found studies of the effect of fiscal policies in these countries, so we have been unable to further explore this issue. Therefore, we decide to drop these countries from our sample.

Figure 1: Government spending shock: responses of output, gov. spending & multiplier



Note: 68 and 95% confidence bands computed using Newey-West Standard errors.

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 C, 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. 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)) . The left panel of Table C1 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 impulses response of a VAR as in Equation 2[15] and through local projections, as described in Equation 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 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 (1980q1-2015q4), as in Panel A of Table 2, are slightly smaller in size to a restricted sample of 1985q1-2010q4 from (European Commission (2012).

4.1.1 Non-linear effects of Government Spending Shocks

The impact of fiscal policy may change across different states s_t of the economy, such as recessions or periods of high debt. We modify 6 as in Owyang et al. (2013) and Ramey and Zubairy (2017) to accommodate for these potential non linearities:

$$\begin{aligned}\frac{z_{i,t+h} - z_{i,t-1}}{y_{i,t-1}} =& \mathbb{1}\{s_t = B\} \left(\alpha^B_{i,h} + \beta^B_{i,h} \frac{shock_{i,t}}{y_{i,t-1}} + \boldsymbol{\delta}^B_{i,h}(L)\boldsymbol{x}_{i,t-1} \right) + \\ & \mathbb{1}\{s_t = R\} \left(\alpha^R_{i,h} + \beta^R_{i,h} \frac{shock_{i,t}}{y_{i,t-1}} + \boldsymbol{\delta}^R_{i,h}(L)\boldsymbol{x}_{i,t-1} \right) + \xi_{i,t+h}\end{aligned} \tag{7}$$

[15]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.

where $\mathbb{1}\{s_t = S\}$ ins an indicator function that takes value 1 when the state s_t takes the value $S \in \{B, R\}$. Equation 7 allows for the contemporaneous and dynamic impact of the shock to be different during two regimes.[16]

We first consider two different regimes according two business cycle fluctuations: booms and recessions, respectively. We defined recessions as periods with 2 consecutive quarters of negative output growth rates.

The upper panel of Figure 2 shows the response of output and government spending to a government spending shock that occurs during periods of economic expansion while the bottom panel of Figure 2 shows the same effects when the shock takes place during recessions. The multipliers associated to this estimations are shown in Panels D and E of Table 2. A comparison of Figure 1 and the upper pane Figure 2 suggest that the overall effect of government spending is qualitatively very similar to that observed during periods of booms, which is corroborated by the multipliers shown in Panel D of Table 2.[17] The results during times of recessions are however both qualitatively and quantitatively different to the main linear results described above. In this case the responses of output to an increase in government spending occurring during a recession are very close to zero (bottom panel of Figure 2). This translates to cumulative multipliers that are not significantly different from zero for most time horizons and countries.

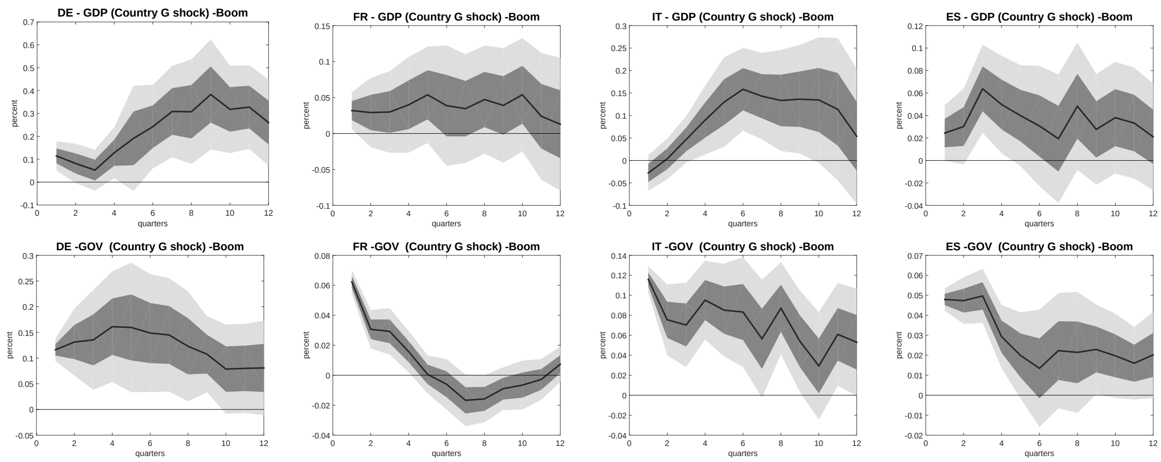
We also consider nonlinearities in the effect of government spending produced by high levels of fiscal stress. In this case, we consider two possible regimes s_t in Equation 7: low and high levels of fiscal stress. A regime of high fiscal stress is defined as periods when we have observed three consecutive quarters of increasing debt-to-GDP ratio. The upper panel in Figure 3 shows the response of output and government spending to a government spending shock that occurs during periods of low fiscal stress while the bottom panel in Figure 3 shows the same effects when the shock takes place during periods of high fiscal stress. Multipliers for both regimes are shown in Panels F and G of Table 2, respectively. While the responses to shocks occurring during periods of low fiscal stress are very similar to those occurring during booms, the response of shocks that happen during periods of high stress are very heterogeneous. Results on France and Italy during high stress suggest that consolidations that reduce government spending

[16]During the analysis of nonlinearities we save on degrees of freedom by considering one lag (as opposed to 4) in Equation 6. Note that due to the nature of the local projections (as opposed to a VAR) this does not assume that the computed impulse response function have less persistence.

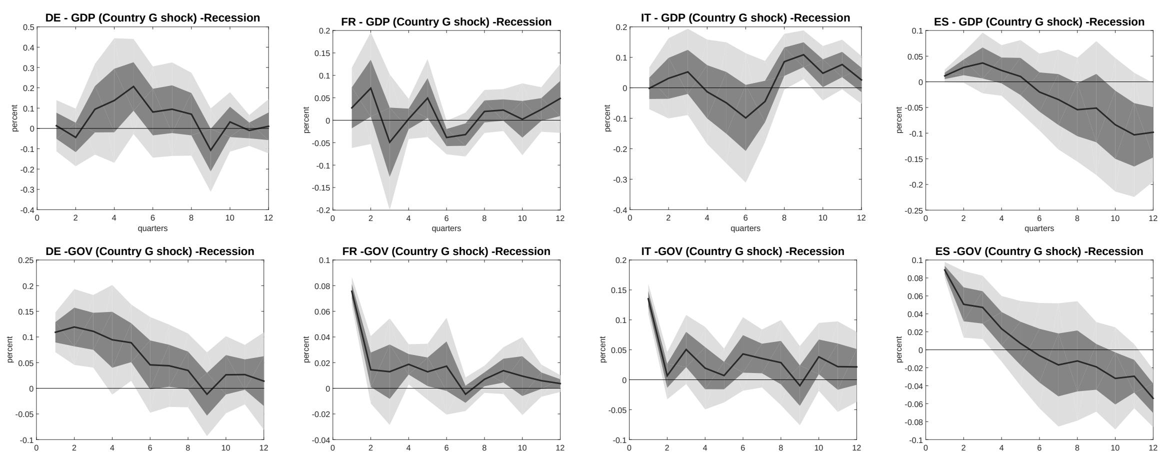
[17]In France, the multiplier during times of booms has much larger magnitude during the second and third year. This is not due to a quantitatively different response of output, but to a a quickly declining response of government spending that becomes slightly negative and reduces the denominator of the function that defines the cumulative multiplier.

Figure 2: Government spending shock and the business cycle

Panel A: Government spending shock, during periods of booms



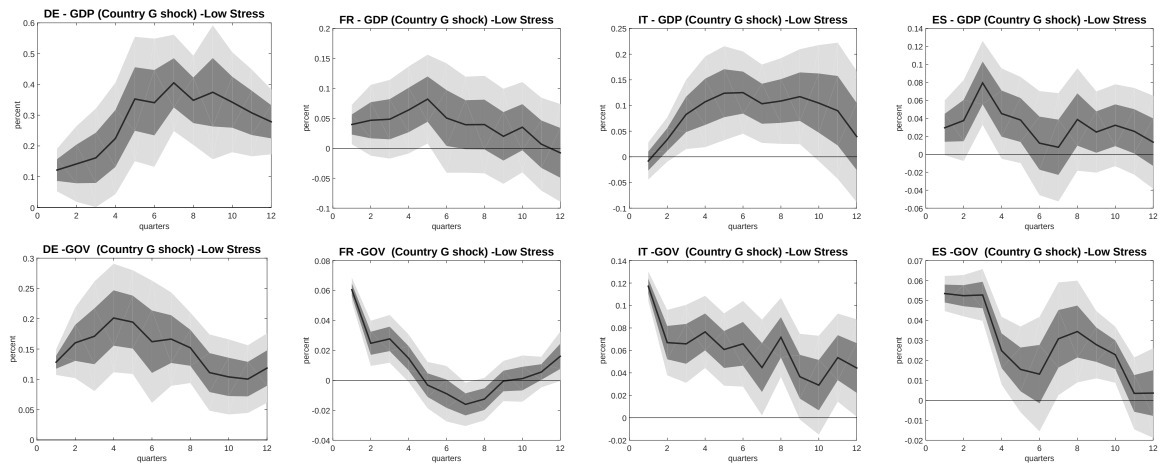
Panel B: Government spending shock, during periods of recessions



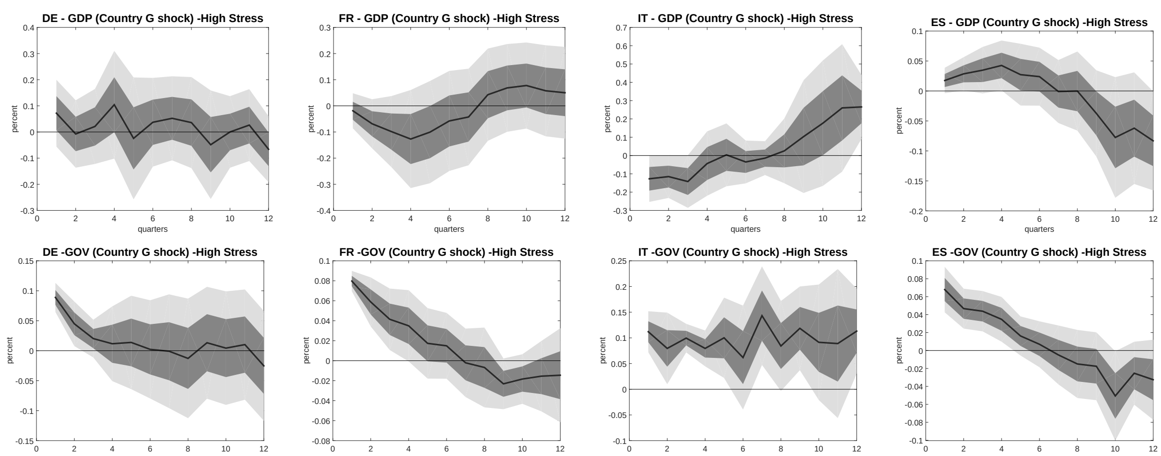
Note: 68 and 95% confidence bands computed using Newey-West standard errors.

Figure 3: Government spending shock, during periods of public finance stress

Panel A: Government spending shock, during periods of low public finance stress



Panel B: Government spending shock, during periods of high public finance stress



Note: 68 and 95% confidence bands computed using Newey-West standard errors.

may have potentially positive effects on output when occur during periods with a high debt-to-GDP ratio. However, these results must be interpreted with caution due to an increased uncertainty in the estimations.

4.2 Net Tax Revenues Shocks

In this section we explore the dynamic effects of tax changes. We estimate a version of Equation 6, where the variable $shock_t$ is the exogenous shock to net tax revenues as identified in Section 3. To construct the cumulative multiplier we estimate Equation 6 for both output and net tax revenues and compute the multiplier at period h as the ratio of the areas below the responses of output and net tax revenues at horizon h.

Figure 4 shows the response of output and net tax revenues to an exogenous increase in net tax revenues. The tax multipliers are reported in Panel A in Table 3. We find that on impact and at least until the first year, all countries experience a fall in output as a result of an increase in tax revenues. The impact multiplier ranges from -0.03 to -0.45. The responses are associated however to high uncertainty. For example, for the case of Germany, the impact response is only significant at confidence levels of just below 68%. The responses of Italy, Spain are significantly negative on impact, and in the case of Italy until the first year. An area-wide tax shocks is associated with significant and negative multiplier of about -0.6 in the first year.

4.2.1 Non-linear effects of Net Tax Revenues Shocks

[TO BE ADDED]

5 Fiscal Spillovers in the Euro Area

In this section we analyse how exogenous fiscal shocks originating in a country can have an effect on the economic activity of another euro area country.

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):

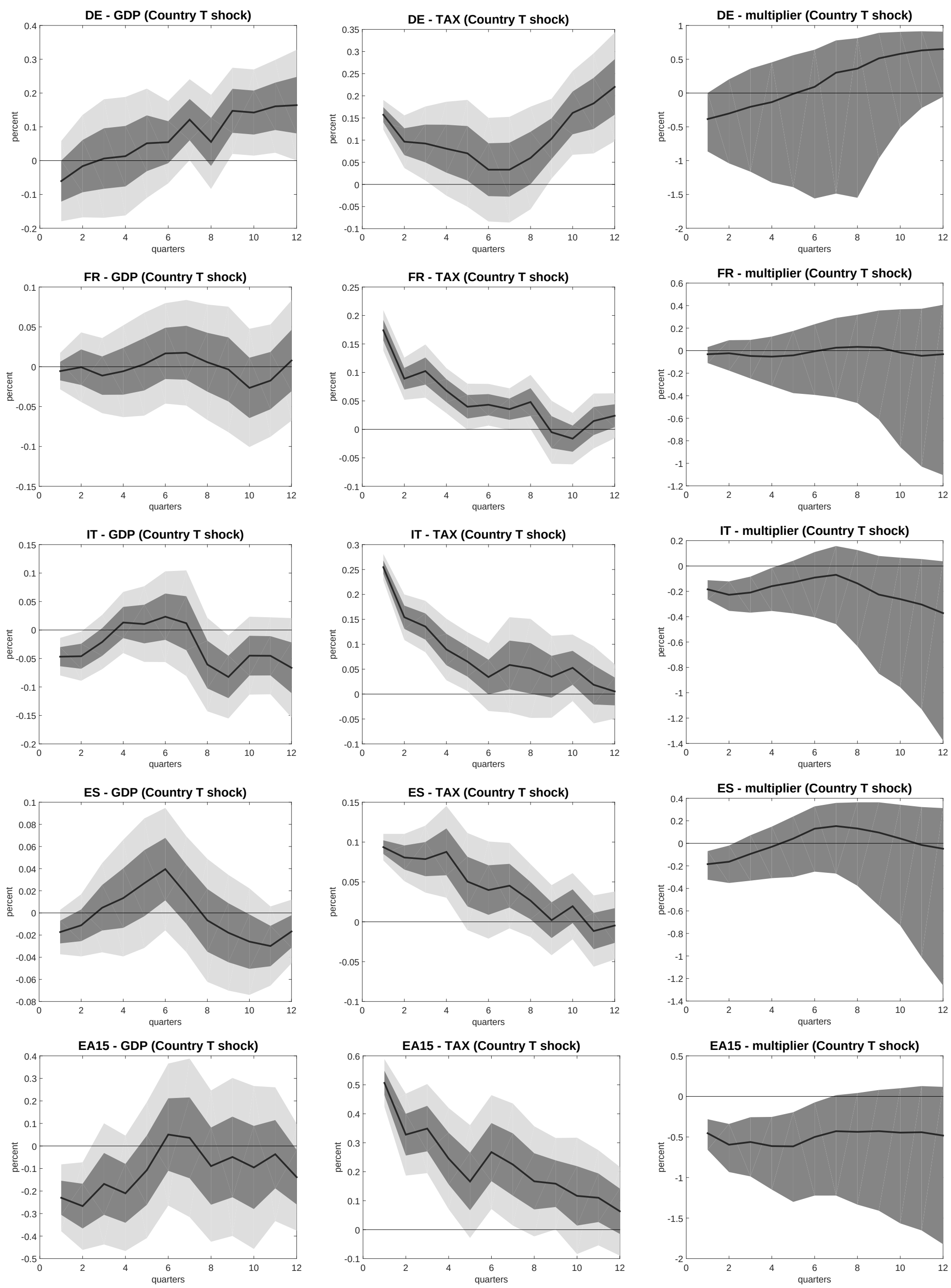
$$\frac{y_{i,t+h} - y_{i,t-1}}{y_{i,t-1}} = \alpha_{i,h} + \beta_{i,j,h} \frac{shock_{j,t}}{y_{i,t-1}} + \boldsymbol{\delta}_{i,h}(L)\boldsymbol{x}_{i,t-1} + \xi_{i,t+h} \quad (8)$$

$$\frac{g_{j,t+h} - g_{j,t-1}}{y_{i,t-1}} = \lambda_{i,h} + \gamma_{i,j,h} \frac{shock_{j,t}}{y_{i,t-1}} + \boldsymbol{\rho}_{i,h}(L)\boldsymbol{x}_{j,t-1} + u_{i,t+h} \quad (9)$$

where y and g represent output and government spending in real terms, and $x_{n,t-1}$ are controls specific for country n.[18] 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 is computed as the ratio of the sum of coefficients

[18] 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 (in specifications that include these variables), controls are included in logs.

Figure 4: Net tax revenue shock: output, net tax revenues & multiplier



Note: 68 and 95% confidence bands computed using Newey-West standard errors.

$\beta_{i,j,h}$ in the output equation by the sum of $\gamma_{i,j,h}$ coefficients in the government spending equation.

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 8 and 9. 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 $j \neq i$:

$$spillover_{i,h}^{D} = \frac{\sum_{j \neq i} \sum_{r=0}^{h} \beta_{i,j,r}}{\sum_{j \neq i} \sum_{r=0}^{h} \gamma_{i,j,r}} = \sum_{j \neq i} M_{i,j,h} \frac{\gamma_{i,j,r}}{\sum_{j \neq i} \gamma_{i,j,r}} \tag{10}$$

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. Intuitively, Equation 10 weights the cross-country multipliers $M_{i,j}$ 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 10 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 8 to 10 required 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 the 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 8 and 9:

$$spillover_{j,h}^{O} = \sum_{i \neq j} \frac{\sum_{r=0}^{h} \beta_{i,j,r}}{\sum_{r=0}^{h} \gamma_{j,r}} w_j = \sum_{i \neq j} M_{i,j,h} w_j \tag{11}$$

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.

5.1 Results

Panel A in Table 4 shows the output effects (in cumulative multipliers) 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 10). The results suggest that there exists positive spillovers in Germany, France and Spain, although with differences in the dynamics of this effect and its magnitude. 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, what suggests a special sensitivity of this country to foreign fiscal actions.[19] 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 Panel B in Table 4 we explore the average effect of a fiscal action in one country over the economic activity of the rest of the countries (the spillover by origin $spillover^O$ defined in Equation 11).The results suggest that all countries generate large and positive spillover 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.[20] Italy and Spain also show significant spillover effects and larger in magnitude: the multiplier during the second year 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 years, respectively. All in all, we take the results summarised in Panels A and B in Table 4 as evidence of positive fiscal spillovers among the major euro area economies.

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

[20] Goujard (2016) reports similar numbers for Germany, with a multiplier of fiscal consolidations in Germany of 0.23 in the first year.

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 a, an increase in government spending in one country may stimulate the domestic demand and hence, trigger the exports of trading partners.[21] We evaluate how much this channel could help in explaining the above results. To this extent we carry out two experiments. First, we compute the destination $spillover^D$ defined in Equation 10, where the dependent variable in Equation 8 has been substituted by exports. This statistic allows to analyse whether a country sees an increase in its exports after a simultaneous expansionary fiscal policy by its neighbors. Second, we estimate the origin $spillover^O$ defined in Equation 11 in country j, but in this case, the dependent variable in Equation 8 represents the sum of exports in the rest of countries $i \neq j$. This method allows us to explore the capacity of a country implements a fiscal expansion, to stimulate the trade amongst its partners. The results of both methods are described in Panels C and D of Table 4, respectively.

Panel C shows the export multipliers in one country when the rest has embarked in simultaneous expansionary policies. The results support the trade channel described above, and countries which experience 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 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 D 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: countries which generate spillover 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

[21] 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 a another euro area country.

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 Panels C and D suggest that the trade channel is important in explaining the fiscal spillovers in the euro area.

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 3, and substitute this new shock in Equations 8 and 9 (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 E in Table 4 shows that these effects are large and positive for all countries except Italy (consistent with the results in Panel A). 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 F shows estimates of $spillover^{O}$ in Equation 11 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 4.

Finally, we explore the fiscal spillovers effects derived from exogenous changes in public investment. Panel G in Table 4 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 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 line with the idea that investment spending multipliers have larger effects and that such fiscal action in 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 expansions. When looking at the countries originating the public investment spillover effect ($spillover^{O}$), 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.[22] Inter-

[22]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)

estingly, 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.

5.2 Alternative estimation of government spending spillovers

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:

$$shock_{i,t} = \sum_{j \neq i} \omega_{ij} \varepsilon^{G}_{j,t} G_{j,t-1} \tag{12}$$

where ω_{ij} represent the trade weights between countries i and j,[23], $\varepsilon^{G}_{j,t}$ is the government spending shock identified in Section 3, and $G_{j,t}$ is the real government spending in country j in time t.

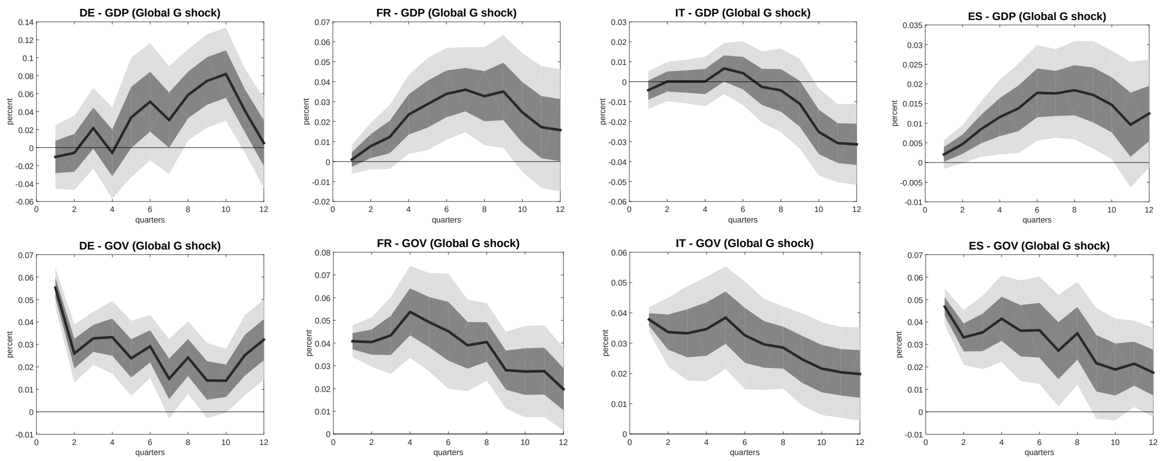
Next, we plug this new aggregated variable in equations 8 and 9 to estimate the fiscal spillovers effects. Note that our two measures of spillovers *by destination*, described in the previous subsection in Equation 10 and Equation 12 above, identify different objects. The former explores the effect of 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 magnitude of the latter results to be similar to those described in Panel A of Table 4, but smaller in magnitude.

The results of this estimation are shown in Figure 5 and Panel A of Table 5. The responses in Figure 5 show a positive and significant expansion in Spain, France, and, with somewhat higher uncertainty, 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

is however significant at just marginally smaller levels of confidence (67%).

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

Figure 5: Fiscal spillovers, by country of destination



Note: 68 and 95% confidence bands computed using Newey-West standard errors.

in the medium and long run.

Panel A of Table 5 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 4, 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 show 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 significant at levels of 68% until the third year.[24] 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.[25] Goujard (2016) finds larger effects: the

[24]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.

[25]Auerbach and Gorodnichenko (2013) finds that the spillovers tend to be negative but insignificant

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.

6 Conclussions

[TO BE ADDED]

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).

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7 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*
Panel D: booms					
impact	0.99**	0.51**	-0.24*	0.51*	0.11
1 year	0.69**	0.95*	0.31*	0.96**	0.43
2 years	1.27**	3.06*	1.01**	1.22*	0.40
3 years	1.85	4.90*	1.29*	1.29*	0.25
Panel E: recessions					
impact	0.12	0.37	-0.01	0.13*	-0.57
1 year	0.46	0.43	0.32	0.47*	-0.52
2 years	1.01	0.33	-0.12	0.00	-0.18
3 years	0.82	0.79	0.55	-7.13	-0.06
Panel F: low stress					
impact	0.95**	0.66**	-0.07	0.55*	0.32
1 year	0.98**	1.56*	0.66*	1.04**	1.10*
2 years	1.57**	4.71*	1.19**	1.04*	1.67*
3 years	1.92**	4.25*	1.40*	1.15*	2.56*
Panel G: high stress					
impact	0.81*	-0.24	-1.14**	0.26*	-0.44
1 year	1.15	-1.46*	-1.16*	0.64*	0.23
2 years	1.73	-1.98	-0.59	0.88	1.12*
3 years	1.19	-1.30	0.30	-1.23	1.22*

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

Table 3: Net Tax Revenues Multipliers

	DE	FR	IT	ES	NL	BE	EA
Panel A: total T							
impact	-0.38	-0.03	-0.18**	-0.18*	-0.42**	-0.15**	-0.45**
1 year	-0.13	-0.05	-0.16*	-0.03	-0.53**	-0.31**	-0.61**
2 years	0.36	0.03	-0.14	0.13	-1.14*	-0.39**	-0.44
3 years	0.65	-0.03	-0.37	-0.05	-1.85	-0.55**	-0.48
Panel B: booms							
impact	0.08	-0.17**	-0.23**	-0.14	-0.53**	-0.12**	-0.36**
1 year	0.58*	-0.51**	-0.03	0.06	-0.55**	-0.26**	-0.18
2 years	0.89*	-0.57*	0.00	0.29	-1.18*	-0.26*	0.08
3 years	0.93*	-0.81	-0.31	0.02	-1.78	-0.39*	-0.17
Panel C: recessions							
impact	-1.53*	0.73**	0.07	0.03	-1.02**	-0.38*	-0.11
1 year	-2.15	1.07*	0.06	-0.23	-11.36	-0.53*	-2.01
2 years	-2.58	0.83**	0.22	-6.96	-18.59	-0.49	-0.92*
3 years	-0.36	1.09**	0.44	2.41	-6.32	-0.62	-0.79
Panel D: low stress							
impact	-0.17	-0.06	-0.24**	-0.19*	-0.51**	-0.20	-0.60**
1 year	0.01	-0.16	-0.25*	-0.06	-0.48*	-0.35*	-0.62*
2 years	0.71	0.01	-0.27	0.03	-0.91*	-0.36**	-0.25
3 years	0.86	-0.08	-0.58*	-0.44	-1.18	-0.55	-0.35
Panel E: high stress							
impact	-1.12*	-0.04	0.04	-0.57**	0.66*	0.77	-0.04
1 year	-0.33	0.15	1.77**	-1.06**	0.52*	0.62	-0.42*
2 years	0.12	0.28	2.16**	-9.86	0.80*	0.93	-0.92*
3 years	0.53	0.47	-0.25	4.89	1.65*	4.01	-0.63

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

Table 4: 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*
Panel C: 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 D: 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
Panel E: 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 F: 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 G: 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 H: 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 5: 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**
Panel B: by origin				
impact	-0.04	0.73	-0.35	-0.44
1 year	0.36	-0.68	0.75	1.45
2 years	0.46	-0.55	1.33*	1.50
3 years	0.03	0.65	1.65*	1.16

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 describe the variables and sources employed to construct the objects z_t and $\boldsymbol{u}_t$ described in Section 2 for each country and revenue/spending chapter.[26] We also explain how we remove some one-off events (such us allocations of mobile licenses) that could otherwise distort the data.

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.[27] We refer to these data as *official quarterly data*. When no quarterly data is available, our methodology explained in Section 2 requires both annual data (to maintain coherence with official data) and monthly/quarterly indicators $\boldsymbol{u}_t$ 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 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

[26]Please refer to Table 7 for the description and full name of each revenues and spending category.

[27]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.

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.

- 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. Interest Rates (defined as the 10-year bonds), public debt (General Government Consolidated Debt) and exports are obtained from Eurostat. All variables are available for the 1980q1-2015 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 are obtained from Eurostat. Interest Rates are 10-year bonds (from Eurostat). Debt is General Government Consolidated Debt (from Eurostat) and Real Exports are obtained from Eurostat. All variables are available for the 1980q1-2015 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 no 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 GDPfrom 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 (sieres name *CARSA* for nominal GDP, and *VOBARSA* for real GDP).[28] Interest Rates (defined as the 10-year bonds), public debt (General Government Consolidated Debt) and exports are obtained from Eurostat. All variables are available for the 1980q1-2015 period.

Spain

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

Other variables. Nominal and real GDP, Interest Rates (defined as the 10-year bonds), public debt (General Government Consolidated Debt) and exports are obtained from Eurostat. All variables are available for the 1980q1-2015 period.

Netherlands

We have availability of official quarterly data since 1999q1 (from ESA2010). There is also earlier official data from ESA95 for other categories: DTX, TIN and THN (from 1991q1), and SCT (from 1998q1). Official annual data is available since 1980 (since 1995 in the case of ESA2010).

- TOR. Sources of indicators: Central Government Revenues (Ministry of Finance, cash data) since 1980q1.

[28] 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.

- DTX. We construct an 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. Since we have not been able to locate a suitable indicator, we interpolate the official annual figures until 1997q4 using a linear trend.

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

- TOE. Sources of indicators: Central Government Expenditures (Ministry of Finance, cash data) since 1980q1. We correct a one-off event in the level of the variable for the year 1995 by imposing it to have the same growth rate as the sum of the TOE components. Correction

- 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. Since we have not been able to locate a suitable indicator, we interpolate the official annual figures until 1998q4 using a linear trend.

- 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. Due to several erratic fluctuations in the series, we use the variable gross capital formation *quarterly non-financial accounts for general government (ESA2010)* as official quarterly data (as opposed to gross capital formation and acquisitions less disposals of non-financial non-produced assets, used in the rest of countries). Sources of indicators: Government Gross Fixed Capital Formation (BIS) from 1980q1-1990q4 and and Government Financial Statistics, vintage of ESA95 figures (Eurostat) from 1991q1 onwards.

- INP. Since we have not been able to locate a suitable indicator, we interpolate the official annual figures until 1998q4 using a linear trend.

Other variables. Nominal and real GDP, Interest Rates (defined as the 10-year bonds), public debt (General Government Consolidated Debt) and exports are obtained from Eurostat. All variables are available for the 1980q1-2015 period.

Belgium

We have availability of official quarterly data since 1991q1 (ESA2010 figures start in 1995q1). Official annual data is available since 1980 (since 1995 in the case of ESA2010).

- TOR. Sources of indicators: Total Revenue from Treasury (National Bank of Belgium, cash data) since 1980q1.
- DTX. Sources of indicators: Direct Tax Revenues (National Bank of Belgium, cash data) since 1980q1.
- SCT. We construct and indicator by combining the estimates of other revenue categories as TOE-DTX-TIN.
- TIN. Sources of indicators: Custom and VAT taxes (National Bank of Belgium, cash data) since 1980q1.
- GCN. Sources of indicators: Government Final Consumption Expenditure, value, GDP expenditure approach (OECD) from 1980q1 onwards.
- TOE, THN, SIN, GIN and INP We have not been able to locate suitable indicators for these categories, therefore we interpolate the official annual figures until 1990q4 using a linear trend. In the case of TOE, we correct a one-off event in the level of the variable for the in the quarter 2005q1 by imposing the same growth rate as the sum of the TOE components.

Other variables. Nominal and real GDP, Interest Rates (defined as the 10-year bonds), public debt (General Government Consolidated Debt) and exports are obtained from Eurostat. All variables are available for the 1980q1-2015 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), public debt (General Government Consolidated Debt) and exports are obtained from Eurostat. All variables are available for the 1980q1-2015 period.

Appendix B: Constucting Output and Price Elasticities

In this section we described the method employed to construct the output and price elasticities described in Section 3.

[STILL HAVE TO PROPERLY WRITE THIS UP]

Output elasticity of net tax revenues. We follow Blanchard and Perotti (2002) and Perotti et al. (2005) and decompose the within-quarter elasticity of tax revenues with respect to output (or prices) as:

$$\alpha_t, y = \sum_i \eta_{T_i,B_i} \eta_{B_i,Y} \frac{T_i}{T} \tag{13}$$

where T_i is the level of net taxes if type i,[29] η_{T_i,B_i} is the elasticity of taxes of type i to their tax base, and $\eta_{B_i,X}$ is the elasticity of the tax base to output.

The elasticities $\eta_{T_i,B_i}\eta_{B_i,Y}$ are decomposed for each component i as:

- The output elasticity of the *personal income* tax, $\eta_{tdirh,y}$, is obtained from:

$$\eta_{tdirh,y} = \left(\eta_{tdirh,w}\eta_{w,emp} + 1\right)\eta_{emp,y} \tag{14}$$

  where $\eta_{tdirh,w}$ is the elasticity of personal income tax revenues to earnings, $\eta_{w,emp}$ is the elasticity of earnings to employment and $\eta_{emp,y}$ is the output elasticity to employment.

- The output elasticity of the *social security contributions* $\eta_{ss,y}$, is given by:

$$\eta_{ss,y} = \left(\eta_{ss,w}\eta_{w,emp} + 1\right)\eta_{emp,y} \tag{15}$$

  where $\eta_{ss,w}$ is the elasticity of social security contributions to earnings.

- The elasticity of *corporate income taxes* to output, $\eta_{tdirc,y}$:

$$\eta_{tdirc,y} = \eta_{tdirc,gos}\eta_{gos,y} \tag{16}$$

  with $\eta_{tdirc,gos}$ being the elasticity of corporate income tax revenues to the gross operating surplus, and $\eta_{gos,y}$ the elasticity of the gross operating surplus to output.

[29] T_i is negative for the case of transfers, and positive when refers to taxes.

- The output elasticity of *indirect taxes*, $\eta_{tind,y}$, is:

$$\eta_{tind,y} = \eta_{tind,c}\eta_{c,y} \tag{17}$$

where $\eta_{tind,c}$ is the elasticity of indirect tax revenues to consumption, and $\eta_{c,y}$ the elasticity of consumption to output.

- The elasticity of transfers to output is assumed to be 0.2 for all countries, following Perotti et al. (2005).

The parameters $\eta_{T_i,B_i} = \{\eta_{tdirh,w}, \eta_{ss,w}, \eta_{tdirc,gos}, \eta_{tind,c}\}$ are calibrated using estimations from Price et al. (2014).

The parameters of elasticities of taxes bases to employment ($\eta_{w,emp}$) and output ($\eta_{emp,y}$, $\eta_{gos,y}$ and $\eta_{c,y}$) are estimating from a regression of the tax base on output using quarterly data. [30] The resulting elasticities are shown in the first row of Table B1.

Output elasticity of government spending. Assumed to be 0.

Price elasticity of revenues. Assumed to be the elasticities $\eta_{T_i,B_i} - 1$. The resulting price-output elasticities are shown in the second row of Table B1.

Price elasticity of government spending. We assume a value of $\alpha_{g,p} = -0.5$ for all countries, following Perotti et al. (2005), with the exception of France, where $\alpha_{g,p} = 0$, as in Cleaud et al. (2014).

Interest rates elasticities. Assumed to be 0.

Table B1: Output and price elasticities of tax revenues

	DE	FR	IT	ES	NL	BE	EA
$\alpha_{tax,output}$	1.36	2.01	1.70	1.81	1.68	1.75	1.61
$\alpha_{tax,price}$	1.04	0.96	1.08	0.85	0.95	0.96	0.96

[30]Employment is total employees (from 1995q1 to 2015q4), earnings is compensation to employees per head (from 1995q1 to 2015q4), gross operating surplus is gross operating surplus and mixed income (from 1999q1 to 2015q4, with the exception of France: from 1980q1 to 2015q4) and consumption is real personal consumer expenditure (from 1995q1 to 2015q4). All the series were obtained form Eurostat and converted in real terms using the GDP deflator.

Appendix C: Additional Tables and Figures

Table C1: Government Spending Multipliers: Comparison with the Literature and Alternative Specifications

	Empirical Literature (a)			1985-2010 (b)						1980-2015 (b)					
	1985-2010			Blanchard-Peroti			Local Projection			Blanchard-Peroti			Local Projection		
	impact	1 year	2 years	impact	1 year	2 years	impact	1 year	2 years	impact	1 year	2 years	impact	1 year	2 years
GERMANY	0,4	1,2	1,8	1,0	1,3	2,1	1,0	0,9	1,9	1,0	0,9	1,3	1,0	0,9	1,4
FRANCE	1,6	1,5	1,2	0,4	0,8	1,5	0,5	0,8	1,1	0,3	0,6	1,2	0,4	0,5	1,1
ITALY	0,1	0,3	0,8	0,0	0,6	1,1	0,0	0,6	1,3	-0,1	0,6	1,1	-0,1	0,6	1,1
SPAIN	0,3	1,2	1,8	0,5	1,5	1,7	0,5	1,3	1,3	0,5	1,0	1,4	0,5	1,1	1,4
EURO AREA	0,6	1,4	1,7	0,4	1,3	1,7	0,5	1,5	2,3	0,3	1,0	1,3	0,3	1,0	1,1

Appendix D: Fiscal Variables in the New Dataset

Figure D1: Germany: fiscal variables

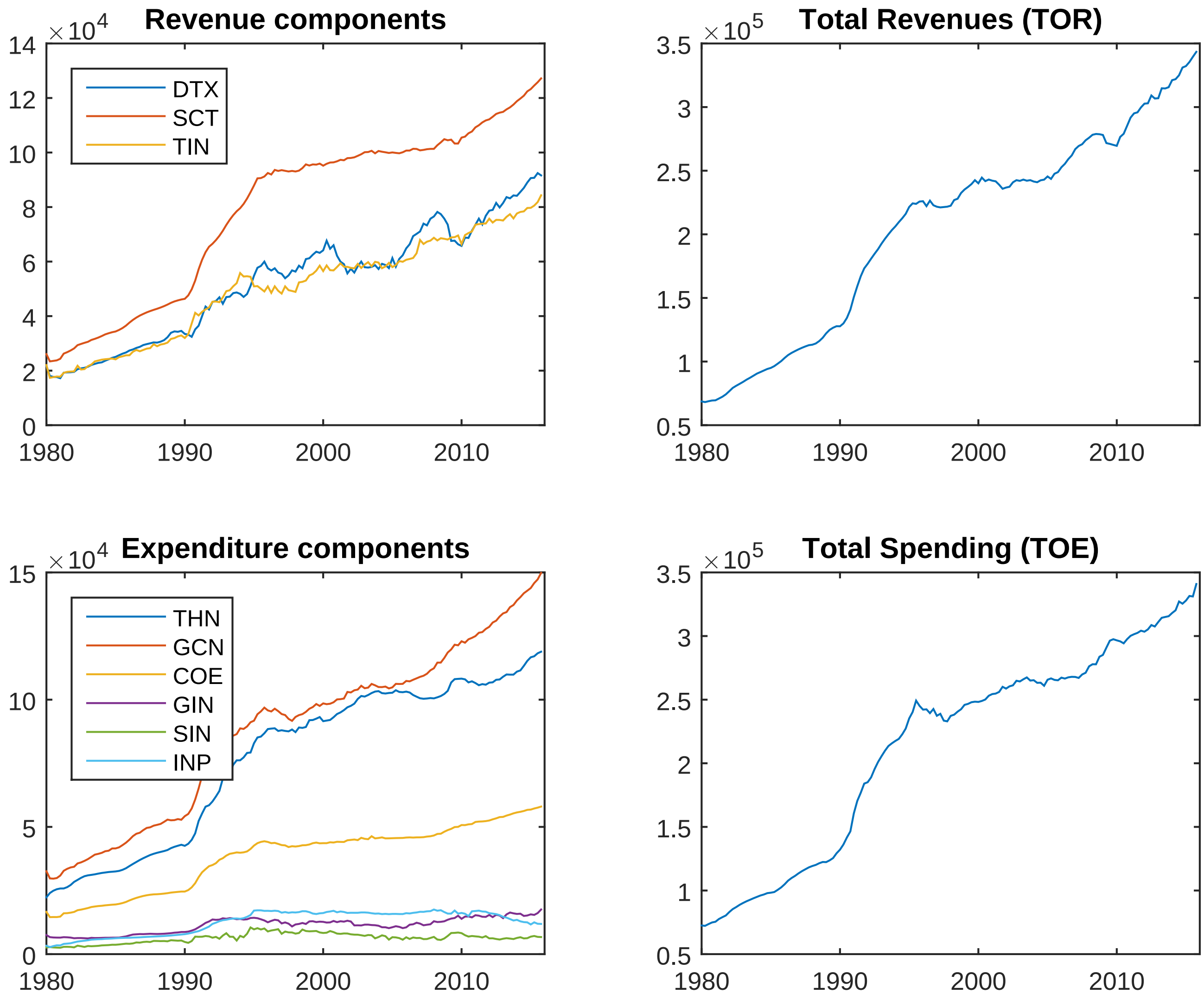

Figure D2: France: fiscal variables

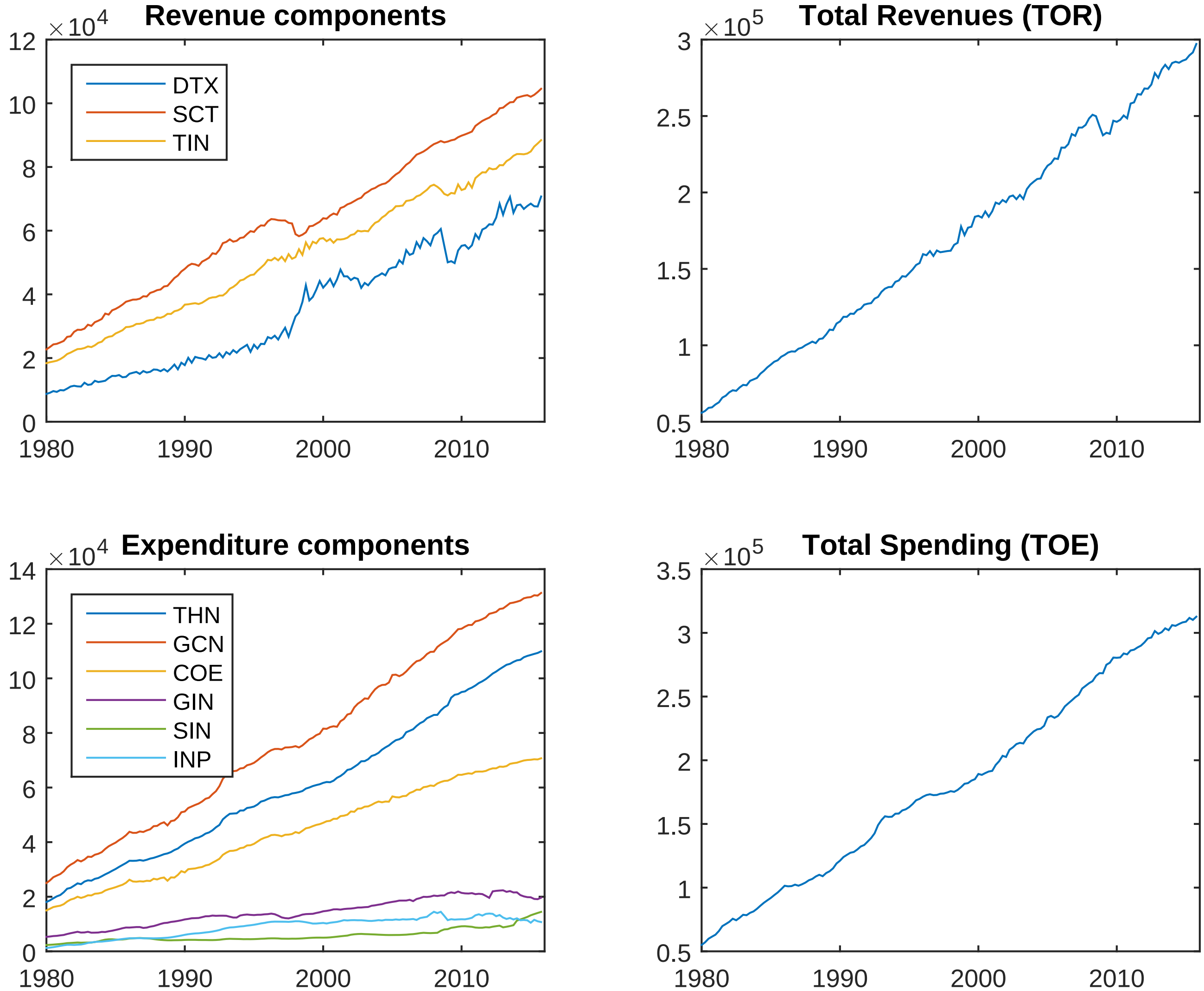

Figure D3: Italy: fiscal variables

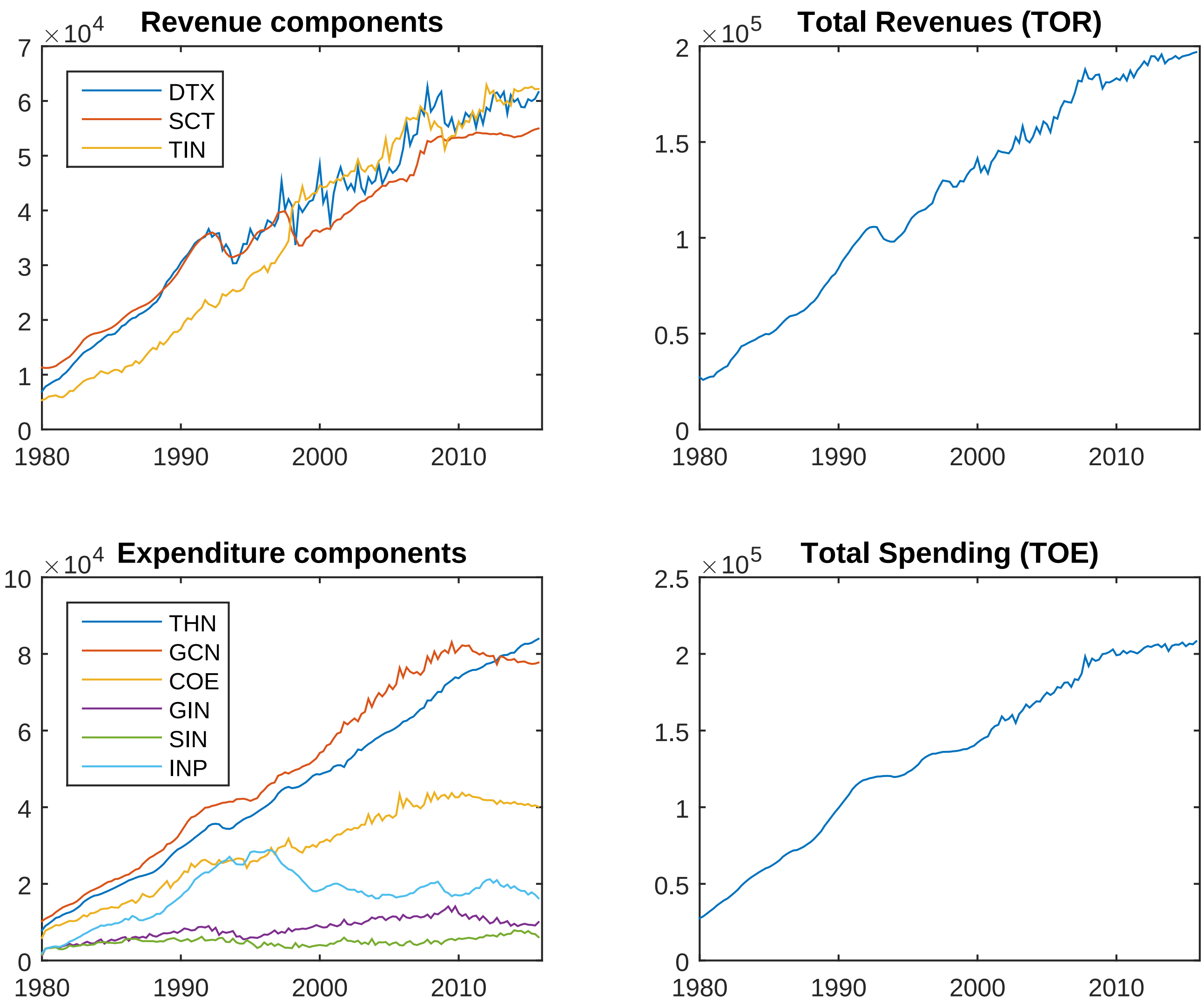

Figure D4: Spain: fiscal variables

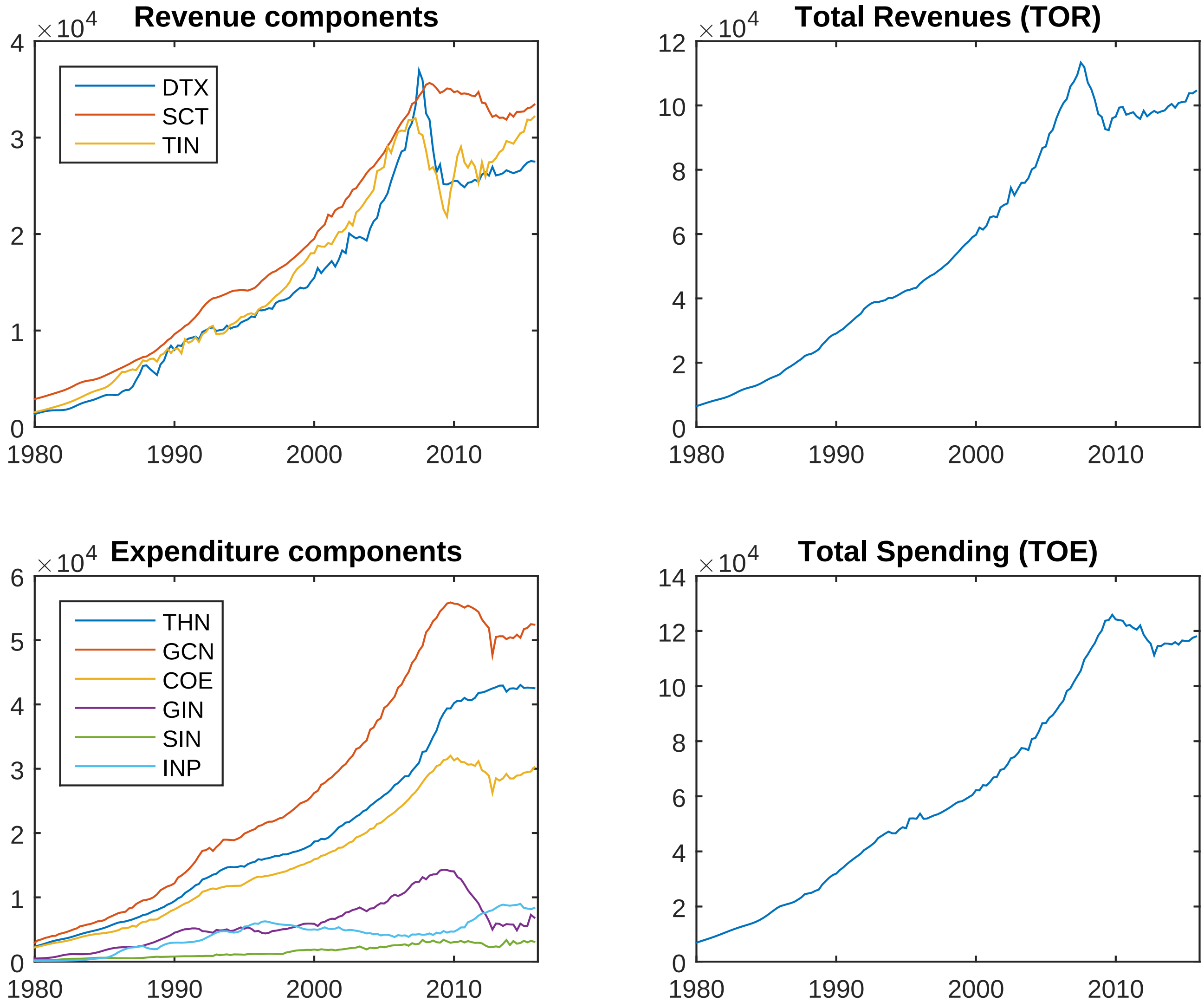

Figure D5: Netherlands: fiscal variables

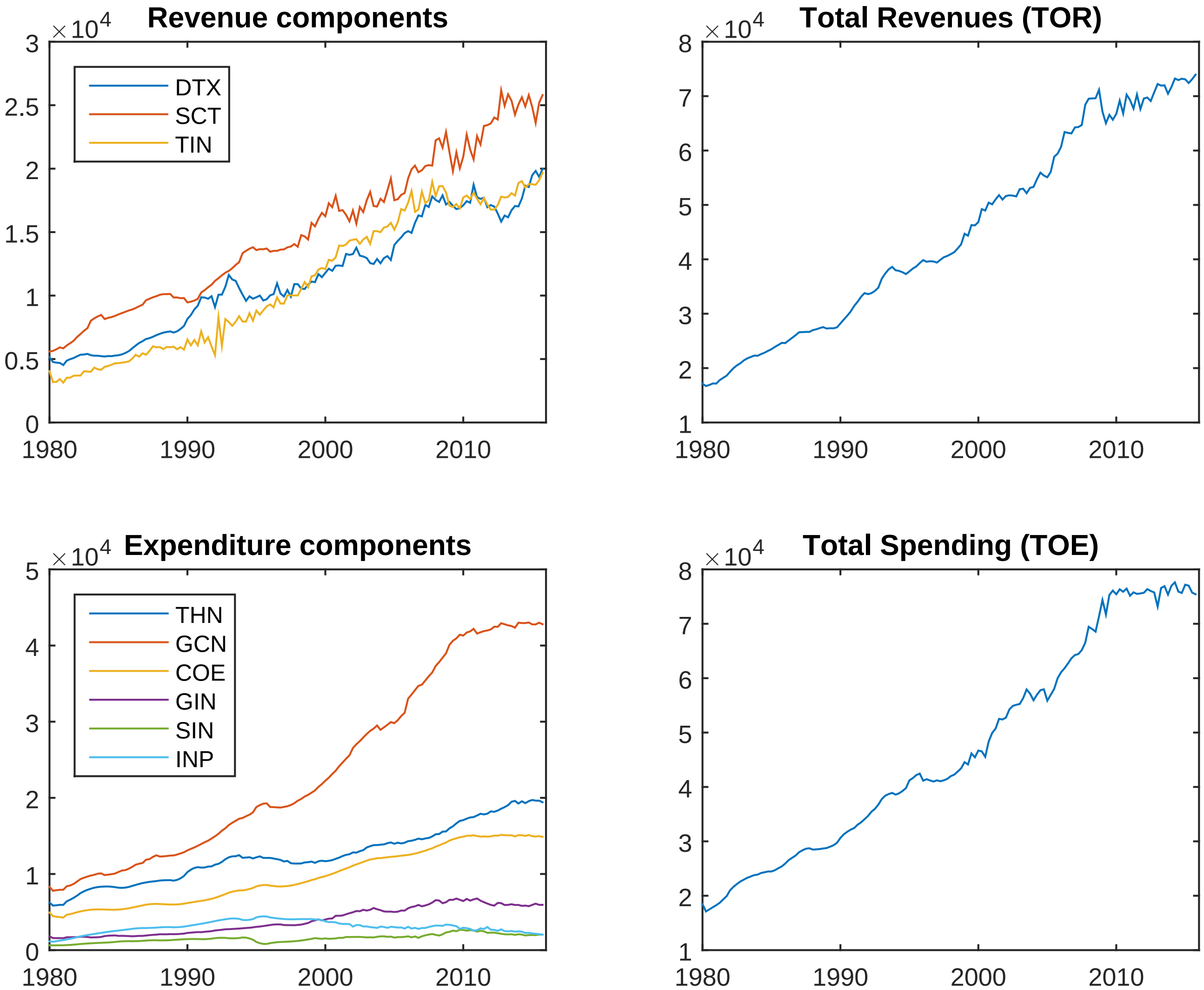

Figure D6: Belgium: fiscal variables

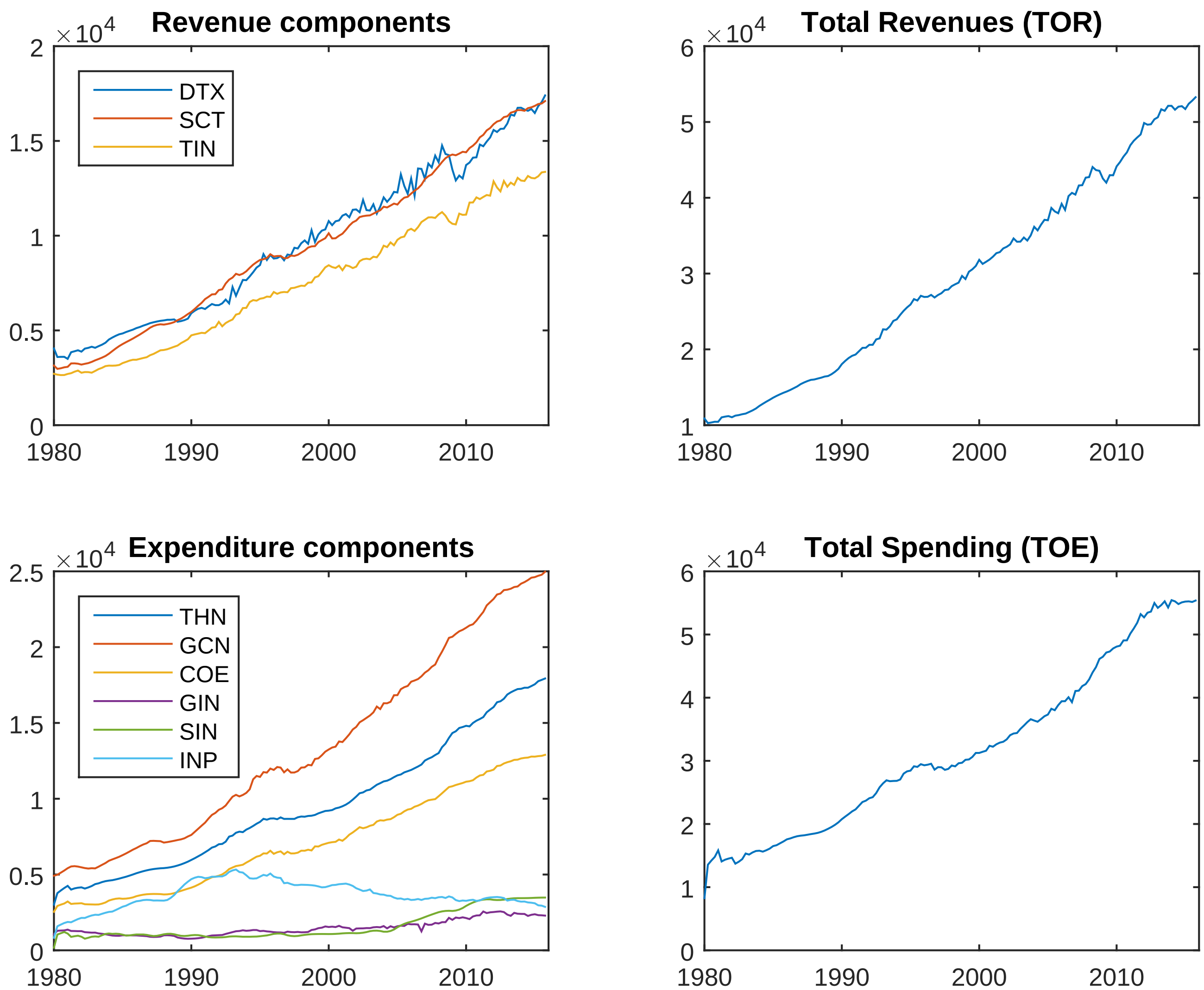

Figure D7: Euro area: fiscal variables