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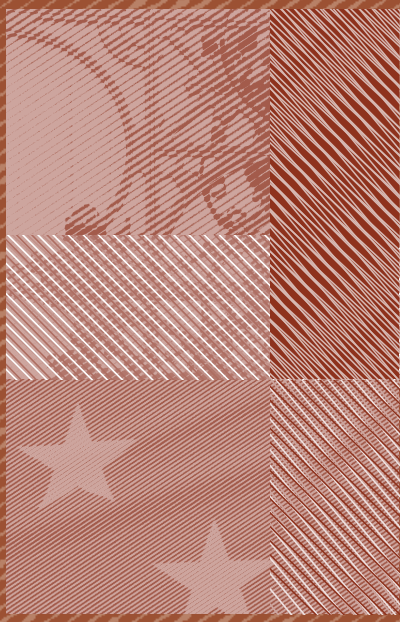

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Abstract

We analyse the impact of fiscal policy shocks in the euro area as a whole, using a newly available quarterly dataset of fiscal variables for the period 1981-2007. To allow for comparability with previous results on euro area countries and the US, we use a standard structural VAR framework, and study the impact of aggregated and disaggregated government spending and net taxes shocks. In addition, to frame euro area results, we apply the same methodology for the same sample period to US data. We also explore the sensitivity of the provided results to the inclusion of variables aiming at measuring "financial stress" (increases in risk) and "fiscal stress" (sustainability concerns). Analysing US and euro area data with a common methodology provides some interesting insights on the interpretation of fiscal policy shocks.

Keywords: Euro area, SVAR, Fiscal Shocks, Fiscal multipliers.

JEL classification: E62, H30.

1 Introduction

In the course of 2008 policymakers have implemented a wide array of discretionary fiscal measures to stimulate the economic activity and soften the economic downturn. By June 2009 almost all OECD economies and many emerging countries had announced or implemented some sort of fiscal stimulus packages. In the case of European economies, the European Commission launched at the end of 2008 the "European Economic Recovery Plan" (EERP), aimed at providing a coordinated fiscal stimulus for the European Union (EU) as a whole. At the current juncture, the impact of such fiscal packages remains uncertain.

This is certainly the case for the euro area, given the scarcity of relevant studies. Given the single monetary policy in the euro area since 1999, and the synchronization of monetary policies already since the beginning of the 1990s among core euro area countries, the aggregate analysis of fiscal policy shocks for the area as a whole is a pertinent endeavour. Even though fiscal policy has been a country-specific issue over the last two decades,[1] the use of historical data in euro area wide models is of practical relevance for policy makers.[2] And given the potential importance of spillover effects of fiscal policy in a highly integrated area such as the EMU, the results available for some specific countries[3] do not necessarily provide a good guidance for analysing the macroeconomic impact of fiscal shocks in the euro area as a whole.

Thus, the main aim of this paper is to assess the impact of fiscal policy shocks in a (weighed) representative euro area country (the euro area aggregate) on inflation and GDP, the key macroeconomic variables of interest for the ECB. In order to frame our results, we also include in every step of our analysis the parallel responses obtained with a common methodology for the US, an economic area similar in size, though historically more integrated, for which a large number of reference studies exist. Due to data availability for the euro area, we focus on the sample 1981-2007.

The scarcity of results analysing the impact of fiscal shocks for the euro area as a whole and the countries thereof, is ultimately due to the lack of quarterly data for the general government sector. In fact, until very recently, official data following national accounts conventions for the EMU and the countries comprising it, covering a wide set of variables, were only available in non-seasonally adjusted terms for the period 1999Q1 onwards. This limitation has been recently overcome by Paredes et al. (2009) that provide a quarterly fiscal database for the euro area aggregate for the period 1980Q1-2007Q4. The raw ingredients they use are closely linked to the ones used by national statistical agencies to provide their best estimates (intra-annual fiscal data, mostly on a cash basis), and they preserve full coherence with official, annual data.

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1. This has been the case even under the operation of the Stability and Growth Pact, the fiscal policies' coordination agreement in place in the EU since 1999.

2. See, for instance, Smets and Wouters (2003 and 2005), Fagan et al. (2005), Christoffel et al. (2008) and Ratto et al. (2009).

3. For euro area country studies see Heppke-Falk et al. (2006) for Germany, de Castro (2006) and de Castro and Hernández de Cos (2008) for Spain, Giordano et al. (2007) for Italy, Marcellino (2006) for the four largest countries of the euro area or Afonso and Sousa (2009a, 2009b) for Germany, Italy and Portugal, and Bénassy-Quéré and Cimadomo (2006) and Beetsma and Giuliodori (2009) for a group of EU countries. On different grounds, Jacobs et al. (2007) incorporate a fiscal closure rule in a VAR for the euro area.

Along the lines of the most recent and standard strand of the literature that started with Blanchard and Perotti (2002), the effects of fiscal policy shocks area assessed within a SVAR framework where identification of fiscal policy shocks is achieved by exploiting decision lags in policy making and information about the elasticity of fiscal variables to economic activity. Therefore, apart from the novelty of the results for the euro area itself, by relying on a common standard methodology and sample period, our analysis provides comparability and consistency between the results for the euro area and the US.

Our identified government spending shocks can be neatly interpreted in the light of historical episodes both in the euro area and the US, as well as net taxes' shocks in the euro area. In addition, net taxes' shocks in the case of the US tend to match the episodes identified by Romer and Romer (2007) in their "dummy variable" approach.

We find for the euro area standard qualitative responses of GDP and inflation to government spending and net-tax shocks. Our results are within the standard ranges of results obtained in similar empirical studies for the US and euro area countries.[4] To make it short: expansionary fiscal shocks do have a short-term positive impact on GDP and private consumption, with government spending shocks entailing, in general, higher effects on economic activity than (net) tax reductions. At the same time, we find that spending multipliers are of similar size and lower than 1 in both the euro area and the US, whereas multipliers of net taxes are less persistent in the former case. However, in the case of a spending shock the reaction of fiscal variables differs markedly between the euro area and the US, both, in terms of the persistence of spending and in terms of the accompanying reaction of taxes. Furthermore, we find that the shape of the dynamic response of government consumption shocks in the US is determined by military expenses, a factor not present in the case of the euro area. Moreover, although our US multipliers of government expenditure for the sample comprising 1981-2000 are broadly consistent with those obtained by Perotti (2004), we provide empirical evidence that these multipliers have increased during the last years. A similar behaviour is also observed for the euro area aggregate. Finally, we show that when we control for a measure of "fiscal stress" (changes in government debt), fiscal multipliers turn out to be higher and more persistent than in the baseline case. However, when we control for a measure of "financial stress" fiscal multipliers do not change significantly.

The rest of the paper is organised as follows: section 2 describes the data, section 3 methodological issues and section 4 the results. Finally, we present some concluding remarks in section 5.

4. For a discussion on fiscal multipliers in simulation models see Cwik and Wieland (2009) and Cogan et al. (2009).

2 The data

As in Blanchard and Perotti (2002) and Perotti (2004), the baseline VAR estimated in this paper includes quarterly data on public expenditure (g_t), net taxes (t_t) and GDP (y_t), all in real terms,[5] the GDP deflator (p_t) and the ten-year interest rate of government bonds (r_t).[6] All variables are seasonally adjusted and enter in logs except the interest rate, which enters in levels.

The definition of fiscal variables follows Blanchard and Perotti (2002). In particular, government spending (g_t) is defined as the sum of government consumption and investment, while net taxes (t_t) are defined as total government current receipts, less current transfers and interest payments on government debt.[7] The reason for this grouping is that government spending on goods and services might have different effects, as it affects directly the aggregate demand of the economy, while transfers and taxes exert their effects through real disposable income that could be partially saved. These definitions have become commonplace in the most recent empirical literature. Given this definitions, the general government primary balance is obtained as the difference between the levels of t_t and g_t.

We use data covering the period 1981:Q1 to 2007:Q4.[8] For the US, both fiscal and national accounts data have been taken from the NIPA accounts from the Bureau of Economic Analysis. In the case of the euro area (EMU henceforth), fiscal data have been taken from a newly available quarterly fiscal data set compiled by Paredes et al. (2009). They employ intra-annual fiscal data, mostly on a cash basis, in a mixed-frequencies state space model to obtain quarterly fiscal data for the aforementioned period. These data ensure consistency with annual and quarterly national accounts data where available. The main advantage of the new Paredes et al. (2009) data set is that it avoids the endogenous bias that arises if fiscal data interpolated on the basis of general macroeconomic indicators were used with macroeconomic variables to assess the impact of fiscal policies. These variables are seasonally adjusted according to the statistical model used to draw the corresponding quarterly data[9]. Other macroeconomic data for the euro area are taken from ECB's Area Wide Model Database [see Fagan et al. (2005)].

5. In all cases the GDP deflator is employed so as to obtain the corresponding real values.

6. The long-term interest rate is preferred to the short-term one because of its closer relationship with private consumption and investment decisions. However, this choice turned out to be immaterial to the results in that the inclusion of short-term rates in the VAR led to similar conclusions.

7. More concretely, transfers include all expenditure items except public consumption, public investment and interest payments.

8. For comparison purposes with Blanchard and Perotti (2002) and other more recent studies, we have estimated also the baseline VAR for the US employing data covering the period 1953:Q2-2007:Q4. The results we obtain are qualitatively and quantitatively similar to those of these authors and are available upon request.

9. Another alternative would consist in using TRAMO-SEATS [see Gómez and Maravall (1996)] to extract the seasonal component.

3 The (S)VAR model

3.1 Specification

We apply the structural vector autoregressive approach proposed by Blanchard and Perotti (2002) and Perotti (2004). The basic point in this approach is that identification of fiscal policy shocks is achieved by exploiting decision lags in policy making and information about the elasticity of fiscal variables to economic activity.

The reduced-form VAR is specified in levels and can be written as

$$X_t = D(L)X_{t-1} + U_t \tag{1}$$

where $X_t \equiv (g_t, t_t, y_t, p_t, r_t)$ is the vector of endogenous variables and $D(L)$ is an autoregressive lag polynomial. The benchmark specification includes a constant term, but no deterministic time trends. The vector $U_t \equiv (u_t^g, u_t^t, u_t^y, u_t^p, u_t^r)$ contains the reduced-form residuals, which in general will present non-zero cross-correlations. The VAR includes two lags of each endogenous variable according to the information provided by LR tests, the Akaike, Schwarz and Hannan-Quinn information criteria and the final prediction error.[10]

3.2 Identification strategy

The reduced-form residuals have little economic significance in that they are linear combinations of structural shocks. In particular, the reduced-form residuals of the g_t and t_t equations, u_t^g and u_t^t, can be thought of as linear combinations of three types of shocks: a) The automatic responses of spending and net taxes to GDP, price and interest rate innovations, b) systematic discretionary responses of fiscal policy to the macro variables in the system (for instance, reductions in tax rates that some countries could implement systematically in response to recessions), and c) random discretionary fiscal policy shocks, which are the truly uncorrelated structural fiscal policy shocks. Thus, from (1) the reduced-form residuals in the first two equations can be expressed as:

$$u_t^g = \alpha_{g,y} u_t^y + \alpha_{g,p} u_t^p + \alpha_{g,r} u_t^r + \beta_{g,t} e_t^t + e_t^g \tag{2a}$$

and

$$u_t^t = \alpha_{t,y} u_t^y + \alpha_{t,p} u_t^p + \alpha_{t,r} u_t^r + \beta_{t,g} e_t^g + e_t^t \tag{2b}$$

where e_t^g and e_t^t are the "structural" discretionary fiscal shocks. As we are interested in analysing the effects of e_t^g and e_t^t, on the rest of the variables of the system, estimations for the $\alpha_{i,j}$'s and $\beta_{i,j}$'s in (2) are needed.

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10. In order to assess the robustness of our results to different specifications and transformations, we tried several alternatives, including estimating with variables in per capita terms, adding a time trend, allowing for four lags instead of two and substituting the long-term interest rate by a short-term one. These different alternatives showed broadly the same qualitative results and are available upon request.

The approach we follow here is based on Blanchard and Perotti (2002). The key to this approach is the observation that approving and implementing new measures in response to innovations in the main macroeconomic variables typically takes longer than three months. Hence, the use of quarterly variables allows for setting the discretionary contemporaneous response of government expenditure or net taxes to GDP, prices or interest rate innovations to zero. Therefore, the coefficients $\alpha_{i,j}$'s in (2a) and (2b) only reflect the automatic responses of fiscal variables to innovations in the rest of the variables of the system, the first component aforementioned, and they can be estimated using institutional information on the elasticity of taxes and spending to GDP, prices and the interest rate. In particular, given that interest payments on government debt are excluded from the definitions of expenditure and net taxes, the semi-elasticities of these two fiscal variables to interest rate innovations, i.e. $\alpha_{g,r}$ and $\alpha_{t,r}$, are set to zero. While this assumption appears justified for government expenditure and plays no role when analysing its effects, it is slightly more controversial for net taxes.[11]

Consider now equation (2a). Our choice of the items included in the definition of government expenditure, notably public consumption and investment, makes it hard to think about any automatic response of public expenditure to economic activity. Accordingly, we can set $\alpha_{g,y}$= 0. The case of the price elasticity is different, though. Some share of purchases of goods and services is likely to respond to the price level. In addition, the wage component is typically indexed (either formally or via ex-post adjustements) to the CPI, even though indexation takes place with some delay. Thus, we adopted the same eclectic approach as in Perotti (2004), according to which the price elasticity of government expenditure was set to -0.5.[12]

The output and price elasticities $\alpha_{l,j}$ in (2b) are weighted averages of the elasticities of the different net-tax components, including transfers, computed on the basis of information like statutory tax rates and estimations of the contemporaneous responses of the different tax-bases and, in the case of transfers, the relevant macroeconomic aggregate to GDP and price changes. In general, contemporaneous output elasticities of net taxes can be calculated as:

$$\alpha_{t,y} = \sum_i \varepsilon_{T_i,B_i} \varepsilon_{B_i,y} \frac{T_i}{T} \qquad (3)$$

with $T = \sum T_i$ being the level of net taxes[13], ε_{T_i,B_i} the elasticity of the ith category of net taxes to its own tax base and $\varepsilon_{B_i,y}$ the GDP elasticity of the tax base of the ith category of net taxes. Price elasticities for some components of net taxes were, however, obtained directly by econometric estimation, whereas others were calibrated.

According to our estimations, output elasticities are 1.94 and 1.54 for the US and the euro area, respectively, whereas price elasticities amount to 1.15 in the US and 1.14 in

11. In many cases, the income tax base includes interest income as well as dividends, which in general co-vary negatively with interest rates. Nevertheless, the full set of effects of interest rate innovations on the different tax categories are very complex to analyse, especially in the euro area, and, on the other hand, their contemporaneous effects are deemed to be very small.

12. While this assumption is immaterial for the EMU results, the two extreme values for this elasticity, 0 and -1, affect the magnitude of output multipliers of government spending in the US to a greater extent. Section 4.6 presents these results.

13. The Ti's are positive in the case of taxes and negative in the case of transfers.

the EMU.[14] These elasticities are similar to those obtained in previous papers. For instance, Perotti (2004) gauges an output elasticity of 1.97 for the USA (for the subsample 1980-2000), while the price elasticity is set to 1.4. There are no reference values for the euro area though. The closer available results would be those for Germany, estimated at 0.72 and 0.98 in Heppke-Falk et al. (2006). The higher euro area results compared to Germany might indicate, among other factors, the presence of cross-country spill-over effects that potentially lead to higher multipliers than at the national level.

Once output and price elasticities have been estimated, the so-called "adjusted" fiscal shocks *(u^{CA})* can be derived as follows:

$$u_t^{g,CA} = u_t^g - (\alpha_{g,y} u_t^y + \alpha_{g,p} u_t^p + \alpha_{g,r} u_t^r) = \beta_{g,t} e_t^t + e_t^g \quad (3a)$$

$$u_t^{t,CA} = u_t^t - (\alpha_{t,y} u_t^y + \alpha_{t,p} u_t^p + \alpha_{t,r} u_t^r) = \beta_{t,g} e_t^g + e_t^t \quad (3b)$$

As mentioned in Perotti (2004), there is little guidance, theoretical or empirical, on how to identify the two structural shocks in (3a) and (3b), We assume that expenditure decisions are prior to tax ones, which implies a zero value for $\beta_{g,t}$. This allows us to retrieve e_t^g directly from (3a) and to use it in (3b) in order to estimate $\beta_{t,g}$ by OLS[15]. Since we are interested in studying the effects of fiscal policy shocks, the ordering of the remaining variables is immaterial to the results. Accordingly, the reduced-form output residuals are assumed to be a linear combination of the fiscal shocks.

$$u_t^y = \gamma_{y,g} u_t^g + \gamma_{y,t} u_t^t + e_t^y \quad (4)$$

By definition, some contemporaneous correlation between the reduced-form residuals of the fiscal equations and e_t^y is expected. Hence (4) is estimated by instrumental variables, using the structural uncorrelated fiscal shocks e_t^g and e_t^t as instruments for u_t^g and u_t^t, respectively. Likewise, the coefficients of Γ corresponding to the price and interest rate equations can be obtained in turn in a similar way.

The innovations model can be written as $\Gamma U_t = \mathrm{B} V_t$, where $V_t \equiv (e_t^g, e_t^t, e_t^y, e_t^p, \mathrm{e}_t^r)$ is the vector containing the orthogonal structural shocks. The respective matrixes Γ and B can be written as

14. Table A1 provides further details about the different elasticities behind these aggregate output and price elasticities. In particular, it is worth noting that the higher output elasticity in the US is mainly explained by a higher wage elasticity of employment, on the one hand, and a higher GDP elasticity of employment, on the other.

15. As shown in Perotti (2004), the correlation between the two cyclically adjusted fiscal shocks is very low, so the ordering is immaterial for the results.

$$\Gamma = \begin{pmatrix} 1 & 0 & -\alpha_{g,y} & -\alpha_{g,p} & -\alpha_{g,r} \\ 0 & 1 & -\alpha_{t,y} & -\alpha_{t,p} & -\alpha_{t,r} \\ -\gamma_{y,g} & -\gamma_{y,t} & 1 & 0 & 0 \\ -\gamma_{p,g} & -\gamma_{p,t} & -\gamma_{p,y} & 1 & 0 \\ -\gamma_{r,g} & -\gamma_{r,t} & -\gamma_{r,y} & -\gamma_{r,p} & 1 \end{pmatrix}$$

and (5)

$$\mathrm{B} = \begin{pmatrix} 1 & \beta_{g,t} & 0 & 0 & 0 \\ \beta_{t,g} & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

Accordingly, the reduced-form residuals are linear combinations of the orthogonal structural shocks of the form $U_t = \Gamma^{-1}\mathrm{B}V_t$.

3.3 Possible weaknesses of the SVAR approach to model fiscal policy shocks

One frequent criticism to the identification of quarterly fiscal policy shocks is that fiscal decisions are mainly taken on a year-by-year basis as embedded in the budget. However, while acknowledging that the yearly budget incorporates important policy measures, supplements to it and other decisions affecting fiscal policy during the year are always possible and, indeed, have been commonplace in most of the sample period under consideration.

Another important criticism relates to implementation lags, i.e the typical long lag between the announcement of a fiscal measure, and the time the measure is actually adopted. Under rational expectations, economic agents adjust their decisions on consumption, saving and labour supply as soon as they have information on future changes in fiscal policy. If this is the case, the VAR-based estimated effects on the basis of quarterly data might be biased, although the sign of the bias is not clear. In particular, Ramey (2007) finds that failing to account for the anticipation effect causes the SVAR to capture shocks too late, missing some non-keynesian effects of fiscal policy (the initial decline in consumption that occurs as the news is known). By contrast, Blanchard and Perotti (2002) and Heppke-Falk et al. (2006) try to address this criticism including an indicator of future fiscal policy measures in their estimation procedure, finding qualitatively similar results. Perhaps, the existence of liquidity constrains or the presence of shortsighted consumers might reduce the significance of the announcement effect. Leeper et al. (2008) analyse the difficulties that fiscal foresight introduces in the estimation and interpretation of conventional analyses of fiscal shocks; even though they show that not accounting for anticipation effects might distort the interpretation of net taxes' shocks[16], they also hint that under certain circumstances foresight might not impinge on the identification of other shocks, like government spending shocks. However, Yang (2007) argues that including lagged interest rates and prices leads to lower responses to tax shocks in that lagged interest rates and prices contain information about macroeconomic variables related to current tax changes.

16. See also Yang (2005).

Thus, the inclusion of prices and interest rate in our VAR might help assuage the foresight problem.

Finally, Favero and Giavazzi (2007) argue that the omission of public debt in the VAR leads to biased results as they fail to take into account the debt dynamics that arises after a fiscal shock and, more importantly, overlook the possibility of taxes and spending responding to the level of debt. We address this issue and include debt (changes in debt) in a similar way as Favero and Giavazzi in subsection 4.4 below.

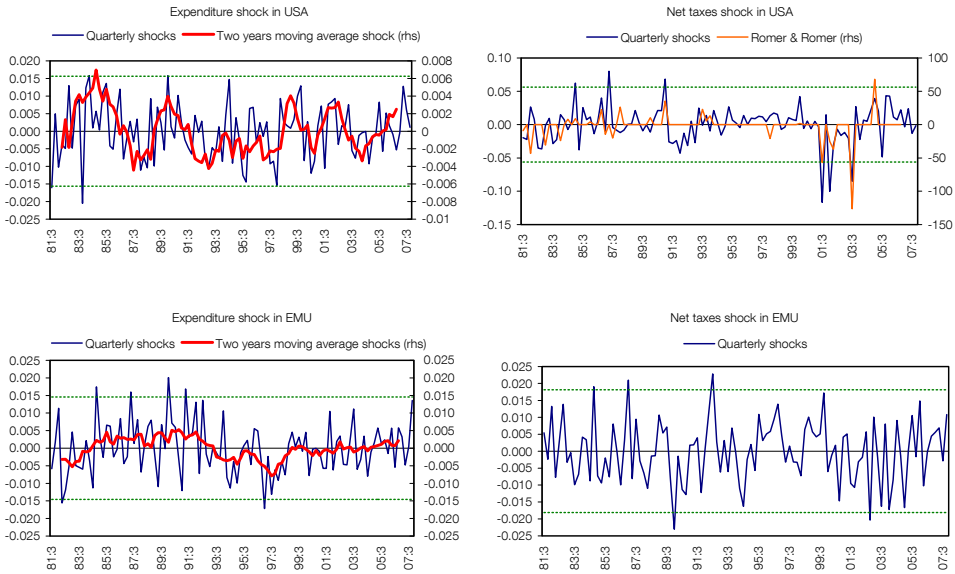
4 The effects of government spending and tax shocks

4.1 Interpreting the fiscal shocks

Figure 1 represents the fiscal shocks that we estimate in our baseline VAR for US and the EMU. In general, the largest fiscal shocks tend to be associated with episodes of discretionary government actions. Beginning with the US, in the case of net taxes the shocks tend to match the changes in net taxes episodes identified by Romer and Romer (2007) in their "dummy variable" approach. The Bush tax cuts in 2001 and 2003 are by far the largest tax cuts episodes identified in our sample. We identify also some positive shocks related to the Omnibus Budget Reconciliation Acts of 1987, 1990 and 1993. In the case of government spending, we identify most of the episodes of military build-ups that have taken place in our sample (the Reagan build-up in the first part of the 80s: the I Golf War military build-up in 1991; another in 1998 when there was a significant increase in defence spending; and the 2001 increase in defence spending, after the September 11 terrorists attacks). In terms of contractionary shocks, we estimate negative shocks in the late 1980s and early 1990s, which might be associated with the fiscal consolidation process accomplished in the Clinton administration.

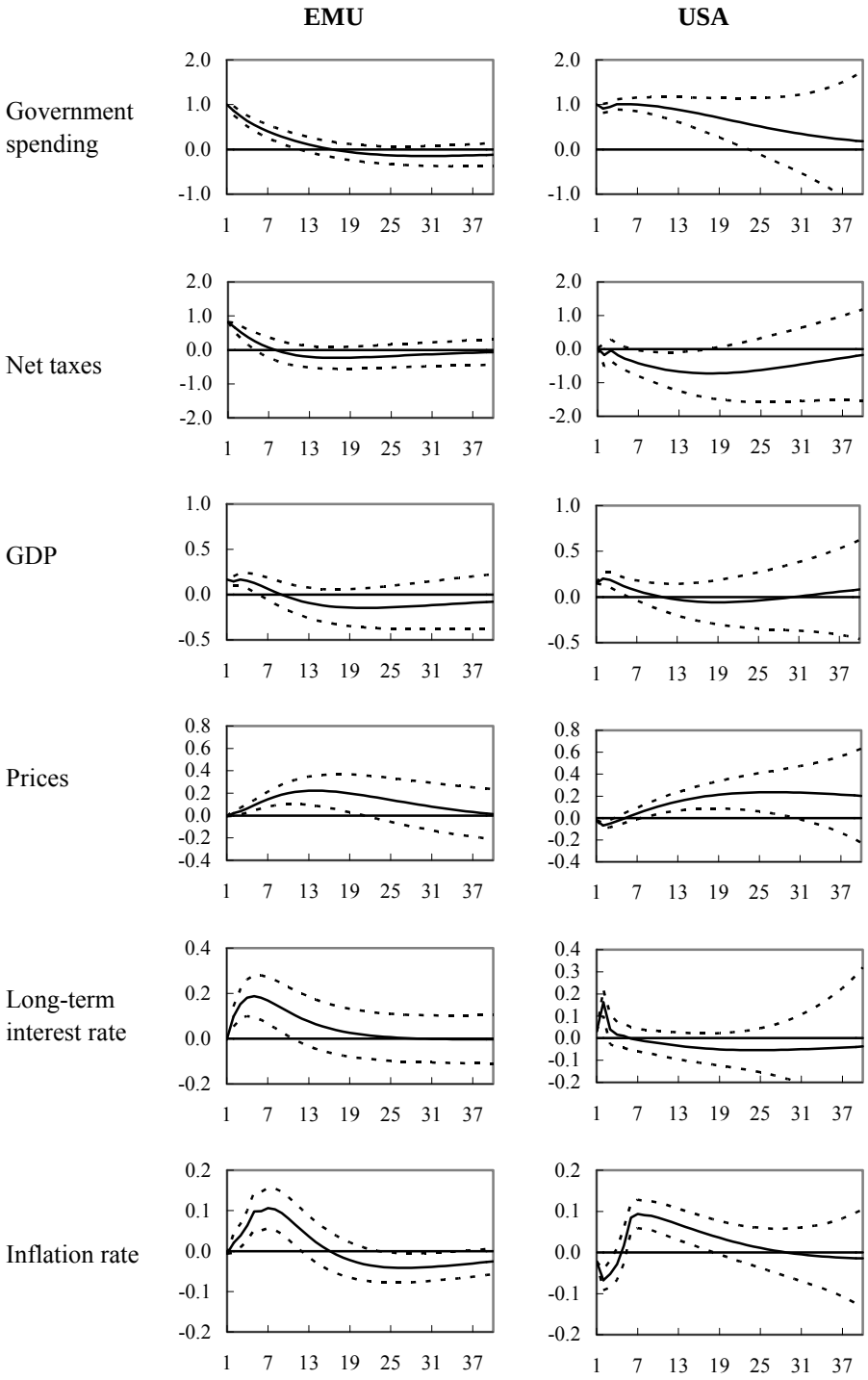
In the case of EMU, negative shocks in public spending are found throughout the period 1994-1997 related to the fiscal consolidation episodes previous to the euro adoption, as the decision whether or not a country entering EMU was taken on the basis of the fiscal deficit recorded in 1997. We identify also positive shocks in 1990-1991 associated with the German reunification process that was followed by a significant increase in public spending. In the case of net revenue, we estimate positive residuals along the years 1995-1997, related also to the fiscal consolidation process previous to the EMU accession.

Figure 1: Estimated shocks to fiscal variables



The dotted line indicates the one-standard deviation band-width.

Figure 2: Responses to an increase in government spending



4.2 The baseline VAR

Figure 2 displays the responses of the endogenous variables to a positive expenditure shock in both the EMU and the US.[17] Comparison between both sets of results shows that, in

17. Impulse responses show deviations with respect to the baseline to a one-percent shock of the relevant fiscal variable. Hence, GDP responses cannot be directly interpreted as output multipliers.

general, the responses of the macroeconomic variables display similar patterns. Firstly, GDP increases and remains significant for five quarters in both cases, becoming non-significant thereafter. These results are largely in line with previous evidence for the US and other countries. In general, government spending shocks are found to yield positive output responses in the short-term [Perotti (2004); Neri (2001); Mountford and Uhlig (2009)], although the size and persistence of output multipliers varies significantly across studies.[18]

As for the impact of a government spending shock on the other variables in the system, prices increase with respect to the baseline, leading to a hump-shaped response of inflation in both cases. Despite being a rather intuitive and, on the other hand, expected result, previous evidence is far from conclusive. For example, Fatás and Mihov (2001) and Mountford and Uhlig (2009) find negative effects on prices and inflation, whereas in the case of Marcellino (2006) the impact found is not significant in the case of Germany, Spain and Italy and positive in the case of France. In turn, Perotti (2004) reports mixed evidence depending on the country and period under consideration. Likewise, the long-term interest rate rises in response to the shock. However, some slight differences can be noticed here, notably US rates' reaction is quicker but shorter lived, whereas the positive reaction of long-term rates in the euro area appears slightly more gradual and remains significant for more than 2 years.[19]

In any case, the most salient differences between the euro area and the US are related to the responses of fiscal variables. Specifically, government spending shocks seem to be more persistent in the US than in the euro area.[20] In order to assess the reasons behind such a difference in persistence, government expenditure in the US VAR was replaced by non-military government spending. Interestingly, Figure 3 shows that non-military spending shocks in the US display a very similar degree of persistence to the impulse response of total government spending in the euro area. Therefore, the higher persistence of government expenditure shocks in the US can be attributed to the higher persistence of military spending shocks.

Another important difference relates to the reaction of net taxes. Hence, while net taxes fall in the US, their response turns out to be positive in the euro area. In order to disentangle the reasons behind such different responses, net taxes in our baseline VARs were replaced in turn by total receipts (mainly tax revenues) and transfers. Figure 4 represents the impulse responses of these variables to government spending shocks. As expected, transfers fall in the US due to the improvement in economic activity. Conversely, and surprisingly we admit, transfers rise slightly in the euro area. In turn, the response of taxes also shows a markedly different behaviour, increasing in the euro area in the first two years after the shock and declining persistently in the US. These patterns reveal a different design of fiscal packages in the US and the EMU and/or dissimilar fiscal policy reaction functions of net taxes. While expenditure build-ups in the US have often been accompanied by tax cuts,

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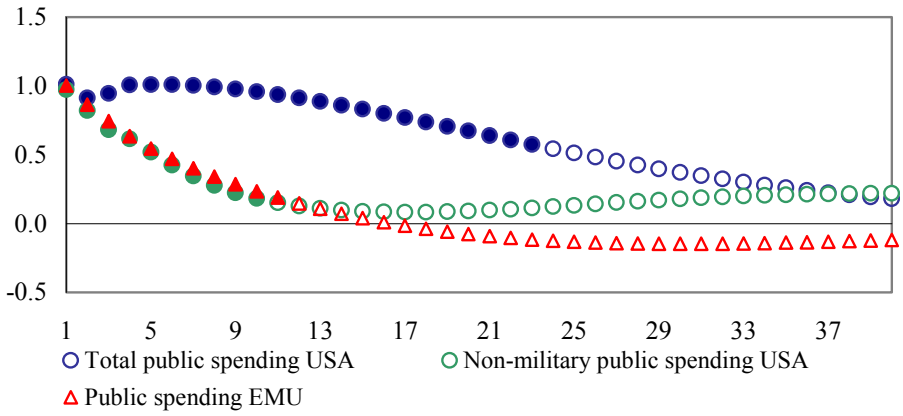
18. Caldara and Kamps (2008) show that, after controlling for differences in the specification of the reduced form model, all identification approaches used in the literature yield qualitatively and quantitatively very similar results for government spending shocks. By contrast, they find strongly diverging results for the effects of tax shocks. These differences stem from differences in the size of the automatic stabilisers estimated or calibrated under alternative identification approaches.

19. In the literature, the impact of expansionary government spending shocks on interest rates tends to be positive, although rather small [see for instance Perotti (2004)].

20. The persistence in the response of US government spending to its own shocks is also found in Blanchard and Perotti (2002). Similarly, de Castro and Hernández de Cos (2008) also observe highly persistent spending shocks in Spain. By contrast, Giordano et al. (2007) find little persistence with Italian data.

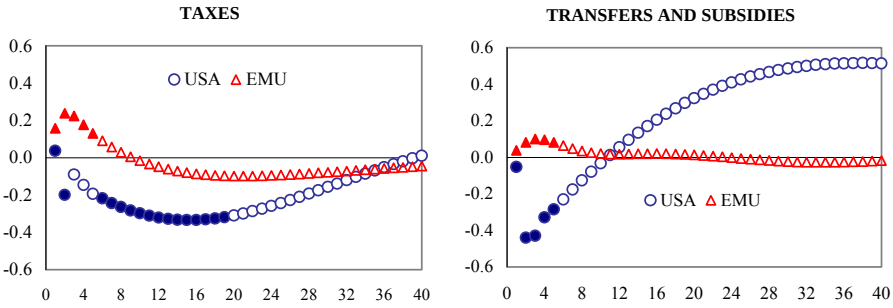
European governments on average have tried to avoid incurring large budget deficits, revealing higher concerns in relation to fiscal sustainability.[21]

Figure 3: Persistence of government spending shocks



The filled spots indicate that the impulse response is significant within a one-standard deviation band-width.

Figure 4: Responses of net tax components to a government spending shock



The filled spots indicate that the impulse response is significant within a one-standard deviation band-width.

Despite similar output responses between the euro area and the US aforementioned, impulse responses are not directly comparable in that they depend on the size of the shock. Rather, comparison should be made in terms of multipliers. However, cumulative multipliers[22] to expenditure shocks in Table 1 turn out to be very similar in both geographical areas, with differences between them being statistically insignificant given the standard errors. In both cases, these output multipliers are rather low, slightly below 1 in the first year following the shock, diminishing thereafter and becoming non-significant from the third year onwards. Such low multipliers are indicative of sizeable crowding-out effects in both economic areas.

21. In principle, higher sustainability concerns in the euro area might be justified as the challenges posed by ageing populations are to be felt more imminently.

22. The cumulative multiplier at a given quarter is obtained as the ratio of the cumulative response of GDP and the cumulative response of government expenditure at that quarter.

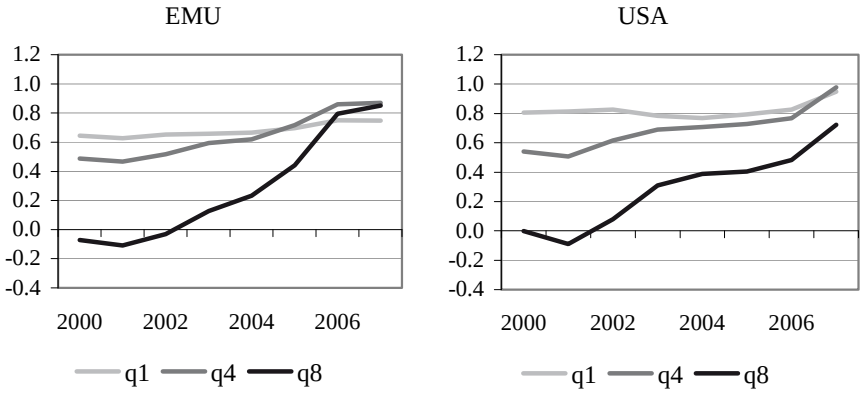
Table 1: Cumulative output multipliers

			Quarters					
			1	4	8	12	16	20
EMU	**81-07**	Government spending	0.75*	0.87*	0.85*	0.61	0.26	0.02
		Net taxes	-0.79*	-0.63*	-0.49	-0.49	-0.58	-0.74
USA	**81-07**	Government spending	0.76*	0.91*	0.67*	0.46	0.30	0.19
		Net taxes	-0.02	-0.06	-0.35*	-0.65*	-0.90	-1.11

Note: The asterisks indicate significance within the one-standard deviation band-width

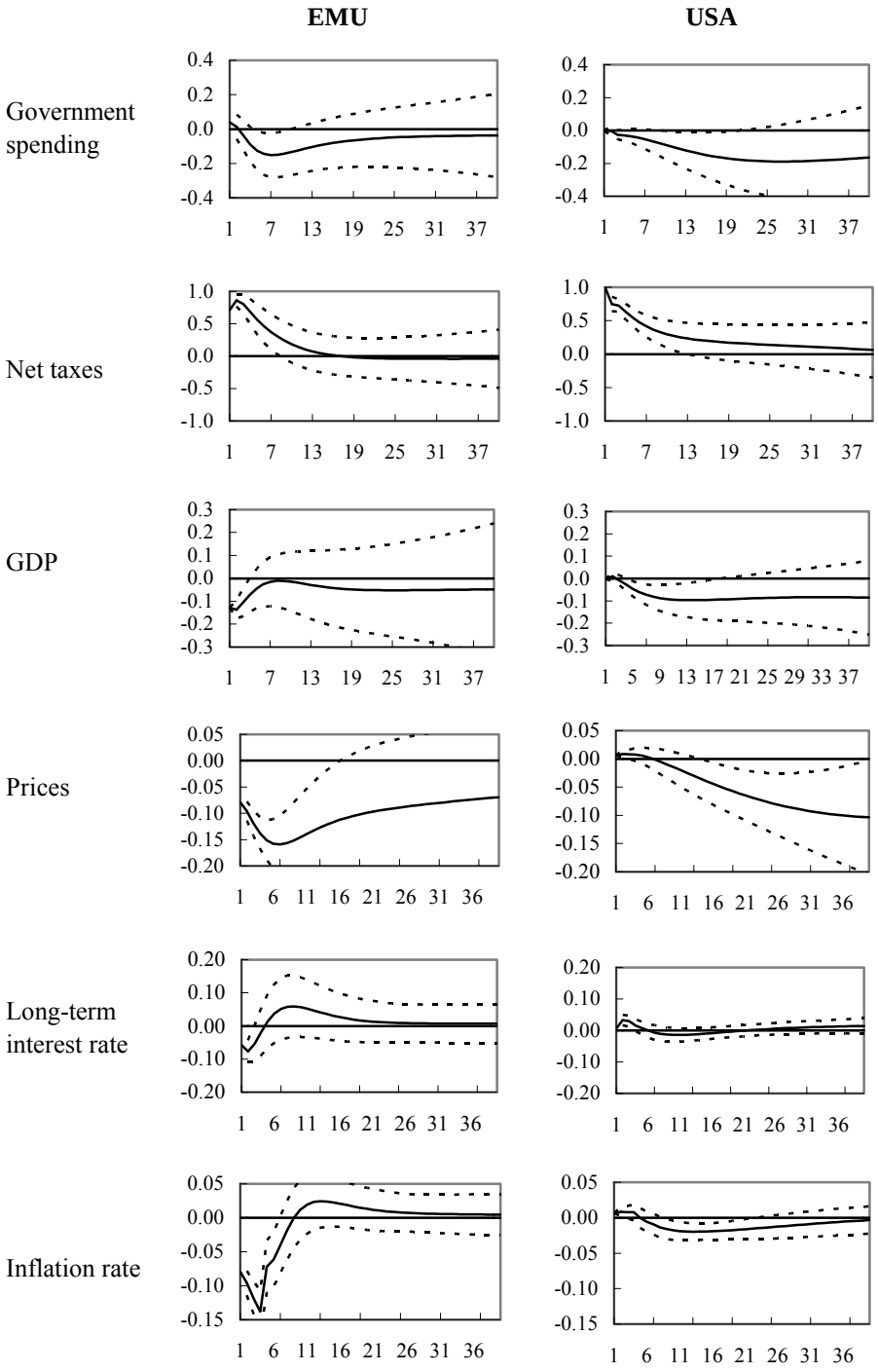
On the other hand, our output multipliers are significantly larger than those reported in Perotti (2004) for the sample covering the period 1980-2000. However, if our sample period is restricted until 2000, we obtain multipliers for the EMU and the US very similar to those obtained by Perotti. Thus, our larger output multipliers seem to be due to what has happened between 2000 and 2007. Actually, Figure 5 shows that recursive output multipliers have increased steadily since 2000 in both areas, especially at the 4th and 8th quarters after the shock. The cause of this result may be related to the "global saving glut" which might have caused a decrease in global risks premia, diminishing the crowding-out effects of fiscal policy on private investment[23]. However, this fact remains an open question that might deserve further research in the future.

Figure 5: Recursive output multipliers to government spending shocks



23. Laubach (2009) analyses the effects of public deficits and debt on interest rates and finds that the relationship between deficits and interest rates turns from positive to negative in the period after 1999:Q1.

Figure 6: Responses to an increase in net taxes



The responses to net-tax shocks are depicted in Figure 6. Specifically, GDP falls on impact in response to net-tax increases in the EMU, whereas the negative response of output in the US shows up only after some quarters. However, while the GDP response in the euro area remains significant for only three quarters, the decline of GDP in the US appears to be more persistent. Likewise, prices, and consequently inflation, fall in the quarters following the shock in the euro area, presumably due to lower demand pressures. Conversely, this kind of reaction emerges later in the US. Interestingly, interest rates fall on impact in the EMU, whereas the opposite behaviour is observed in the USA. In any case, these responses

become non-significant three quarters after the shock. Finally, government expenditure eventually falls in both the EMU and the US. In turn, output multipliers turn out to be negative and lower in absolute value than government spending output multipliers when significant (see again Table 1). Moreover, despite net-tax output multipliers being larger in the EMU[24], they are only significant during the first year after the shock. However, the delayed but more persistent GDP response in the US leads to significantly negative output multipliers during the second and third year.

As in the case of spending shocks, these results are qualitatively similar to the findings in previous studies. In general, many empirical papers find that tax multipliers are lower than spending ones in the short-term, which is consistent with the theoretical prediction that part of the higher disposable income stemming from tax cuts is saved. This is the case in Blanchard and Perotti (2002) and Mountfourd and Uhlig (2009). However, some evidence suggests that in the longer term tax multipliers could be higher than spending multipliers**.**

4.3 Financial and fiscal stress and the impact of fiscal policy

The estimates presented in the baseline VAR section should be considered as average effects in "normal times". However, there is considerable evidence showing that fiscal multipliers could be country-, time-, and circumstances-dependent. As a consequence, in addition to the stability test performed in previous sections, it is interesting to contrast to what extent our findings depend on the cyclical conditions of the economy or are conditioned by the presence of financial constrains[25] or fiscal stress [Perotti (2004)].

Controlling for financial stress leaves the baseline results broadly unchanged. In order to approximate financial stress, we included the spread of US corporate bonds in the VAR as an exogenous variable.[26] As regards impulse response functions, the results are qualitatively equal to those drawn with the baseline VAR in both the EMU and the US, with only some differences concerning the magnitude of some multipliers (see Table 2). In particular, controlling for financial stress leads, in general, to slightly higher output multipliers to spending shocks in the US, whereas the opposite is true for the EMU. Net-tax shocks also offer some discrepancies, with larger negative multipliers in the US and similar to the baseline specification in the EMU, although in this latter case the cumulative negative multiplier displays higher persistence. These results suggest that, in periods of uncertainty and financial stress, EMU consumers could be "less Ricardian" than their American counterparts where

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24. It is worth noting here that the selection of the seasonal adjustment method affects output multipliers, even though qualitative and quantitative results are quite similar when using alternative methods. This sensitivity to the seasonal-adjustment method is a well-know issue in the specialised econometric literature. For the sake of transparency, we report alternative results in this footnote. If instead of using the model-consistent seasonally-adjusted time series and alternative method like TRAMO-SEATS were used (see Gómez and Maraval, 1996), cumulative output multipliers to public spending shocks would have been estimated at 1.04 in q1, 1.13 in q4, 1.16 in q8, 1.03 in q12, 0.90 in q16 and 0.80 in q20, being still significant along the third year after the shock. These multipliers are somewhat higher than those reported in Table 1. In the case of shocks to net taxes multipliers are somewhat smaller than those in Table 1: -0.32 in q1, -0.30 in q4, -0.26 in q8, -0.19 in q12, -0.12 in q16 and -0.06 in q20, although only significant during the first year following the shock.

25. Tagkalakis (2008), with a panel of nineteen OECD countries, finds that in the presence of binding liquidity constraints on households, fiscal policy is more effective in boosting private consumption in recessions than in expansions.

26. In the case of the Euro area, there is not a market for corporate bonds before 1999. However, given that financial markets are highly integrated, the spread of US corporate bonds appears as a sensible proxy. IN any case, we also included in the analysis a similar spread for Germany as a proxy for the euro area. The results in this latter case are almost indistinguishable from those with the US spread.

households prefer to save.[27] However, in view of the width of confidence intervals, differences in point estimates with respect to the baseline do not seem significant, except maybe for the case of shocks to net taxes in the US.

Regarding "fiscal stress", Perotti (1999) provides some evidence showing that initial fiscal conditions —such as the initial level of debt— are important determinants of the effects of fiscal policy shocks.[28] Therefore, in order to account for the possibility of non-linear responses to fiscal shocks, we included in our VAR the changes in the debt-to-GDP ratio. This led to significant changes in the results as Table 2 shows. In particular, our evidence points out that when we control for fiscal stress, spending and tax multipliers are higher and more persistent, especially in the EMU. This behaviour appears consistent with the hypothesis that European consumers perceive sustainability concerns due to the challenges posed by ageing populations more intensively.

Table 2: Cumulative output multipliers with fiscal and financial constraints

			Quarters					
			1	4	8	12	16	20
Expenditure shocks								
	81-07	**Baseline**	**0.75***	**0.87***	**0.85***	**0.61**	**0.26**	**0.02**
EMU		With financial stress	0.74*	0.81*	0.70*	0.39	-0.03	-0.55
		With fiscal stress	0.91*	1.16*	1.46*	1.66*	1.85*	2.04*
	81-07	**Baseline**	**0.76***	**0.91***	**0.67***	**0.46**	**0.30**	**0.19**
USA		With financial stress	0.81*	1.07*	0.82*	0.53	0.29	0.11
		With fiscal stress	0.82*	1.26*	1.34*	1.37*	1.42*	1.49*
Net-tax shocks								
	81-07	**Baseline**	**-0.79***	**-0.63***	**-0.49**	**-0.49**	**-0.58**	**-0.74**
EMU		With financial stress	-0.87*	-0.78*	-0.69	-0.63	-0.61	-0.64
		With fiscal stress	-1.53*	-1.41*	-1.90*	-2.90	-4.44	-6.61
	81-07	**Baseline**	**-0.02**	**-0.06***	**-0.35***	**-0.65**	**-0.90**	**-1.11**
USA		With financial stress	-0.26*	-0.57*	-0.92*	-1.23	-1.49	-1.71
		With fiscal stress	-0.01*	-0.28*	-0.67*	-1.04*	-1.42*	-1.81

Note: The asterisks indicate significance within the one-standard deviation band-width

27. The multipliers obtained after controlling for stress situations cannot be interpreted as the multipliers observed under stress situations; rather they are the remaining effect on the multipliers after having "cleaned" for the sheer effect on output multipliers of changes in the proxy variables for stress situations.

28. In the same line, Favero and Giavazzi (2007) argue that the omission of public debt in the VAR leads to biased results as they fail to take into account the debt dynamics induced by fiscal shocks. In fact, they find lower spending multipliers when the debt feedback is taken into account.

4.4 Responses of private consumption and investment to fiscal shocks

Theory and evidence regarding the way an increase in government spending or a tax shock affects private consumption are not conclusive. In particular, neoclassical models predict a negative response of this variable [Baxter and King (1993)], while the opposite is found in Keynesian and neo-Keynesian models. On empirical grounds, Fatas and Mihov (2001), Blanchard and Perotti (2002) and Gali, López Salido and Vallés (2004) find that the reaction of private consumption to an unexpected government spending shock is positive and persistent. On the contrary, Mountford and Uhlig (2009) find that the response of private consumption is statistically insignificant, while Ramey (2007) provides evidence of a negative reaction of private consumption.

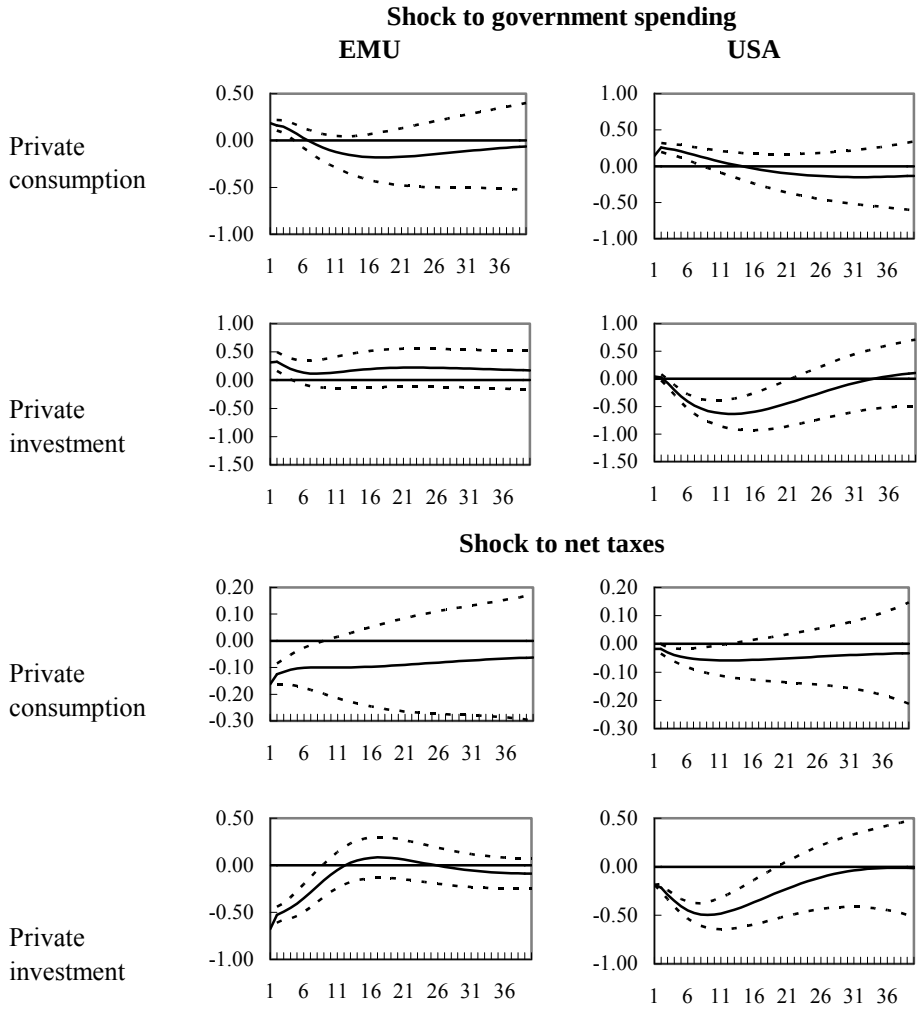
Table 3: Cumulative multipliers for the main GDP components

			Quarters					
			1	4	8	12	16	20
Expenditure shocks								
	81-07	**Output**	**0.75***	**0.87***	**0.85***	**0.61**	**0.26**	**0.02**
EMU		Private consumption	0.48*	0.46*	0.31*	0.09	-0.18	-0.48
		Private Investment	0.25*	0.28*	0.35*	0.26*	0.29	0.34
	81-07	**Output**	**0.76***	**0.91***	**0.67***	**0.46**	**0.30**	**0.19**
USA		Private consumption	0.49*	0.77*	0.67*	0.54*	0.41	0.29
		Private Investment	0.20*	-0.32*	-1.69*	-3.02*	-4.34*	-5.72*
Net-tax shocks								
	81-07	**Output**	**-0.79***	**-0.63***	**-0.49**	**-0.49**	**-0.58**	**-0.74**
EMU		Private consumption	-0.73*	-0.46*	-0.51*	-0.65	-0.84	-1.06
		Private Investment	-2.30*	-2.83	-9.93	-21.83	-8.97	-4.68
	81-07	**Output**	**-0.02**	**-0.06***	**-0.35***	**-0.65**	**-0.90**	**-1.11**
USA		Private consumption	-0.13*	-0.22*	-0.28*	-0.30	-0.32	-0.34
		Private Investment	-0.23*	-0.55*	-1.25	-2.25	-3.49	-4.71

Note: The asterisks indicate significance within the one-standard deviation band-width

As regards investment, theory and evidence point to significant crowding-out effects after a fiscal shock: For instance, Blanchard and Perotti (2002), Mountford and Uhlig (2009) and Afonso and Sousa (2009a) find that investment falls in response to a positive spending shock. As for taxes, Romer and Romer (2007) find that tax increases have a large negative effect on investment.

Figure 7: Responses of private consumption and investment



In order to assess the responses of these variables, they were included in turn in the VAR replacing GDP.[29] Figure 7 displays the responses of private consumption and investment to both spending and net-tax shocks. The responses of private consumption broadly mimic those of GDP in the baseline VAR, notably increasing after a government spending shock, in line with Keynesian and neo-Keynesian models, although such positive response phases out rather quickly. On the other hand, an increase in net taxes brings private consumption downwards in the quarters following the shock in both cases, and the response becomes insignificant after the second year. As Table 3 shows, private consumption multipliers are, in general, lower than GDP ones after a shock to government spending in both geographical areas, and in all cases below unity, whereas they are of similar magnitude after a shock to net taxes (with the exception of the US along the first year following the shock).

In turn, a shock to government spending brings about a negative response of private investment in the US, unveiling a sizeable crowding-out effect. However, private investment in

29. To identify the fiscal shocks, we need to compute the elasticities of fiscal variables to private consumption and investment. They are gauged by multiplying the GDP elasticities by the inverse of the output elasticities of private consumption and investment, respectively.

the euro area increases after this type of shocks, in line with the accelerator hypothesis. This different behaviour of private investment might be related to the slower reaction of interest rates in the euro area, assuaging thereby the crowding-out of private expenditure.[30] In the case of a shock to net taxes, private investment falls in both the euro area and the US.

4.5 The effects of different expenditure and net-tax components

In general, the literature on the quality of public finances presents evidence showing that the different government expenditure items or net-tax components entail different effects on economic variables, although there is no strong evidence regarding their short-term impact. As for the composition of expenditure, Baxter and King (1993) argue that an increase in government investment has a stronger impact on output than an increase in government consumption.[31] In order to provide some evidence in this direction, the fiscal variables in the baseline VAR were replaced by some components. Thus, government spending was replaced in turn by public consumption and investment, whereas net taxes left their place to taxes and transfers, respectively.

As Figures 8 and 9 show, public consumption and investment shocks lead to qualitatively similar results, with mildly positive and short-lived GDP responses and higher inflation. However, output multipliers stemming from public investment shocks turn out to be much higher than those due to government consumption (see Table 4) and to government spending as a whole. This evidence is consistent with Baxter and King (1993) and suggests the presence of spillovers between public investment and private sector productivity.[32]

Table 4: Cumulative output multipliers of public consumption and investment

			Quarters					
			1	4	8	12	16	20
	81-07	**Government spending**	**0.75***	**0.87***	**0.85***	**0.61**	**0.26**	**0.02**
EMU		Public consumption	0.86*	1.14*	1.26*	1.16	1.00	0.84
		Public investment	1.56*	1.61*	1.59*	0.92	-0.20	-1.61
	81-07	**Government spending**	**0.76***	**0.91***	**0.67***	**0.46**	**0.30**	**0.19**
USA		Public consumption	0.49*	0.73*	0.55*	0.37	0.20	0.08
		Public investment	2.00*	1.96*	0.90	0.17	-0.29	-0.57

Note: The asterisks indicate significance within the one-standard deviation band-width

30. However, given that multipliers in Table 3 are derived from different VAR models, the net-exports contribution to demand growth cannot be directly obtained as the difference between output multipliers and, on the other hand, private consumption and private investment multipliers. To do so, a VAR including all demand components, jointly with some constraints, should be estimated. Moreover, the role played by inventories cannot be disregarded.

31. De Castro and Hernández de Cos (2008) obtain similar evidence for Spain.

32 See also Heppke-Falk et al. (2006) for Germany. On the contrary, Fatás and Mihov (2001) find very small effects of public investment expenditure on output.

Figure 8: Responses to an increase in government consumption

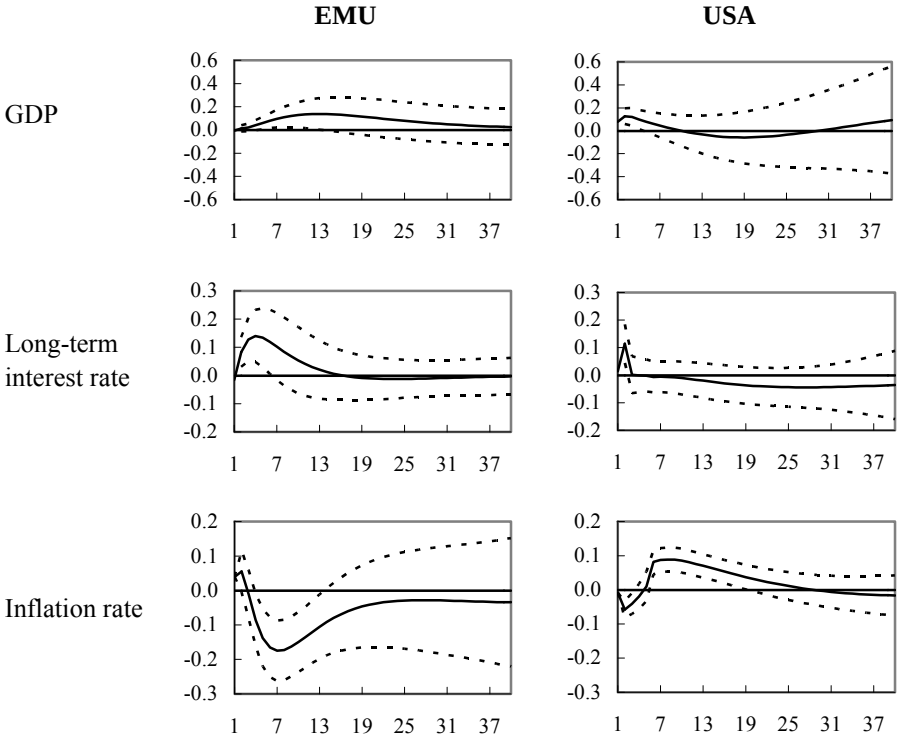
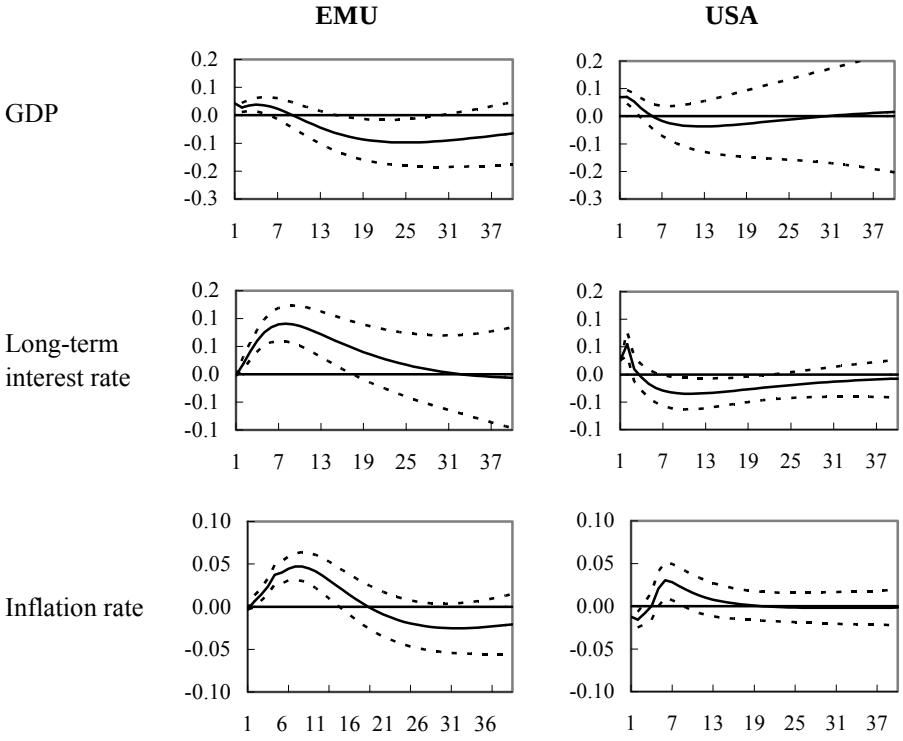
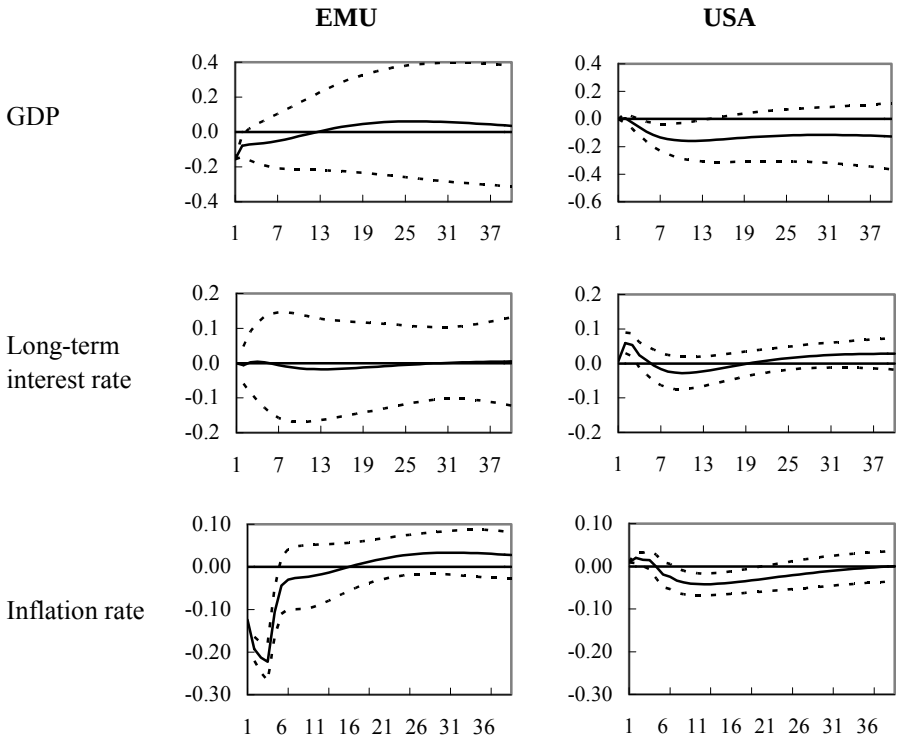


Figure 9: Responses to an increase in public investment



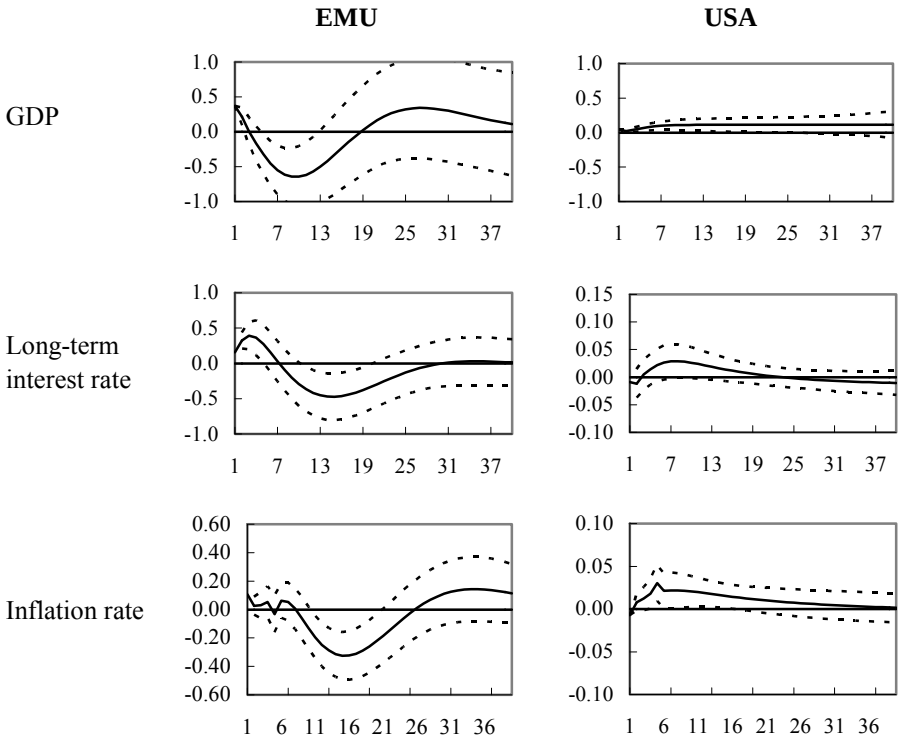
As for the components of net taxes, higher taxes entail negative responses of GDP in both areas, although consumers in EMU seem to react more quickly to discretionary taxes changes. In both cases, the inflation rate falls below the baseline whereas long-term interest rates barely react to this type of shocks (see Figure 10).

Figure 10: Responses to an increase in taxes



Responses to transfers shocks appear different, though. While the subsequent output rise in the US is quite persistent, the initial increase in the EMU reverts after some quarters, turning to negative (see Figure 11). In fact, this different behaviour might be related to the upward response of interest rates on impact in the euro area. As far as inflation is concerned, it goes up in the short run in the US, phasing out after the 6th quarter after the shock. By contrast, inflation in the euro area only declines in the medium term.

Figure 11: Responses to an increase in transfers



4.6 Robustness checks

In order to check the robustness of our baseline results, we tried some alternative VAR specifications. Moreover, we also assessed the sensitivity of our results to different values for the contemporaneous price elasticity of government expenditure (set to -0.5 in the baseline). Since the profiles of impulse-response functions were very similar in all cases, we only present the implications for output multipliers in the fourth and eight quarters after the shock. These can be found in Table 5.

Cumulative output multipliers, in both the EMU and the US, in Table 5 are barely affected by the inclusion of deterministic trends or by increasing the lag length. Despite some minor differences in point estimates, these always fall within the one-standard deviation band-width of baseline estimates. Accordingly, one can conclude that the multipliers under these alternative specifications are not statistically different from baseline ones. This is also the case when extreme values, namely 0 and -1, price elasticities of government expenditure are set. However, one interesting result is drawn in this latter case: differences in output multipliers to government spending shocks between the EMU and the US widen markedly, becoming even significant in some cases. Hence, when the price elasticity of government expenditure is set to -1 (nominal government spending does not react contemporaneously to price changes), point estimates of output multiplies to spending shocks increase in the euro area and reduce in the US, whereas the opposite result is observed when this elasticity is set to 0.

Table 5: Output multipliers under alternative specifications

	4 quarters ahead			8 quarters ahead		
	Response	Upper-band	Lower-band	**Response**	Upper-band	Lower-band
Expenditure shocks						
UEM baseline	**0.87**	1.13	0.61	**0.85**	1.34	0.36
UEM time trend	**0.90**	1.17	0.64	**0.85**	1.36	0.34
UEM 4 lags	**0.88**	1.14	0.62	**0.88**	1.39	0.37
UEM α_{gp}= 0	**0.80**	1.05	0.55	**0.77**	1.27	0.27
UEM α_{gp}= -1	**0.94**	1.20	0.68	**0.93**	1.43	0.43
Dummy 1990	**0.85**	1.12	0.58	**0.85**	1.34	0.36
Dummy Maastricht	**0.55**	0.82	0.28	**0.51**	1.08	-0.06
Dummy Stability and Growth Pact	**0.95**	1.22	0.68	**1.25**	1.74	0.76
Dummy EMU	**0.85**	1.11	0.59	**0.86**	1.36	0.36
Since reunification	**1.66**	1.97	1.36	**1.91**	2.55	1.28
USA baseline	**0.91**	1.20	0.62	**0.67**	1.06	0.28
USA time trend	**0.65**	0.99	0.30	**0.53**	1.00	0.05
USA 4 lags	**1.08**	1.42	0.74	**0.89**	1.43	0.35
USA α_{gp}= 0	**1.06**	1.34	0.78	**0.88**	1.24	0.52
USA α_{gp}= -1	**0.75**	1.06	0.45	**0.43**	0.86	0.00
Net-tax shocks						
UEM baseline	**-0.63**	-0.33	-0.94	**-0.49**	0.52	-1.50
UEM time trend	**-0.80**	-0.43	-1.16	**-0.51**	0.25	-1.27
UEM 4 lags	**-0.62**	-0.30	-0.94	**-0.40**	0.42	-1.22
UEM α_{gp}= 0	**-0.65**	-0.33	-0.97	**-0.50**	0.38	-1.38
UEM α_{gp}= -1	**-0.59**	-0.26	-0.92	**-0.47**	0.63	-1.57
Dummy 1990	**-0.73**	-0.43	-1.03	**-0.68**	0.06	-1.42
Dummy Maastricht	**-0.48**	-0.22	-0.74	**-0.33**	0.29	-0.95
Dummy Stability and Growth Pact	**-0.69**	-0.39	-0.99	**-0.62**	0.12	-1.36
Dummy EMU	**-0.63**	-0.32	-0.94	**-0.48**	0.24	-1.20
Since reunification	**-0.38**	-0.12	-0.63	**-0.32**	0.28	-0.91
USA baseline	**-0.06**	0.07	-0.18	**-0.35**	-0.06	-0.64
USA time trend	**0.09**	0.24	-0.06	**0.03**	0.41	-0.35
USA 4 lags	**-0.12**	0.02	-0.26	**-0.38**	-0.03	-0.73
USA α_{gp}= 0	**-0.05**	0.08	-0.17	**-0.34**	-0.03	-0.65
USA α_{gp}= -1	**-0.06**	0.07	-0.20	**-0.36**	-0.02	-0.70

As for the euro area itself, it can be argued that important structural breaks might be present in our sample, notably the Maastricht Treaty, the implementation of the Stability and Growth Pact or the start of EMU, with the adoption of the euro as the single currency. Potentially, these episodes might condition fiscal policy implementation and, consequently, the responses to fiscal shocks. In order to assess the empirical relevance of this criticism, we have introduced several robustness checks.

First, we included dummy variables aimed at capturing any of these possible structural breaks. In particular, in one of the specifications tried, we introduced a dummy variable taking the value 1 in the post-EMU period and 0 otherwise (rows "dummy EMU" in Table 5). Our estimates show that the inclusion of dummy variables do not affect qualitatively the results and output multipliers barely change in many cases, except for the Maastricht or the Stability Pact ones. Even in these cases, output multipliers fall within the one-standard

deviation confidence bands of baseline estimates, for which differences cannot be deemed as statistically significant. In fact, these dummies are non-significant in most of the equations, which is consistent with the idea that the process to EMU accession has been a rather smooth process that started affecting the respective economic systems well before its official start, at least from the point of view of fiscal policy.

Moreover, in order to test the stability of our results to the German-reunification and whether or not this event entailed a fiscal policy regime shift, we have also constrained the estimation to the sample ranging as of 1991. Albeit our results are qualitatively similar to our baseline VAR, output multipliers turn out to be somewhat different. Specifically, output multipliers to expenditure shocks are remarkably higher (row "since reunification" in Table 5), whereas multipliers to net-tax shocks become non-significant.

Finally, one could argue that assessing the effects of fiscal shocks in the euro area does not make much sense before its start in 1999. In order to take into account such criticism, we split our sample in 1995[33] and estimated the VAR for the more recent period. The results, however, did not differ qualitatively from those reported in the previous sub-section. In particular, GDP, inflation and interest rates showed positive responses to spending shocks, although estimated very imprecisely mainly due to the few observations relative to the number of coefficients to be estimated. Furthermore, we estimated the VAR for the period 1981-1998. While the short-term responses displayed the same signs as with the baseline VAR, output multipliers to spending shocks were significantly lower, estimated at around 0.3 although non-significant. However, as we showed before, rather than being exclusively due to changeover to the euro, such slow multipliers are also observed in the US for a similar period.

33. Even though the decision on EMU entry was taken on the basis of the Commission fiscal estimates/projections for 1998, reflecting planned deficits, we decided to take as break point for the sample 1995. The decision reflects the fact that the 1999-2007 period is too short for the estimation of the VARs; nevertheless, a usual argument in the literature is to claim that agents already anticipated the start-up of the EMU before the actual start in 1999, and thus, 1995 or 1997 is typically chosen in empirical studies as a sensible date for the purposes of estimation.

5 Conclusions

This paper contributes to previous literature analysing the effects of fiscal policy for the euro area as a whole, employing a new database that contains quarterly fiscal variables. The use of a common methodology for the euro area and the US economy allows drawing some interesting conclusions.

In line with previous evidence, we find that GDP and inflation increase in response to government spending shocks, although output multipliers are, in general, very similar in both areas and small, typically below unity. However, we provide evidence of output multipliers increasing steadily after 2000 in both the EMU and the US, possibly related to the "global saving glut". On the other hand, government expenditure shocks show a higher degree of persistence in the US, which seems to be explained by the persistence of military spending. In turn, net-tax increases weight on economic activity, with the negative response being shorter-lived in the euro area. In any case, these effects do not appear sizeable. In line with previous studies, we find that tax multipliers are lower than spending ones in the short-term.

As for the reaction of the main GDP components, as expected, private consumption displays similar pattern responses to GDP in both the euro area and the US. Private investment responses are not so homogeneous though: it declines in response to higher government spending or net taxes in the US, whereas in the EMU only tax increases seem to entail a negative reaction of private investment.

Finally, we allow for the possibility of non-linear effects of fiscal policy depending on a set of circumstances. In particular, we analyse the implications of financial and fiscal stress prevailing in the economy. Controlling for these stress situations does not change the pattern of impulse responses, although it may affect output multipliers. In particular, in the case of financial stress, differences with respect to the baseline VAR, in general, do not seem to be statistically significant. However, when we control for fiscal stress, spending and tax multipliers become higher and more persistent, especially in the EMU.

Appendix A. Construction of output and price elasticities

In order to calculate the output and price elasticities we basically follow the OECD methodology proposed in Giorno et al. (1995), which focuses on four tax categories, i.e. personal income tax, corporate income tax, indirect taxes and social security contributions. In addition, they consider the elasticity of transfer programmes, notably unemployment benefits. On this issue, in more general terms see Golinelli and Momigliano (2009) for a survey of the cyclical response of fiscal policies.

According to this methodology, the output elasticity of the personal income tax can be obtained as:

$$\varepsilon_{tdirh,y} = (\varepsilon_{tdirh,w}\varepsilon_{w,emp} + 1)\varepsilon_{emp,y} \quad \text{(A.1)}$$

where $\varepsilon_{tdirh,w}$ is the elasticity of personal income tax revenues to earnings, measured by the compensation per employee, $\varepsilon_{w,emp}$ is the employment elasticity of the real wage and $\varepsilon_{emp,y}$ the GDP elasticity of employment. Analogously, the output elasticity of social security contributions is:

$$\varepsilon_{ss,y} = (\varepsilon_{ss,w}\varepsilon_{w,emp} + 1)\varepsilon_{emp,y} \quad \text{(A.2)}$$

with $\varepsilon_{ss,w}$ being the elasticity of social contributions to earnings.

The output elasticity of corporate income tax revenues stems from:

$$\varepsilon_{tdirc,y} = \varepsilon_{tdirc,gos}\varepsilon_{gos,y} \quad \text{(A.3)}$$

where $\varepsilon_{tdirc,gos}$ is the elasticity of tax revenues to the gross operating surplus and $\varepsilon_{gos,y}$ the output elasticity of the gross operating surplus. In the same fashion, given that the main tax base for indirect tax collections is private consumption, the output elasticity of indirect taxes is obtained as:

$$\varepsilon_{tind,y} = \varepsilon_{tind,c}\varepsilon_{c,y} \quad \text{(A.4)}$$

where $\varepsilon_{tind,c}$ and $\varepsilon_{c,y}$ are the private consumption elasticity of indirect taxes and the output elasticity of private consumption, respectively.

Since we employ data on a national accounts basis, collection lags should not affect the elasticities to the respective tax-bases significantly. Hence, these have been taken from van den Noord (2000) and Bouthevillain et al. (2001). The output elasticities of the relevant tax

bases were, however, obtained from econometric estimation on a quarterly basis. In general, the general equation used for estimating these elasticities was:

$$\Delta Ln(B_t^i) = \gamma + \varepsilon_i \Delta Ln(Y_t) + \eta_t \tag{A.5}$$

where B^i is the relevant tax base for the i[th] tax category and ε_i is the output elasticity of such tax base. These equations, given the likely contemporaneous correlation between the independent variable and the error term, were estimated by instrumental variables. However, if the variables B^i and Y are cointegrated, (A.5) contains a specification error. In this case, the following ECM specification would be preferable:

$$\begin{aligned}\Delta Ln(B_t^i) = \gamma + \mu(Ln(B_{t-1}^i) - \lambda Ln(Y_{t-1}) - \phi) + \varepsilon_i \Delta Ln(Y_t) \\ + \sum_{j=1}^{k} \varphi_j \Delta Ln(Y_{t-j}) + \sum_{j=1}^{k} \nu_j \Delta Ln(B_{t-j}^i) + \eta_t\end{aligned} \tag{A.6}$$

where λ measures the long-term contemporaneous elasticity we are interested in.

Information on the output elasticity of net transfers is more limited than in the former cases. Although unemployment benefits respond to the underlying economic conditions, many expenditure programmes do not have built-in conditions that make them respond contemporaneously to employment or output. Therefore, recalling Perotti's argument, an output elasticity of net transfers of -0.2 has been assumed.

As for price elasticities, following van der Noord (2000) the elasticity of direct taxes paid by households, corporate income taxes and social contributions were obtained as $\varepsilon_{tdirh,p} = \varepsilon_{tdirh,w} - 1$ (yielding 0.9), $\varepsilon_{tdirc,p} = \varepsilon_{tdirc,gos} - 1$ (with a value equal to 0) and $\varepsilon_{ss,p} = \varepsilon_{ss,w} - 1$ (being -0.1), respectively. Indirect taxes are typically proportional. Hence, following Perotti (2004), a zero price elasticity was assumed. Finally, although transfer programmes are indexed to the CPI, indexation occurs with a considerable lag. Thus, the price elasticity of transfers was set to -1. Table A.1 shows the resulting output and price elasticities.

Table A.1: Output and price elasticities of net taxes

	USA	EMU
$\varepsilon_{tdirh,w}$	1.9	2.0
$\varepsilon_{w,emp}$	0.8	0.65
$\varepsilon_{emp,y}$	0.55	0.39
$\varepsilon_{ss,w}$	0.9	1.0
$\varepsilon_{tdirc,gos}$	1.0	1.0
$\varepsilon_{gos,y}$	0.92	1.08
$\varepsilon_{c,y}$	0.95	0.97
$\varepsilon_{tind,c}$	1.0	1.0
Output elasticities		
$\varepsilon_{tdirh,y}$	1.39	0.90
$\varepsilon_{ss,y}$	0.95	0.64
$\varepsilon_{tdirc,y}$	0.92	1.08
$\varepsilon_{tind,y}$	0.95	0.97
$\varepsilon_{transf,y}$	-0.2	-0.2
$\boldsymbol{\varepsilon_{t,y}}$	**1.94**	**1.54**
Price elasticities		
$\varepsilon_{tdir,p}$	0.9	1.0
$\varepsilon_{ss,p}$	-0.1	0.0
$\varepsilon_{tind,p}$	0.0	0.0
$\varepsilon_{transf,p}$	-1.0	-1.0
$\boldsymbol{\varepsilon_{t,p}}$	**1.15**	**1.14**

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