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Fiscal multipliers in deep economic recessions and the case for a 2-year extension in Greece's austerity programme

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This paper presents two distinct empirical methodologies for deriving estimates of fiscal multipliers in Greece in periods of economic expansion and recession. Our results seem to provide support to the findings of some recent empirical studies documenting much higher fiscal multipliers in recessionary conditions than in expansionary output phases. Yet, our study contains a number of interesting novel features, related not only to the data series and variables used, but also as regards its technical aspects.

In particular, our Structural Vector Autoregression (**SVAR**) models estimate government *spending multipliers* that are not far away from what has been estimated for Greece in a number of earlier empirical studies (i.e., multipliers in the vicinity of 0.5). However, our (regime-switching) Smooth Transition Vector Autoregression (**STVAR**) models estimate *strongly significant* government spending multipliers that are as high as 1.32 in recessionary phases along with negative (and broadly insignificant) multipliers for periods of economic expansion. This finding is particularly pronounced for government *wage* expenditure, where the estimated multiplier is found to be as high as 2.35 (and strongly significant) in recessionary regimes and negative (and largely insignificant) in economic expansions.

Based on the aforementioned, we examine a number of different scenarios regarding the structure and the implementation profile of a new austerity package Greece is currently negotiating with the EC/ECB/IMF troika of official lenders as part of the conditionality underlying the new bailout programme agreed in early 2012. The purpose of this exercise is to estimate the extent of potential output losses due to fiscal austerity (fiscal drag) as well as the ensuing increases in the public debt to GDP ratio and the government borrowing requirement.

Overall, our results appear to be making a fairly strong argument in favor of a 2-year extension in the new austerity programme along with a more gradual implementation profile of related expenditure cuts and revenue generating measures. From a more *qualitative* perspective, a 2-year extension in the new fiscal adjustment programme could also have other positive consequences. Among other, it could: **(i)** increase the credibility of the new (revised) fiscal targets, as the government would now need to improve its primary position in a more gradual fashion and **(ii)** have less severe repercussions for domestic social cohesion and political stability, especially since an extension of the new fiscal programme (by at least two years) has been a key aim of ruling coalition partners' programmatic agreement.

1. Non-technical summary

Prior theoretical and empirical work on the response of main macroeconomic aggregates to exogenous fiscal shocks has shown that the *size* and, in certain instances, the *sign* of the *fiscal multiplier* can be *country-*, *estimation method-* and *economic conditions-specific*. In general, it appears that quite diverse views continue to exist among professional economists and policy makers as regards the quantitative and qualitative effects of fiscal policy.

The ongoing debate over the potential effects of fiscal policy changes on output and other macroeconomic aggregates has elevated to a new dimension following the outbreak of the 2007/2008 global financial crisis, as governments around the globe introduced significant fiscal stimulus packages in an effort to contain the ensuing contraction in economic activity. More recently, and as a response to the deepening sovereign debt crisis, the fiscal policy stance in a number of euro area periphery economies has again shifted into a highly restrictive territory.

In Greece, an internal devaluation programme has been in place since May 2010, when the country signed its first bailout programme with its euro area partners and the IMF. A second support programme was agreed in early 2012, aiming to provide coverage of the government borrowing need for the period 2012-2014 and to ensure attainability of following strategic objectives: erase past competitiveness losses and facilitate a return to sustainable medium-term growth, reinstate fiscal sustainability and safeguard the stability of the domestic financial system.

As an important part of the conditionality underlying the second bailout programme, Greece committed earlier this year to implement a new fiscal austerity package for the period 2013-2014, consisting mainly of expenditure-side measures. The identification of measures comprising the said package (and their ratification by the Greek Parliament) constitute a key prerequisite for the release of the next EFSF-IMF loan tranche (€31.3bn) that was originally due to arrive in June 2012, but was eventually delayed as a result of the prolonged pre-election period.

As of the time of writing this report, a final agreement between the Greek government and the troika on the modalities of the new austerity package was still pending, with official sources and press reports suggesting that an agreement was imminent as the two sides have already concurred on the main bulk of its components. According to current planning, the new austerity package will need to be applied in the period 2013-2104, feature a front-loaded implementation profile and generate a net fiscal improvement (*i.e.,* reduce the general government primary deficit) by ca €13.6bn.

The new austerity package will inevitably unleash additional deflationary pressures on the domestic economy, at least during the initial phase of its implementation, especially as the bulk of new measures target further reductions in wages, pension and special benefits. As per the Greek draft 2013 budget that was submitted to Parliament in early October 2012, the new austerity measures are expected to have a *net* impact on domestic output of (*i.e.,* reduce nominal GDP) by around €5.34bn. Based on the draft budget's assumption we estimate the net impact of the new package on output to be a further GDP contraction of ca €3bn in 2014.

These estimates assume a certain time-implementation profile of the new package that should be considered preliminary and subject to sizeable revisions upon a final agreement between the government and the troika on the modalities of the new package. Yet, they imply certain assumptions on the size of fiscal multipliers, which are not far from what a number of earlier studies by *e.g.* the IMF, the OECD and others have estimated for Greece.

But, what if the size of fiscal multipliers in the present deep recessionary conditions proves out to be much higher than that assumed by the official sector? What would be the ramifications for domestic output and, by implication, public debt dynamics and the evolution of the government's borrowing requirement in the years ahead? How would a more gradual implementation of austerity measures affect domestic economic conditions and debt dynamics, under a scenario envisaging a 2-year extension in the new austerity programme? Finally, what explains the fact that Greek GDP growth has been persistently undershooting official sector forecasts since the signing of the first bailout programme in May 2010?

This paper attempts to address these and other relevant issues, by presenting two distinct empirical methodologies for deriving estimates of fiscal multipliers in Greece during periods of economic expansion and recession. Our results seem to provide support to the findings of some recent empirical studies documenting much higher fiscal multipliers in recessionary conditions than in expansionary output phases. Yet, our study contains a number of interesting novel features related not only to the data series and variables used, but also as regards its technical aspects.

In particular, our Structural Vector Autoregression (**SVAR**) models estimate government *spending multiplier*s that are not far away from what has been estimated for Greece in a number of earlier empirical studies (i.e., multipliers in the vicinity of 0.4-0.5). However, our (regime-switching) Smooth Transition Vector Autoregression *(***STVAR**) models estimate *strongly significant* government spending multipliers that are as high as 1.32 in recessionary phases along with negative (and broadly insignificant) multipliers for periods of economic expansion. This finding is particularly pronounced for government *wage* expenditure, where the estimated multiplier is found to be as high as 2.35 (and strongly significant) in recessionary regimes and negative (and largely insignificant) in economic expansions. Based on the aforementioned, we examine a number of different scenarios regarding the time-of-implementation profile of the new austerity package and the size of fiscal multipliers under different macroeconomic regimes (recession vs. expansion) to estimate the extent of potential output losses due to fiscal austerity as well as the ensuing increases in the debt to GDP ratio and the government borrowing requirement.

Under an *adverse scenario* assuming no extension in the new fiscal adjustment programme, a prolongation of the domestic recession for two more years and the maximum estimated multiplier values in recessionary regimes, we estimate GDP losses that are more than double in size those currently suggested by official forecasts. By implications, under the aforementioned scenario, the ensuing rise in the public debt ratio and the government borrowing requirement is found to be higher than expected currently by the official sector. On a less worrying note, under a *less adverse scenario* envisaging a 2 year extension (and a more gradual implementation profile of the new austerity measures) as well as a faster stabilization of domestic output, cumulative GDP losses in 2013-2016 due to fiscal austerity are estimated to be nearly half these estimated under the first scenario for the period 2013-2014.

It should be emphasized that the above results are derived on a *ceteris paribus* basis and refer to the *net* impact of fiscal austerity on output (fiscal drag), the government's borrowing requirement and the dynamics of the debt to GDP ratio, under the different scenarios under examination. As such, they *do not* represent forecasts of the aforementioned response variables (i.e., GDP, debt ratio and the government borrowing requirement) as, besides fiscal policy shocks, other factors may affect their future evolution. For instance, domestic output growth may be affected by shifts in investor sentiment towards Greece and perceptions about the country's euro membership status, domestic monetary conditions and the availability of credit, FDI inflows related to the domestic privatization program, external macroeconomic conditions as well as a multitude of other factors.

Notwithstanding the aforementioned, we interpret our results as making a fairly strong argument in favor of a 2-year extension in the new austerity programme along with a more gradual implementation profile of related expenditure cuts and revenue generating measures.

From a more *qualitative* perspective, a 2-year extension in the new fiscal adjustment programme could also have other positive consequences. Among other, it could: **(i)** increase the credibility of the new (revised) fiscal targets, as the government would now need to improve its primary position in a more gradual fashion and **(ii)** have less severe repercussions for domestic social cohesion and political stability, especially since an extension of the new fiscal programme (by at least two years) has been a key aim of ruling coalition partners' programmatic agreement.

The rest of this paper is structured as follows: Chapter 2 provides a short literature review on the determinants and estimation methods for fiscal multipliers; Chapter 3 provides a brief review of recent fiscal developments in Greece; Chapters 4 and 5 present our empirical result and their policy implications; and Chapter 6 concludes.

2. Fiscal multipliers: definition, determinants & estimation

2.1 What is the fiscal multiplier?

The term *fiscal multiplier* refers to the ratio of a change in output (ΔY) to an exogenous change in the fiscal balance (ΔG if the latter refers to a change in government spending or ΔT if it relates to a change in government revenue).[2] Depending on the time horizon considered, there are several relevant ratios that fit the term fiscal multiplier:

The *impact* multiplier, defined as the ratio of a *contemporaneous* change in output (at time t_0) to an exogenous change in the fiscal balance at time t_0 (≡ $\Delta Y(t_0) / \Delta G(t_o)$).

The multiplier at some future point in time (say, N period from now), defined as the ratio of a change in output at time t_0+N to an exogenous change in the fiscal balance at time t_0 (≡ $\Delta Y(t_0 + N) / \Delta G(t_o)$).

The *cumulative* multiplier, defined as the ratio of the cumulative change in output over an exogenous change in the fiscal balance over a time horizon of N periods (≡ $\sum \Delta Y(t_0 + i) / \Delta G(t_0)$, with i = 0, 1,…,N).

The *peak* or *maximum* multiplier, defined as the ratio of the largest change in output over any time horizon N to an exogenous change in the fiscal balance at time t_0 (≡ max $\Delta Y(t_0 + N) / \Delta G(t_o)$, for every N).

2.2 What are the determinants of the fiscal multiplier?

Prior theoretical and empirical work on the response of main macroeconomic aggregates to exogenous fiscal shocks has shown that the *size* (and, in certain instances, the *sign*) of the fiscal multiplier can be *country-*, *time-*, *estimation method-,* and *economic conditions-specific*. In general, it appears that quite diverse views continue to exist among professional economists and policy makers as regards both the quantitative and qualitative effects of fiscal policy.[3]

Ilzetzki, Mendoza and Vegh (2010) provide a quite telling example of the ongoing disagreements in the economics profession regarding the size of the fiscal multiplier. The authors referred to a January 2009 *Wall Street Journal* piece, in which Roberto Barro argued that peacetime fiscal multipliers were essentially zero, while, at the other extreme, Chair of President Obama's Council of Economic Advisers. Christina Romer, used multipliers as high as 1.6 in estimating the job gains that would be generated by the $787bn stimulus package approved by Congress in February 2009. As the aforementioned authors emphasize, *"The difference between Romer's and Barro's views of the world amounts to a staggering 3.7mn jobs by the end of 2010".*

From a purely theoretical perspective, neoclassical models would predict that a positive shock to government spending would lead to a crowding out of private consumption, while Keynesian and some neokeynesian models would predict the opposite effect. To complicate things further, uncertainty regarding the size (or even the sign) of the fiscal multiplier in developing and emerging markets is even higher, not only because of the scarcity of timely and reliable national and government account statistics, but also because of a long history of fiscal profligacy and sovereign debt crises that have blurred the credibility and sustainability of any fiscal expansion.

In a recent paper, Spilimbergo et al (2011) provide some stylized facts on the potential size and determinants of fiscal multipliers, based on an extensive literature review on the topic. As per the said study, the size of the multiplier is large if: **a)** "leakages" are limited *i.e.,* only a small part of the fiscal stimulus is channeled to savings or imports; **b)** monetary conditions are accommodative (*i.e.,* a fiscal stimulus does not lead to an increase in the interest rate); and **c)** the country's fiscal position is sustainable following a fiscal expansion.

[2] A more extensive note on relevant definitions and the determinants of fiscal multipliers can be found in *e.g.* Spilimbergo et al, IMF Staff Position Note (09/11).
[3] See e.g. Perotti (2004).

Taking a closer look at the conditions highlighted above, the authors clarify that:

a) "Leakages" are limited if:

- The propensity to import is relatively small, meaning that, on a *ceteris paribus* basis, large *closed* economies and/or economies featuring barriers to trade have larger multipliers than *open* economies with no barriers to trade.
- The measures mainly target *liquidity constrained* consumers. That is, an exogenous fiscal shock (*e.g.* increase in government spending) does not lead to a rise in precautionary savings by consumers in anticipation of higher taxation in the future. On the contrary, liquidity constrained households spend a significant portion of the windfall (e.g. wage increase, government purchases of goods and services that lead to higher household income) to increase current consumption.
- The size of the *automatic stabilizers* (i.e., the output elasticity of government revenue and spending) is relatively small, meaning that the automatic offsets to an exogenous fiscal shock are limited.
- Domestic economic conditions are recessionary and the economy is far from its *full employment* equilibrium. If such conditions prevail, an increase in government spending does not necessarily lead to an increase in interest rates that could, in turn, compress private investment and consumption. An important point to make here is that the above condition may not apply to countries featuring *unsustainable* fiscal positions. In the latter case, an unwarranted fiscal expansion could further exacerbate investor worries over fiscal sustainability, leading to a further increase in sovereign bond yield spreads and domestic interest rates.
- The fiscal stimulus has a larger spending component relative to tax cuts (and vice versa), as the initial impact of the first effect could have a more immediate impact on domestic demand, while households may save part of a tax cut.

b) Monetary conditions are accomodative if:

- A fiscal shock (*e.g.* expansion) does not put upward pressure on the nominal interest rate, so that it does not lead to crowding out of domestic investment and consumption. On the latter point, a number of recent empirical studies have documented that the fiscal multiplier can rise by a factor of 2 or 3 if the nominal interest rate is on (or very close to) the lower nominal bound (0.0%).
- The exchange rate is fixed. Apparently, the latter situation does not necessary apply to crisis situations of the type Greece and other EZ periphery economies currently experience. Although the ECB policy rate is currently 0.75% and short-term euro area interbank rates are close to zero[4], domestic monetary conditions in Greece remain extremely tight due to the ongoing crisis and the domestic liquidity squeeze.

c) As per a relevant argument provided in the previous section, one would expect the fiscal multiplier to be, *ceteris paribus*, lower the more unsustainable the sovereign debt level and the country's fiscal position are considered to be.

Other factors that can influence the size of the fiscal multiplier include:

a) *Degree of financial market development and intermediation.* A relatively low degree of financial intermediation in the domestic economy usually implies that liquidity-constrained households and businesses can not easily borrow to intertemporally smooth consumption and investment and thus, a positive fiscal impulse can lead to higher current consumption (and less precautionary saving) than otherwise the case.

b) *General macroeconomic and financial conditions in the domestic economy and externally.* As noted in Spilimbergo et al (2011), heightened uncertainty in the midst of the global economic and financial crisis induced U.S. consumers to increase precautionary savings, decrease their marginal propensity to consume and thus, reduce the size of the multiplier. That is demonstrated by official data showing that the 2008 U.S. tax rebate has been largely saved. On the other side of the spectrum, one could convincingly argue that the crisis may have actually increased the size of the fiscal multiplier, as the ensuing credit crunch has raised the proportion of liquidity-constrained households and, furthermore, monetary authorities in major industrialized countries have reduced their nominal policy rates towards the zero percent bound. In view of the ambiguous effects of the global economic and financial crisis on the size of the fiscal multipliers, the aforementioned authors caution against deriving firm conclusion from re-estimating the size

[4] At the time of writing this piece (Oct. 4, 2012) the short-term Euribor rates were as follows: 1-month: 0.11%, 3-month: 0.22%, 6-month: 0.43% & 12-month: 0.68%.

of the multiplier in the present situation, on the basis that the recent crisis may have caused structural breaks in relevant macroeconomic time series utilized by conventional estimation methods.

2.3 What is the sign of the fiscal multiplier?

As regards the sign of the fiscal multiplier, many empirical studies document a positive multiplier for an exogenous government spending shock (*e.g.* increase in government consumption of goods and services) and a negative multiplier for a government revenue shock (higher taxation), with the former exceeding the latter in absolute terms. However, other studies conducted for different countries and/or over different time periods have documented quite diverse results as regards the size (and the sign) of the fiscal multiplier. At the extreme, a fiscal expansion can have contractionary implications for the domestic economy (and vise versa), especially if it exacerbates fiscal sustainability concerns. To complicate things even further, an increase (decrease) in different government expenditure or revenue categories[5] can have quite different effects on output, with the diversity of estimated multipliers increasing even further if one considers the response of individual components of domestic GDP (e.g. private consumption vs. investment; imports vs. exports).

2.4 What is the size of the fiscal multiplier?

As we have already noted, the size of the fiscal multiplier can be *time-, country-, estimation method-* and *regime-specific*. In an IMF staff note prepared in March 2009 for the G-20 Ministerial Meeting, a range of fiscal multipliers was used[6]. The low set of multipliers included 0.3 on revenue, 0.5 on capital spending, and 0.3 on other spending. The high set of multipliers included o.0 on revenue, 1.8 on capital spending, and 1 for other spending. Cross-country VAR estimates of fiscal multipliers range from negative to 0.5, in part because of higher fiscal sustainability concerns in lower income countries. However, these estimates can be downward biased because the lack of accurate data leads to attenuation bias.

2.5 Estimation Methods

Various methodological approaches have been developed to study the effect of fiscal policy changes on economic activity, with much of empirical research in this area being based on the linear Structural Vector Autoregression (SVAR) model or the linearized Dynamic General Equilibrium (DSGE) model. Alternative identification approaches, including, in particular, the narrative approach of Ramey and Shapiro (1998) and Romer and Romer (2010) rely primarily on public information in identifying the nature of fiscal shocks. However, though the latter approach provides a convenient (and more plausible) method of identification, it seems to restrict itself to the study of a very limited class of shocks, especially military spending build-ups and tax changes that are unrelated to the current state of the economy (recession vs. expansion) or short-term policy considerations.[7]

Another important limitation of all three methodological approaches highlighted above is that, by construction, they rule-out *state-dependent* multipliers. Yet, recent theoretical and empirical work has emphasized that government spending multipliers may be larger in recessions than expansions.[8] These recent findings seem to be in agreement with earlier Keynesian arguments in favor of using discretionary fiscal policy in recessionary periods to stimulate aggregate demand. Intuitively, when the economy has a slack, expansionary government spending shocks are less likely to crowd out private consumption or investment.

[5] E.g. wage hikes or cuts, higher/lower government purchases of goods and other services, hikes or cuts in the personal income tax rates or the rates for corporate taxation and/or social security contributions.
[6] See http://www.imf.org/external/np/g20/pdf/031909a.pdf.
[7] For a more thorough discussion on these and other related issues see e.g. Auerbach and Gorodnichenko (2010)
[8] See e.g. Christiano et al. (2009); Woodford (2010); Auerbach and Gorodnichenko (2010, 2011); Bachmann and Sims (2011); and Shoag (2011).

Using an estimation approach similar in many respects to the *Smooth Transition Autoregressive (STAR) models* developed in Granger and Teravista (1993), Auerbach and Gorodnichenko (2010) estimate spending multipliers that are approximately zero in expansions and as high as 2.0 in recessions. Other recent studies broadly confirm the existence of sizeable cyclical variations of fiscal multipliers. Among others, Bachmann and Sims (2011), report that the spending multiplier is approximately zero in expansions and approximately 3 in recessions. Separately, Shoag (2010) examines state-level variation in government spending and finds that the multiplier is approximately 3.0-3.5 when labor markets have a slack (recession) and approximately 1.5 when there is no slack (expansion).

In the present paper, we start our empirical investigation by utilizing the classic SVAR approach developed in Blanchard and Perotti (2002) and extended further in Perotti (2004) to estimate the size of fiscal multipliers for a range of different government revenue and expenditure categories in Greece. As a second step, we apply a variant of the Smooth Transition Vector Autoregression (STVAR) model presented in Auerbach and Gorodnichenko (2011) to investigate the *time-* and *economic conditions-dependent* properties of Greece's fiscal multiplies.

The SVAR approach

The classic SVAR approach initiated by Blanchard and Perotti (2002) exploits institutional information about the tax and transfers system, the timing of tax collections and auxiliary estimates of fiscal output elasticities to identify *structural* government spending and revenue shocks in a VAR framework and to consequently estimate the response of output and its main components to given exogenous fiscal impulses. Specifically, the SVAR approach makes the following identifying assumptions: **a)** discretionary fiscal policy *does not* respond to output innovations within the unit of time utilized in the empirical study (typically, one calendar quarter); **b)** non-discretionary responses of major government spending and revenue categories to innovations in output are consistent with auxiliary estimates of fiscal output elasticities (calculated outside the VAR model); and **c)** innovations in fiscal variables not predicted within the VAR constitute unexpected fiscal policy innovations. As we have already noted above, fiscal multipliers estimated within the SVAR framework are *not* time dependent. ***Annex 1*** at the end of this document provides some additional technical detail on the SVAR approach for estimating fiscal multipliers.

Regime-switching VAR model

In order to examine the *time-* and *economic conditions-dependent* characteristics of fiscal multipliers in Greece, this paper follows an approach presented in Auerbach and Gorodnichenko (2011) to incorporate regime-switching in a standard SVAR framework. ***Annex 2*** at the end of this document provides technical detail on the latter approach, which Auerbach and Gorodnichenko call the Smooth Transition Vector Autoregression (STVAR) model.

3. A brief review of recent fiscal developments in Greece

Rampant expenditure growth on the back of broadly irresponsible wage and hiring policies in the broader public sector conspired with untargeted social spending, widespread tax evasion and adverse demographics to result in a hugely unsustainable fiscal position in the period following the outbreak of the 2007/2008 global financial crisis. Greece's structural primary balance underwent a cumulative deterioration of more than 18.5ppts-of-GDP in 2001-2009, with the corresponding deficit reaching ca 14.5%-of-GDP at the end of that period. Notably, the bulk of the aforementioned deterioration can be attributed to an expansion of social spending (particularly, health and pension expenditures) by more than 6ppts of GDP (***Table 1.1***).[9] In response to a further sharp rise in Greek sovereign bond spreads in late 2009 and during the first months of the following year, Greece signed in May 2010 a €110bn financing programme with its Eurozone (EZ) partners and the IMF (henceforth, 1st adjustment programme), aiming to provide adequate government financing for the coming 2-3 years and to assist the country gradually reestablish access to international funding markets, starting in FY-2012.

[9] A more comprehensive review of the magnitude and causes of Greece's fiscal deterioration in the period before the outbreak of the 2007/2008 global crisis can be found in e.g. IMF Country Report No. 12/57, March 2012.

Table 1.1 – Greece: General government revenues & expenditures compared to EU average

(in percent of GDP)

	2001	2008	2009	2010	2011	EU avg. 2008-10 1/
Revenue	40.9	40.7	38.0	39.5	41.0	44.3
Indirect taxes	13.3	12.4	11.3	12.0	12.7	12.8
Direct taxes	8.6	8.0	8.3	7.7	8.3	12.7
Social contributions	12.6	13.2	12.7	13.1	12.4	13.9
Non-tax and other	6.5	7.0	5.7	6.7	7.7	5
Total expenditure	45.3	50.6	53.8	50.2	50.3	49.6
Wages	10.4	12.0	13.4	12.1	12.0	10.9
Social benefits	15.4	19.6	21.1	20.8	21.6	20.7
Other current spending	7.3	8.1	8.9	7.7	6.7	11.1
Interest	6.5	5.1	5.1	5.8	6.9	2.7
Investment	5.8	5.7	5.2	3.9	3.1	4.3

1/ Averages for sub-categories of expenditure refer to the 2008-09 period.

Notably, the aforementioned programme came with strict conditionality that was laid out in a Memorandum of Understanding (MoU) agreed with official lenders. The three main strategic pillars of the 1st adjustment programme were: a) re-establish fiscal sustainability; b) reclaim competitiveness losses and facilitate a return to positive and sustainable medium-term economic growth; and c) safeguard stability of the domestic financial system.

Following a pretty strong start in the initial period after the signing of the 1st adjustment programme, the reforms drive broadly stalled amid increasing social and political resistance to domestic austerity policies and heightened investor doubts over the ability of EZ governments and institutions to deal with the widening crisis. Responding to that difficult situation and in effort to prevent a Greek sovereign default that could have severe consequences for the country's euro membership status (and the stability of the euro area as a whole), Greece and its official lenders signed in March 2012 a new bailout agreement (henceforth, 2nd adjustment programme), covering the period 2012-2014/15. Under the new bailout, €130bn of new EFSF/IMF funding was earmarked for Greece so as to: a) implement a restructuring of privately-held Greek sovereign debt (total notional amount of PSI-eligible debt ~ €206bn); complete a €50bn domestic bank recapitalization programme; and c) cover the overall borrowing requirement for the period 2012-2014. [10] Note also that the 2nd programme incorporated certain additional concessions, including, among others, a lengthening of the maturities of (as well as a reduction in the interest rates on) old EU bilateral loans and new loans to Greece from the EFSF. As in the 1st programme, the 2nd adjustment programme for Greece came with strong conditionality aiming to restore further the country's fiscal position, erase past competitiveness losses/pave the way for a return to sustainable economic growth and complete the recapitalization of the domestic banking system.

As a prior action to the 2nd bailout agreement, the Greek Parliament voted in February 2012 an auxiliary budget (€3.2bn worth of expenditure-side measures) to facilitate fulfillment of the agreed fiscal targets for FY-2012. Furthermore, as part the conditionality underlying the new programme, the Greek government undertook the commitment to identify by the end of May 2012 a new austerity package for the period 2013-2014. The package would consist of new expenditure measures worth 5.5ppts-of-GDP along with 1.5ppts-of-GDP in the form of increased revenue, facilitated by a new radical overhaul of the national taxation system, aiming to improve revenue collection and reduce tax and social security contributions evasion. Agreement between the Greek government and the EC/ECB/IMF troika of official lenders on the new austerity package for 2013-2014 was delayed due to the prolonged pre-election period in Greece, resulting in a considerable delay in the disbursement of a €31.3bn EFSF/IMF tranche that was originally due in June 2012. A

[10] A comprehensive analysis on the main components and modalities the 2nd bailout programme for Greece can be found in *Eurobank EFG Research, 20 March 2012, "New bailout programme for Greece: Conditionality, implications for sovereign solvency and valuation of the Greek PSI deal"* .
http://www.eurobank.gr/Uploads/Reports/6312GREECE%20MACRO%20FOCUS%20March%202%202012.pdf

considerable portion of the aforementioned loan installment (€23.5bn) was earmarked for the completion of the domestic bank recapitalization programme, with the remaining amount intended to be utilized for the partial settlement of outstanding government arrears to third parties (€3.5bn) and for other budgetary financing purposes. As of the time of writing of this report, negotiations continued between the Greek government and the troika on the new fiscal measures for 2013-2014, with official comments and press reports suggesting that the two sides have already agreed on the bulk of these measures. Based on the information available at this point, the new austerity package will consist of €10.6bn of expenditure measures (mainly, horizontal cuts in wages, pension and special worker benefits) and ca €3bn in the form of revenue-side measures (both, in *net* fiscal impact terms).

Following the outbreak of the Greek sovereign debt crisis in late 2009, Greece has undertaken an unprecedented effort to remedy its *twin deficits* problem, under the auspices of two consecutive bailout programmes agreed with its EZ partners and the IMF. On the fiscal side, measures worth ca €49bn or *€22.5 ppts-of-GDP* (including carry over impacts and assuming full implementation of the FY-2012 auxiliary budget) have been introduced in the period 2010-2012, as part of the austerity programme agreed with official lenders (***Table 1.2***). For the period 2013-2014, *"measures to be identified"* relate to corresponding estimates (*i.e.,* as regards the new austerity package) presented in the European Commission's March 2012 assessment of Greece's 2nd bailout programme. Note that neither the actual size nor the (annual) distribution of these measures will necessarily coincide with what will be incorporated in the final (still pending) agreement between the government and the troika on the new austerity package for 2013-2014. ***Table 1.3*** presents the breakdown of the new austerity package for 2013, as reported in the FY-2013 Greek *draft* budget submitted to Parliament on October 1, 2012. This breakdown should be considered as only preliminary and subject to revision in the final FY-2013 budget document.

As a final note to this section, the progress attained so far on the fiscal consolidation front is impressive by historical standards. The primary balance of the General Government was improved by 8.4ppts-of-GDP (and by ca 10ppts-of-GDP in cyclically-adjusted terms) in 2009-2011, with further significant improvements expected in 2012 and 2013.[11] As per the Greek draft budget for FY-2013, the General Government deficit (ESA95 terms) is projected to reach 4.2%-of-GDP, down from 6.6%-of-GDP expected this year. These compare with General Government deficit targets of 6.7%-of-GDP for FY-2012 and 4.6%-of-GDP for FY-2013 envisaged in the government's 2012 *supplementary* budget and the troika's earlier baseline forecasts.[12] In line with the new budget projections, the General Government *primary* balance is now expected to reach a surplus of 1.1%-of-GDP in 2013 (the first positive primary balance since 2002), following a 1.4%-of-GDP deficit in 2012. The aforementioned targets assume full implementation of new austerity measures in FY-2013 with a net fiscal impact of €7.8bn. Under a *no-policy-change* scenario (*i.e.,* no new measures applied in 2013), the General Government deficit would rise instead to 7.1%-of-GDP, while the primary balance would remain in a deficit of 2.0%-of-GDP.

[11] A thorough assessment of Greece's draft budget for FY-2103 can be found in *Eurobank Research; "Greece's 2013 Draft Budget: Key Targets and Assessment"; October 2, 2012.*
http://www.eurobank.gr/Uploads/Reports/GREECE%20MACRO%20FOCUS%20October%202%202012.pdf

[12] In fact, the troika's March 2012 assessment of Greece's stabilization programme forecasted a 7.3%-of-GDP fiscal deficit for this year.

Table 1.2 – Greece: General government deficit and measures

from the deficit in one year to the next

	EUR million	% of GDP
2009 deficit (outcome)	**36,624**	**15.8**
primary deficit drift in 2010	5,681	2.5
change in interest expenditure	894	0.4
measures in 2010 1/	19,074	8.4
impact on ratio of nominal GDP growth	--	0.3
2010 deficit (outcome)	**24,125**	**10.6**
primary deficit drift in 2011	10,592	4.9
change in interest expenditure	1,964	0.9
measures in 2011 1/	16,680	7.7
impact on ratio of nominal GDP growth	--	0.6
2011 deficit (estimate)	**20,002**	**9.3**
primary deficit drift in 2012	10,020	4.9
change in interest expenditure	-2,032	-1.0
measures identified for 2012 1/	13,191	6.5
impact on ratio of nominal GDP growth	--	0.5
2012 deficit (projection)	**14,799**	**7.3**
primary deficit drift in 2013	3,572	1.8
change in interest expenditure	211	0.1
measures identified for 2013 1/	1,584	0.8
measures to be identified in 2013	7,639	3.8
impact on ratio of nominal GDP growth	--	0.0
2013 deficit (target) 2/	**9,359**	**4.6**
primary deficit drift in 2014	1,376	0.7
change in interest expenditure	749	0.4
measures identified for 2014 1/	3,065	1.5
measures to be identified for 2014	4,016	1.9
impact on ratio of nominal GDP growth	--	-0.1
2014 deficit (target) 2/	**4,404**	**2.1**

Note: Deficit in year t = Deficit in year t-1 plus primary deficit drift plus change in interest expenditure min measures (and for the GDP ratios: plus impact on debt ratio of nominal GDP growth).
1/ Including carry-over impacts.
2/ Overall balance consistent with the primary fiscal balance targets.
Source: European Commission March 2012, Eurobank Research

Table 1.3 – Greece: Main components of new austerity package for FY-2013

New fiscal measures for FY-2013 currently being negotiated with the troika (net projected impact) (Millions of euros)	2013
Expenditure	
1. Restructuring of public sector	483
2. Restructuring of local governments	100
3. Wage bill	1,000
4, Pensions bill	3,799
5. Social benefits	347
6. Healthcare costs	803
7. National defense	304
8. Education	132
9. Streamlining of public utilities & other enterprises	241
A. Total expenditure measures	**7,308**
Revenue	
1. Streamlining of family allowances	427
2. Increase in retirement age by 2 years	5
3. Reduction of revenue refunds	60
B. Total revenue measures	**492**
Total projected impact of measures (A + B)*	7,800

* Of which, €118mn to impact FY-2012 budget
Source: FinMin, Eurobank Research

4. Empirical Study

4.1 Data description and definition of variables

Our empirical study is conducted with quarterly data on main real activity and fiscal indicators for Greece, reported by Eurostat.[13] The data for output (and its main components) as well as inflation (based on the GDP deflator) are taken from Greece's national income accounts, while the main government expenditure and revenue aggregates constitute actual (not interpolated) quarterly general government statistics compiled in ESA-95 accounting terms. In their initial form, all time series are comprised of non-seasonally adjusted data. All series are converted in *real* term by dividing with an appropriate deflator index – the GDP deflator is used for government expenditure and revenue series - and they are then transformed into seasonally adjusted series by applying the U.S. Census X11 methodology.[14] ***Table 2.1*** below provides a summary of the raw data and the notation of the variables utilized in our empirical study. ***Table 6.1*** at the end of this document (*Annex* section) provides data descriptive statistics. In addition to the time series depicted below, the following general government expenditure and revenue aggregates are used in our empirical study: (i) real general government primary spending on goods and services, ***RGSPEND,*** constructed as the sum of *RGCONA* and *RGFCF* variables presented in *Table 2.1;* and (ii) ***RTGREV2***, constructed as the deference between *RTGREV* and the sum real general government transfers, subsidies and property income.

As a final note to this section, we emphasize that we consider the usage of government accounts statistics as a rather novel feature of our study, especially for a country like Greece, where the depth and quality of historical fiscal data is rather poor relative to other developed economies. Furthermore, to the best of our knowledge, a vast volume of earlier SVAR studies on fiscal multipliers in major developed countries has been conducted with data extracted solely from the national income accounts. As a robustness check, we also

[13] http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/themes.
[14] See U.S. Department of Commerce, Bureau of the Census

ran our models with national income accounts data taken from the OECD (realizations and forecasts of major fiscal aggregates). Results were broadly similar to those based on our original time series and thus, they are not presented in this document.

Table 2.1 - Raw data and definition of variables

	Notation	Data series (all non-seasonally adjusted)	Scale	Unit
Data from National Income Accounts	GDP	Gross domestic product at market prices	Current prices	Millions of euro
	CON	Final consumption expenditure	Current prices	Millions of euro
	HCON	Final consumption expenditure of households	Current prices	Millions of euro
	GCON	Final consumption expenditure of general government	Current prices	Millions of euro
	XPORT	Total exports	Current prices	Millions of euro
	MPORT	Total imports	Current prices	Millions of euro
	PGDP	GDP deflator	Index	Base 2000
	PCON	Consumption deflator	Index	Base 2001
	PHCON	Household consumption deflator	Index	Base 2002
	PGCON	Government consumption deflator	Index	Base 2003
	PXPORT	Export deflator	Index	Base 2004
	PMPORT	Import deflator	Index	Base 2005
	RGDP	Real GDP	Volume	Current prices/deflator
	RCON	Real consumption	Volume	Current prices/deflator
	RHCON	Real household consumption	Volume	Current prices/deflator
	RGCON	Real government consumption	Volume	Current prices/deflator
	RXPORT	Real exports	Volume	Current prices/deflator
	RMPORT	Real imports	Volume	Current prices/deflator
Data from Government Accounts	GCONA	Final consumption expenditure	Current prices	Millions of euro
	GFCF	Gross fixed capital formation	Current prices	Millions of euro
	TGEXP	Total general government expenditure	Current prices	Millions of euro
	TGREV	Total general government revenue	Current prices	Millions of euro
	WEXP	Compensation of employees, payable	Current prices	Millions of euro
	RGCONA	Real final consumption	Volume	Current prices/GDP deflator
	RGFCF	Real gross fixed capital formation	Volume	Current prices/GDP deflator
	RTGEXP	Real total general government expenditure	Volume	Current prices/GDP deflator
	RTGREV	Real total general government revenue	Volume	Current prices/GDP deflator
	RWEXP	Real compensation of employees, payable	Volume	Current prices/GDP deflator

Source: Eurostat

4.2 Model specifications

(Readers wishing to avoid reviewing the technical detail provided in this section may choose to move to directly to the next one, titled "Empirical results")

Baseline and alternative SVAR specifications

Our baseline SVAR specification comprises of three endogenous variables: **(i)** real general government *primary* spending on goods and services (***RGSPEND***); **(ii)** real general government revenue *net* of transfers, subsidies and property income (***RTGREV2***)[15]; and **(iii)** real output (***RGDP***), with all variables expressed in logarithmic terms. An analytical presentation of the SVAR model is provided at the end of this paper (***Annex 1***). As a *first-line* robustness check, we run our baseline SVAR specification (and the alternative specifications described below) with all endogenous variables expressed in *seasonally adjusted* terms. Then, we estimate our benchmark and alternative models with all variables expressed in *non-seasonally adjusted* terms, but with the addition of seasonal dummy variables (see *Tables 3.1-3.8* in ***Annex 3*** - ***Summary of Empirical Results***).

[15] In line with Blanchard and Perotti (2002), Perotti (2004) and others, the real government revenue variable utilized in our empirical study is net of transfers. As noted in Perotti (2004), summing algebraically taxes and transfers makes sense if one believes that in the short- and medium-run fiscal policy operates mostly via a demand channel. In fact, most empirical studies on fiscal multipliers predict that government spending on goods and services has different effects than transfers, with only the former impacting directly the use of resources.

In addition to the baseline specification described above, we also run a number of alternative ones, so as to measure the effects of exogenous shocks in our real government primary spending and net revenue variables on main output components, including real total (public + private) consumption, ***RCON***, real household consumption, ***RHCON***, real gross fixed capital formation, ***RGFKF***, real exports, ***REXP***, and real imports, ***RIMP***. Furthermore, we measure the response of real output (and its main components) to exogenous shocks in a key primary spending sub-category; namely real government wage expenditure, ***RWEXP***. This is of particular importance for Greece in the present trajectory as the new austerity package for 2013-2014 the country is still negotiating with its official lenders is expected to consist of a significant amount of horizontal cuts in public wages, pensions and special benefits. Furthermore, real wage expenditure accounts for a quite significant part of real government primary spending on goods and services (~ 66% in FY-2011).

The estimated multipliers in euro terms (*i.e.,* change in response variables in euros per one euro change in the corresponding impulse variables) are depicted in *Tables 3.5-3.8 (**Annex 3 -Summary of Empirical Results***). In practice, since the results presented in *Tables 3.1-3.4* are based on variables expressed in logs, we consider as multiplier estimates relevant for our study the corresponding relevant values expressed in euro terms (see *Summary Table 2.2 & Tables 3.5-3.8* in *Annex 3*).

As a final note to this section, and in line with Blanchard and Perotti (2002) and Perotti (2004), we utilize *external* information on the elasticities of government revenue (e.g. taxes) and government primary spending to output and interest rates in order to derive estimates of the coefficients α_{jk} appearing in the equations of reduced-form VAR residuals of the net government revenue and primary spending variables examined in our study (see ***Annex 1.1*** *at the end of this document*).

Estimating time- and regime-dependent fiscal multipliers for Greece

Our estimates of *time-* and *economic conditions (regime)*-dependent fiscal multipliers for Greece are mainly based on the Smooth Transition Vector Autoregressive (STVAR) approach proposed by Auerbach and Gorodnichenko (2010) and extended in Auerbach and Gorodnichenko (2011). Some technical detail on this approach is provided in ***Annex 2*** at the end of this document. Our empirical analysis is based on a 3-variable STVAR model, with the vector of endogenous variables being: $\boldsymbol{X\hat{}_t = [FEg_t, g_t, y_t]'}$. In our baseline STVAR specification $\boldsymbol{y_t}$ represents real GDP log($\boldsymbol{RGDP_{sa}}$); $\boldsymbol{g_t}$ is real government primary spending on goods and services log($\boldsymbol{RGSPEND_{sa}}$); and $\boldsymbol{FEg_t}$ represents the *unanticipated* components of real government primary spending log($\boldsymbol{RGSPEND_{sa}/FRGSPEND_{sa}}$). The latter variable controls for expectations of (revenue-side) fiscal policy changes and it is defined as the difference between (the realized value of) real government primary spending, $\boldsymbol{RGSPEND_{sa}}$,and the *one-year-ahead* forecast of real government primary spending presented *bi-annually* in the European Commission *Spring* and *Autumn Economic Forecasts*. As in Auerbach and Gorodnichenko (2011), we apply a *direct projection* approach to derive impulse-responses.

In addition to the benchmark STVAR model presented above, we also estimate a number of alternative specifications in order to examine: **(i)** the *time-* and *regime-varying* properties of responses of main output components to exogenous shocks in primary government spending; the output components examined in our empirical study include real total consumption, $\boldsymbol{RCON_{sa}}$, real household consumption, $\boldsymbol{RHCON_{sa}}$, and real gross fixed capital formation, $\boldsymbol{RGFKF_{sa}}$; **(ii)** the *time-* and *regime-varying* effects of exogenous shocks in key government spending categories - *e.g.* real wage expenditure, $\boldsymbol{RWEXP_{sa}}$ - on real output and its main components. Finally, as a robustness check, we estimated our baseline and alternative model specifications for two alternative definitions of our *state-of-the-economy indicator* ***z*** (see ***Annex 2***). The first one, ***z1***, was derived as the logit function of real GDP growth with calibrated gamma (***γ***) parameter of 1.5. The second one, ***z2***, was calculated as the logit function of the smoothed real GDP growth with the same calibrated parameter. Results derived with the ***z2*** indicator (not presented in this paper) are qualitatively similar to those based on the ***z1*** indicator and are available upon request.

Tables 3.1.1 - 3.8.2 at the ***Summary of Empirical Results*** section **(*Annex 3*)** provide estimates of regime-dependent multipliers for Greece. (See also ***Annex 2***).

4.3 Empirical results & interpretation

For the convenience of comparing the empirical results from a number of different specifications examined in this study, ***Table 2.2*** below shows the multiplier values estimated by our VAR and STVAR models. The multiplier values presented show the estimated change

(in euro terms) in a given response variable (*i.e.,* real GDP, real total consumption, real household consumption or real gross fixed capital formation) per 1 euro change in the corresponding impulse variable (i.e., real government primary spending on goods and services, real government wage expenditure or real government revenue net of transfers, subsidies and property income).

For our (S)VAR model estimates, we report the respective *impact*, *cumulative* (over 12 quarters) and *peak* multipliers. For our STVAR (*regime-switching* & *no regime switching*) models, we report the average multipliers over an eight-quarter horizon. For the different multiplier values implied by our SVAR models when estimated with seasonally and non-seasonally adjusted (endogenous variable) time series we report the highest (in absolute terms) multiplier estimates. The aforementioned suggest that the results presented in ***Table 2.2*** may not be directly comparable, but we chose the particular reporting strategy to better highlight differences in estimated multiplier values implied by our *regime-* and *no regime-switching* models and to also ensure maximum significance and robustness of reported results.

A number of important points can be made by looking at the estimated multiplier values presented in *Table 2.2*. In what follows, we provide a brief analysis on our empirical results and their potential macroeconomic and policy implications.

Our results appear to provide support to the findings of earlier empirical studies documenting much higher fiscal multipliers in recessionary conditions than in expansionary output phases. Our *no regime-switching* models estimate government primary spending multiplier values (0.22, 0.47) that are not far away from what has been estimated for Greece in a number of earlier studies conducted by the OECD and others. On the other hand, our regime-switching STVAR models estimate (strongly significant) government spending multipliers as high as 1.32 in recessionary phases along with negative (and broadly insignificant) multipliers for periods of economic expansion. This finding is particularly pronounced for government *wage* expenditure, where the estimated multiplier is as high as 2.35 (and strongly significant) in recessionary regimes and as low as -1.88 (and largely insignificant) in economic expansions.[16]

From a purely theoretical perspective, our finding of relatively low (or even negative) government spending multipliers in Greece during periods of economic expansion can be attributed to, among others, the high degree of linkages in the domestic economy (*e.g.* high propensity to import) in the post-EU entry period and before the outbreaks of the global financial crisis (2007/2008) and the Greek sovereign debt crisis (late-2009). Higher government spending in periods of output expansion also appears to have been crowding out household consumption and investment, though the corresponding estimates of our regime switching models remain highly-insignificant.

Although we can not give much credence to the negative government spending multipliers in periods of economic expansions estimated by our regime-switching models, as most of these estimates are statistically insignificant, the same can not be said for our multiplier estimates for recessionary periods. Our government spending multipliers for recessionary regimes are found to be positive (generally higher than unity) and strongly significant.

Linking this finding to the current depressionary conditions in Greece, a plausible argument can be made in favor of implementing targeted measures to support the domestic economy. A positive government spending shock - in the form of, say, targeted measures to support lower incomes or to boost the public investment program via *e.g.* a higher absorption of EU structural funds and/or special schemes to facilitate financing of investment projects - may lead to higher current spending of goods and services by liquidity-constrained domestic households and businesses, in a proportion higher than a *€1 gain in output per €1 higher government spending*.

A potential counterargument to the aforementioned claim is that an unwarranted fiscal stimulus in a trajectory characterized by lingering investor concerns about fiscal sustainability and solvency could further exacerbate worries about the domestic fiscal situation (and the outlook of future EFSF/IMF financing under the present stabilization programme), leading to a new explosion of Greece's sovereign bond yield spreads with depressing implications for domestic economic activity. In view of the latter, we have run our regime-switching STVAR models, controlling for Greece's debt-to-GDP ratio.[17] When controlling for the debt ratio, our government spending multiplier estimates for recessionary periods remain broadly positive, albeit lower in size relative to our baseline specifications (that do not control for the debt ratio), and largely insignificant.[18] Lastly, although we chose to concentrate in this study on *government spending*

[16] See also detailed Tables 3.1.1-3.1.2 & 3.2.1-3.2.2 in *Annex 3*.
[17] A more formal handling of this is provided in *Annex 2*; see equation (6).
[18] Respective results are available upon request.

rather than *government revenue* multipliers (for reasons partly explained in the earlier part of this paper), we note that the revenue multiplier estimates of our SVAR models appear to be broadly in line with the empirical findings of a number of earlier empirical studies.

Summarizing the aforementioned views (and focusing more on present economic realities), we interpret the empirical results presented in *Table 2.2* as follows:

Government spending multipliers in Greece appear to be larger in deep economic recessions than in expansions. Failing to take account of that effect may lead not only to underestimating the effects of fiscal austerity overdose on output, but also to engaging the domestic economy in a prolonged (downward) spiral of depression and fiscal restraint.

A key policy implication of our empirical results (examined in greater detail in the following section of this paper) is that a 2-year extension in the new fiscal austerity package Greece is currently negotiating with its official lenders *may indeed* lead to more favorable outcomes as regards the future path of domestic output and the public debt to GDP ratio. That is, comparing with a scenario assuming no extension in the implementation profile of the new package along with a frontloading of the agreed austerity measures.

Table 2.2 – Summary of empirical multiplier estimates

					Government spending multipliers		Government revenue multiplier (*)
					RGSPEND (Real gvnt primary spending on goods and services)	RWEXP (Real gvnt wage expenditure)	RTGREV2 (Real gvnt revenue net of tranfers, subsidies & property income)
RGDP (real GDP)	VAR	No regime switching		Impact multiplier	0.22 (insign.)	1.11 (insign.)	-0.11 (insign.)
				Cum. multiplier (12Q)	0.15 (isign.)	1.55 (insign.)	-0.36 (insign.)
	STVAR	With regime switching	Recession	Avrg. multiplier	1.32	2.35	n.a
			Expansion	Avrg. multiplier	-1.42 (insign.)	-1.88 (insign.)	n.a
	STVAR	No regime switching		Avrg. multiplier	0.47 (insign.)	0.51	n.a
RCON (real total consumption)	VAR	No regime switching		Impact multiplier	0.88	2.55	0.05 (insign.)
				Cum. multiplier (12Q)	1.23	3.76	-0.22 (insign.)
	STVAR	With regime switching	Recession	Avrg. multiplier	1.44	2.20	n.a
			Expansion	Avrg. multiplier	-0.88 (insign.)	-1.51 (insign.)	n.a
	STVAR	No regime switching		Avrg. multiplier	0.63	0.11 (insign.)	n.a
RHCON (real household consumption)	VAR	No regime switching		Impact multiplier	0.39	1.08	-0.1 (insign.)
				Cum. multiplier (12Q)	0.56	1.71	-0.34 (insign.)
	STVAR	With regime switching	Recession	Avrg. multiplier	0.97	1.62	n.a
			Expansion	Avrg. multiplier	-0.65 (insign.)	-1.15 (insign.)	n.a
	STVAR	No regime switching		Avrg. multiplier	0.44 (insign.)	0.15 (insign.)	n.a
RGFKF (real gross fixed capital formation)	VAR	No regime switching		Impact	1.47	1.07	-0.70
				Cummulative (12Q)	1.78	1.49	-0.99
	STVAR	With regime switching	Recession	Avrg. multiplier	1.01	1.52	n.a
			Expansion	Avrg. multiplier	-0.8 (insign.)	-1.22 (insign.)	n.a
	STVAR	No regime switching		Avrg. multiplier	0.25 (insign.)	0.09 (insign.)	n.a

Source: Authors' estimates

(*) Reported government revenue multiplier values estimated by 3-variable SVAR models with RGSPEND variable utilized for government expenditure.

(**) Numbers in red color, accompanied by "(insign)", suggest not significant estimates at the 10% confidence level.

5. Regime-dependent fiscal multipliers in Greece: Implications for sovereign liquidity & solvency under a 2-year programme extension scenario

In this section, we utilize our empirical estimates of fiscal multipliers to gauge the potential effects of a new austerity package Greece is currently negotiating with its official lenders, as part of the conditionality underlying the county's 2nd bailout programme. According to the current planning, the new package is expected to be implemented over the period 2013-2014 and to have a *net* fiscal impact (*i.e.,* result in a cumulative improvement in the general government primary balance) of ca €13.6bn.[19] ***Table 5.1*** shows the main components and the time implementation profile of the new austerity package, based on the Greek government's draft budget for FY-2013 that was submitted to Parliament on October 1, 2012[20]. The breakdown shown below should be considered strictly preliminary and subject to significant revisions, as negotiations between the government and the troika still continued at the time of writing this report. [21]

Table 5.1 – New austerity package for Greece: Preliminary breakdown

In euro billion	2013	2014	Total (2013-14)
Breakdown (total)	**7.80**	**5.80**	**13.6**
1. Expenditure (1.a+1.b)	**7.31**	**3.29**	**10.6**
1.a Wages, pensions & special benefits	5.25	1.53	6.8
1.b Other expenditure	2.06	1.74	3.8
Revenue	**0.49**	**2.51**	**3.0**

Source: FY-2013 draft budget; local press

Greece's FY-2013 draft budget is framed on an exceptionally adverse macroeconomic environment, envisaging a continuation of the domestic recession for the 6th year in a row. Specifically, it forecasts a real GDP contraction of 3.8%, under a baseline scenario assuming new austerity measures worth €7.8bn being implemented in 2013 (***Table 5.1***). Under a *no-policy change* scenario, real GDP is expected to *instead* contract by ca 1.15% next year.[22] A plausible combination of fiscal multiplier values that are consistent with the projected GDP decline assumed in the FY-2013 draft budget is depicted in ***Table 5.2***.

It goes without saying that if indeed fiscal multipliers in Greece are much higher in deep recessions than in expansions (as our empirical findings demonstrate), then the overall size and the time implementation profile of the new austerity package could have significant repercussions not only for domestic output, but also for the country's sovereign liquidity and solvency position. ***Table 5.3*** below depicts a set of indicative scenarios aiming to demonstrate the potential effects of the new austerity measures on domestic output, the government's borrowing requirement and the evolution of the debt to GDP ratio, under different assumptions regarding the magnitudes of fiscal multipliers in contractionary and expansionary economic conditions. These *regime-dependent* multiplier values are broadly in line with our model estimates presented in the previous section of this report (***Table 2.2***).

[19] This effectively implies that Greece will be possibly required to include in its FY-2013 & FY-2014 government budgets new measures projected to be worth well over €13.6bn in cumulative *nominal* terms, so as to allow for possible implementation slippages and also take into account the effect of automatic fiscal multipliers *i.e.,* the automatic (deteriorating) effect of recession on the government's primary position. For simplicity purposes, the present study ignores such a possibility.

[20] A thorough assessment of Greece's draft budget for FY-2013 can be found in *Eurobank Research; "Greece's 2013 Draft Budget: Key Targets and Assessment"; October 2, 2012.*
http://www.eurobank.gr/Uploads/Reports/GREECE%20MACRO%20FOCUS%20October%202%202012.pdf

[21] According to a number of reports circulated in the Greek press during the weekend of October 13-14, 2012, the new austerity package would be more front-loaded than expected earlier. Specifically, measures worth ca €9bn (in *net* fiscal impact terns) should be implemented in FY-2013, with the remaining 4.3bn due for implementation in the following year. In the analysis presented in this section, we assume the time distribution of measures implied by *Table 5.1*, since at the time of writing this report there was no final agreement between the Greek government and the troika on the specific modalities of the new austerity package.

[22] The new budget projects that, under a *baseline* scenario envisaging new austerity measures worth €7.8bn being implemented in 2013, central government revenue will be lower than under a *no-policy-change* scenario assuming no new measures being applied next year. This is to take into account the dampening effect of the steeper-than-expected recession (assumed under the baseline scenario) on government receipts from direct and indirect taxation. On a more comforting note, the baseline scenario forecasts that lower primary expenditure relative to that assumed in the no-policy-change-scenario will more than offset the ensuing slippage in tax collections, leading to a more favorable outcome as regards the general government overall deficit and its primary position.

Table 5.2 – Multiplier values consistent with the impact of new austerity measures on domestic output assumed in Greece's FY-2013 draft budget

Implied multiplier values		Implied net fiscal austerity impact on GDP (EURbn)	
Wage multiplier	0.7	FY-2013	FY-2014
Other expenditure multiplier	0.7	5.3	3.0
Revenue multiplier	-0.3		

Source: Greek FY-2013 draft budget & authors calculations

Table 5.3 – Estimated net impact of new fiscal austerity package

Austerity impact on GDP (decline; EURbn)	2013	2014	2015	2016	Cumulative
Δ GDP in EURbn (implied by FY-2013 draft budget)	-5.3	-3.0			-8.3
Δ GDP in EURbn (**Scenario 1.1**)	-15.1	-6.2			-21.3
Δ GDP in EURbn (**Scenario 1.2**)	-9.7	-4.6			-14.3
Δ GDP in EURbn (**Scenario 2.1**)	-7.6	-4.9	-1.1	-1.1	-14.6
Δ GDP in EURbn (**Scenario 2.2**)	-7.1	-2.2	-1.1	-1.1	-11.5
Δ GDP in EURbn (**Scenario 3.1**)	-5.3	-3.6	-1.7	-1.7	-12.2
Δ GDP in EURbn (**Scenario 3.2**)	-5.3	-1.7	-1.7	-1.7	-10.3

Austerity impact on debt (rise, ppts-of-GDP)	2013	2014	2015	2016	Cumulative
Δ(debt) in ppts-of-GDP (**Scenario 1.1**)	15.8	7.5			23.2
Δ(debt) in ppts-of-GDP (**Scenario 1.2**)	10.1	5.3			15.4
Δ(debt) in ppts-of-GDP (**Scenario 2.1**)	7.9	5.5	1.3	0.9	15.5
Δ(debt) in ppts-of-GDP (**Scenario 3.2**)	5.5	1.8	1.9	1.2	10.5

Rise in government borrowing gap implied by 2-YR extension (extension vs. no extension scenario; EURbn)	2013	2014	2015	2016	Cumulative
Δ Borrowing gap (**Scenario 2.1**)	6.9	7.6	3.3	0.4	18.3
Δ Borrowing gap (**Scenario 3.2**)	6.6	7.4	4.0	0.7	18.7

Source: Authors' calculations

Description of scenarios depicted in *Table 5.3*

Scenario 1.1

- Size & time-implementation profile of new austerity package is broadly in line with *Table 5.1*.
- Domestic economy remains in recession in both years 2013 and 2014.
- The following multiplier values are assumed for both years 2013, 2014: Government wage & pension expenditure multiplier: **2.35**; other expenditure multiplier: **1.32**; Government revenue multiplier:-**0.11**.
- Output elasticity of the primary balance (i.e., to incorporate the effects of automatic fiscal stabilizers) is assumed, rather conservatively, to be **0.4**. This value is not far from what earlier studies (by OECD and others) have estimated for Greece.

Scenario 1.2

- Size & time-implementation profile of new austerity package is broadly in line with *Table 5.1*.
- Domestic economy remains in recession in both years 2013 and 2014.
- The following multiplier values are assumed for both years 2013, 2014: Government wage & pension expenditure multiplier: **1.32**; other expenditure multiplier: **1.32**; Government revenue multiplier:-**0.11**.
- Output elasticity of the primary balance is assumed to be **0.4**.

Scenario 2.1

- **2-year extension** in the new fiscal austerity programme with **front-loaded** implementation profile (measures for FY-2013 shown in *Table 5.1* are instead implemented over the 2-year period 2013-2014; measures for FY-2014 depicted in *Table 5.1* are instead implemented over the 2-year period 2015-2016).
- Domestic output remains in recession in both years 2013 and 2014; GDP growth shifts into a positive territory thereafter.
- The following multiplier values are assumed: (FY-2013: Government wage & pension expenditure multiplier: **2.35**; other expenditure multiplier: **1.32**; Government revenue multiplier:-**0.11**. FY-2014: Government wage & pension expenditure multiplier: **1.32**; other expenditure multiplier: **1.32**; Government revenue multiplier:-**0.11**. Period 2015-2016: Government wage & pension expenditure multiplier: **0.7**; other expenditure multiplier: **0.7**; Government revenue multiplier:-**0.3)**. Note that, in order to be more conservative, in the recovery phase we assume the multiplier values shown in Table 5.2 and not these suggested by our empirical results for an expansionary output phase.
- Output elasticity of the primary balance is assumed to be **0.4**.

Scenario 2.2

- **2-year extension** in the new fiscal austerity programme with **front-loaded** implementation profile (measures for FY-2013 shown in *Table 5.1* are instead implemented over the 2-year period 2013-2014; measures for FY-2014 depicted in *Table 5.1* are instead implemented over the 2-year period 2015-2016).
- Domestic output remains in recession in 2013, broadly stabilizes in 2014 and shifts afterwards into a positive territory.
- The following multiplier values are assumed: (FY-2013: Government wage & pension expenditure multiplier: **2.35**; other expenditure multiplier: **1.32**; Government revenue multiplier:-**0.11**. Period 2014-2016: Government wage & pension expenditure multiplier: **0.7**; other expenditure multiplier: **0.7**; Government revenue multiplier:-**0.3)**.
- Output elasticity of the primary balance is assumed to be **0.4**.

Scenario 3.1

- **2-year extension** in the new fiscal austerity programme with **equiproportional** implementation profile (implementation of new austerity package is assumed to be equally split over the 2013-2016 period; i.e., one-fourth of total package applied each year).
- Domestic output remains in recession in 2013, broadly stabilizes in 2014 and shifts afterwards into a positive territory.
- The following multiplier values are assumed: (FY-2013: Government wage & pension expenditure multiplier: **2.35**; other expenditure multiplier: **1.32**; Government revenue multiplier:-**0.11**. FY-2014: Government wage & pension expenditure multiplier: **1.32**; other expenditure multiplier: **1.32**; Government revenue multiplier:-**0.11**. Period 2015-2016: Government wage & pension expenditure multiplier: **0.7**; other expenditure multiplier: **0.7**; Government revenue multiplier:-**0.3)**.
- Output elasticity of the primary balance is assumed to be **0.4**.

Scenario 3.2

- **2-year extension** in the new fiscal austerity programme with **equiproportional** implementation profile (implementation of new austerity package is assumed to be equally split over the 2013-2016 period; i.e., one-fourth of total package applied each year).
- Domestic output remains in recession in 2013, shifts into a positive territory thereafter.
- Assumed multiplier values: (FY-2013: Government wage & pension expenditure multiplier: **2.35**; other expenditure multiplier: **1.32**; Government revenue multiplier:-**0.11**. Period 2014-2016: Government wage & pension expenditure multiplier: **0.7**; other expenditure multiplier: **0.7**; Government revenue multiplier:-**0.3)**.
- Output elasticity of the primary balance is assumed to be **0.4**.

Discussion of results presented in *Table 5.3*

It should be emphasized that the results presented in ***Table 5.3*** are derived on a *ceteris paribus* basis and refer to the *net* impact of fiscal austerity on output (fiscal drag), the government's borrowing requirement and the dynamics of the debt to GDP ratio, under a number of different scenarios regarding the time implementation profile of the new austerity package and the size of fiscal multipliers under different macroeconomic regimes (recession vs. expansion). As such, they *do not* represent forecasts of the aforementioned response variables (i.e., GDP, debt ratio and the government borrowing requirement) as, besides fiscal policy shocks, other factors may affect their future evolution.

For instance, domestic output growth may be affected by shifts in investor sentiment towards Greece and perceptions about the country's euro membership status, domestic monetary conditions and the availability of credit, FDI inflows related to the domestic privatization program, external macroeconomic conditions as well as a multitude of other factors. One could even conceptualize the possibility of some positive effects to domestic output growth stemming from fiscal austerity (*i.e., expansionary fiscal contraction*) provided that the new austerity package (in conjunction with more product and labor market reform) succeeds in stabilizing the country's fiscal situation, restoring competitiveness and improving investor perceptions towards Greece.

Notwithstanding the aforementioned, we interpret the results presented in ***Table 5.3*** as making a fairly strong argument in favor of a 2-year extension in the new austerity programme along with a more gradual implementation profile of related expenditure cuts and revenue generating measures. That is because such a scenario would *ceteris paribus* result in less sizeable output loses (i.e., fiscal drag) relative to a *no* extension scenario envisaging a front loading of austerity measures. By implication, the ensuing increase in both the debt-to-GDP ratio and the government's borrowing need would be comparatively lower under a 2-year extension scenario, not only because of less adverse output dynamics vs. the *no* extension scenario, but also because of a lesser risk of fiscal slippage (as regards the attainability of the fiscal targets) due to less steep output losses.

From a more *qualitative* perspective, a 2-year extension in the new fiscal adjustment programme could also have other positive consequences. Among other, it could: **(i)** increase the credibility of the new (revised) fiscal targets, as the government would now need to improve its primary position in a more gradual fashion and **(ii)** have less severe repercussions for domestic social cohesion and political stability, especially since an extension of the new fiscal programme (by at least two years) has been a key aim of ruling coalition partners' programmatic agreement.[23]

[23] For a thorough analysis of political developments in Greece in the period after the June 2012 national election as well as the programmatic agreement of the ruling coalition partners see *Eurobank Research - Greece Macro Focus, June 26, 2012*.
http://www.eurobank.gr/Uploads/Reports/GREECE%20MACRO%20FOCUS%20June%2027%202012.pdf

6. Concluding remarks

This paper presents two distinct empirical methodologies for deriving estimates of fiscal multipliers in Greece in periods of economic expansion and recession. Our results seem to provide support to the findings of some recent empirical studies documenting much higher fiscal multipliers in recessionary conditions than in expansionary output phases. Yet, our study contains a number of interesting novel features, related not only to the data series and variables used, but also as regards its technical aspects.

In particular, our Structural Vector Autoregression (**SVAR**) models estimate government *spending multipliers* that are not far away from what has been estimated for Greece in a number of earlier empirical studies (i.e., multipliers in the vicinity of 0.4-0.5). However, our (regime-switching) Smooth Transition Vector Autoregression (**STVAR**) models estimate *strongly significant* government spending multipliers that are as high as 1.32 in recessionary phases along with negative (and broadly insignificant) multipliers for periods of economic expansion. This finding is particularly pronounced for government *wage* expenditure, where the estimated multiplier is found to be as high as 2.35 (and strongly significant) in recessionary regimes and negative (and largely insignificant) in economic expansions.

Based on the aforementioned, we examine a number of different scenarios regarding the time-of-implementation profile of the new austerity package and the size of fiscal multipliers under different macroeconomic regimes (recession vs. expansion) to estimate the extent of potential output losses due to fiscal austerity as well as the ensuing increases in the debt to GDP ratio and the government borrowing requirement.

Overall, our results appear to be making a fairly strong argument in favor of a 2-year extension in the new austerity programme along with a more gradual implementation profile of related expenditure cuts and revenue generating measures. From a more *qualitative* perspective, a 2-year extension in the new fiscal adjustment programme could also have other positive consequences. Among other, it could: **(i)** increase the credibility of the new (revised) fiscal targets, as the government would now need to improve its primary position in a more gradual fashion and **(ii)** have less severe repercussions for domestic social cohesion and political stability, especially since an extension of the new fiscal programme (by at least two years) has been a key aim of ruling coalition partners' programmatic agreement.

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Annex 1

The SVAR model for estimating fiscal multipliers

In line with the notation presented in Perotti (2004), consider a benchmark VAR specification, including the following 5 (endogenous) variables: g_t representing the log of *real* government *spending* on goods and services[24]; τ_t standing for the log of *real* primary *revenue* net of *transfers* and *property* income;[25] y_t is the log of real output; π_t is the GDP deflator inflation rate; and i_t is the interest rate.[26] Denoting then the vector of endogenous variables as X_t and the vector of reduced form residuals by U_t; the reduced form VAR can be written as:

$$X_t = A(L)X_{t-1} + U_t, \qquad (1)$$

where $X_t = [g_t, \tau_t, y_t, \pi_t, i_t]'$ and $U_t = [u_{gt}, u_{\tau t}, u_{yt}, u_{\pi t}, u_{it}]'$

As emphasized in Perotti (2004), the reduced form residuals of the VAR equations for g_t and τ_t, can be thought as linear combinations of the following three components: **a)** the automatic (non-discretionary) response of taxes and government spending to innovations in output, prices and interest rates; **b)** the *systematic discretionary* policy response to innovations in output, prices and interest rates *e.g.* reductions in tax rates or increased public spending on infrastructural projects implemented systematically when the economy falls into recession; and **c)** the random discretionary shocks to fiscal policy.

The latter component effectively constitutes the *structural* shocks in the VAR framework that are uncorrelated with all other *structural* fiscal shocks. When estimating impulse-response functions within the VAR framework, one is effectively interested in the response of an endogenous variable (say, output y_t) to a unit (exogenous) shock in the same or another endogenous variable (say government spending g_t). Note that the latter impulse-response is actually the fiscal multiplier of government spending. The estimation of impulse-responses requires that the errors of the primitive (or structural) VAR system (henceforth, *structural errors*) can be recovered from the reduced form (or *standard form*) VAR specification presented in equation (1). Once the structural fiscal errors are recovered, one can then estimate the fiscal multiplier as the response of output (and/or its main components) to one until shock in the *structural* VAR errors. In practice, it is not possible to recover all the information present in the primitive system from estimating the reduced-form system (1), unless one is willing to impose certain identifying restrictions in the parameters of the primitive system.

Sticking with the notation presented in Perotti (2004), the reduced form errors in the VAR equations of g_t and τ_t and be writing as follows:

$$u_{\tau t} = \alpha_{\tau y} u_{yt} + \alpha_{\tau \pi} u_{\pi t} + \alpha_{\tau i} u_{it} + \beta_{\tau g} e_{gt} + e_{\tau t} \qquad (2)$$

$$u_{gt} = \alpha_{gy} u_{yt} + \alpha_{g\pi} u_{\pi t} + \alpha_{gi} u_{it} + \beta_{g\tau} e_{\tau t} + e_{gt} \qquad (3)$$

where the coefficients α_{jk} capture the components ***a)*** and ***b)*** of reduced form errors specified above, whereas e_{gt} and $e_{\tau t}$ are the *structural* fiscal shocks, which correspond to component ***c).***

Although cov(e_{gt} , $e_{\tau t}$) =0, the structural fiscal errors are correlated with the reduced form residuals. This effectively means that the structural errors cannot be obtained by an OLS estimation of equations (2) and (3). In order to recover the structural residuals from the reduced form VAR described by equations (1)-(3), Blanchard and Perotti (2002) and Perotti (2004) apply the following identification approach: they note that it typically takes more than one quarter (the time unit they assume in their VAR framework) for discretionary fiscal policy to respond to an innovation in any of the other VAR variables, say output. This identifying assumption is tantamount to

[24] In the benchmark specification presented in Perotti (2004), the government spending variable is assumed to include government *investment* outlays and *current* government purchases (i.e., wage and non-wage expenditure). Also, in Perotti (2004) benchmark specification the real government expenditure and revenue variables as well as real output are expressed in per capita terms.

[25] As noted in Perotti (2004), this two-way breakdown of the government budget is obviously one of many possibilities. Yet, most models predict that government spending on goods and services has different effects than transfers, as only the former has a direct impact on the use of resources. As the Author comments "Summing algebraically taxes and transfers makes sense if one believes that in the short- and medium-run fiscal policy operates mostly via a demand channel".

[26] The baseline specification in Perotti (2004) uses the 10-year interest rate.

assuming that the systematic discretionary policy response is absent in a quarterly data frequency. In other words, component ***b)*** of the reduced form residuals of government spending and revenue is zero and thus, the coefficients α_{jk} in (2) and (3) solely capture only the automatic response of fiscal variables to innovations in y_t, π_t or i_t. If that is the case, the coefficients α_{jk} can then be estimated by using external information on the elasticity of taxes and government spending to output, inflation or the interest rate. Once the structural shocks of government expenditure and revenue are estimated, they can then be used as instruments in the remaining reduced form error equations (for y_t, π_t and i_t) to recover the rest of the structural shocks (e_{yt}, $e_{\pi t}$ and e_{it}).

Annex 1.1

Coefficient estimates in the equations of reduced-form residuals utilized in our study

The benchmark SVAR specification estimated in our study comprises of three endogenous variables; namely, real government primary spending on goods and services, real government revenue net of transfers, subsidies and property income, and real output (see ***Model Specifications*** section of this paper). An alternative model specification is also estimated, including the 10-year Greek government bond yield spread to Bund as an additional (i.e., fourth) endogenous variable. In line with the notation used in equations (2) & (3) above, the equations of *reduced formed* residuals of the government spending and revenue variables in our benchmark (3-variable) SVAR can be written as follows:

$$u_{\tau t} = \alpha_{\tau y} u_{yt} + \beta_{\tau g} e_{gt} + e_{\tau t} \qquad (2')$$

$$u_{gt} = \alpha_{gy} u_{yt} + \beta_{g\tau} e_{\tau t} + e_{gt} \qquad (3')$$

In line with Blanchard and Perotti (2002) and Perotti (2004), we utilize *external* information on the elasticities of government revenue (e.g. taxes) and government primary spending to derive estimates of the α_{jk} coefficients in (2') and (3'). Specifically, we assume that the output elasticity of real government spending equals zero ($\alpha_{gy} = 0$), which is tantamount to making the *plausible* assumption that there is *no* automatic response of government spending to an innovation in GDP within a quarter. Similarly, in the 4-variable VSVAR specifications examined in our study we assume that the interest rate (i.e., bond yield spread) elasticities of net revenue and government spending are zero ($\alpha_{gi} = 0$ and $\alpha_{\tau i} = 0$). Finally, for the output elasticity of net government revenue (e.g. net taxes) we estimate our models for two separate values ($\alpha_{\tau y} = 1.05$ *and* $\alpha_{\tau y} = 0.8$).

In line with Blanchard and Perotti (2002) and Perotti (2004), the coefficient $\alpha_{\tau y}$ is estimated as the weighted average of the output elasticities of each of the five major components of net government revenue; namely: individual income taxes; corporate income taxes, indirect taxes, social security taxes; and a residual item (i.e., the sum of all other current and capital transfers received by the government), which is assumed to have a zero quarterly elasticity to output. To derive the output elasticities of the aforementioned revenue components, we combine institutional information of collection lags, payment installment profiles and other characteristics of the tax system in Greece as well as related estimates released earlier by the OECD (2000) and the European Commission (2012).[27] The relevant estimates reported by the European Commission (and the OECD) are as follows:

Output semi-elasticity of Personal Income Tax: 1.80 (2.20).
Output semi-elasticity of Corporate Tax: 1.08 (0.9).
Output semi-elasticity of Indirect Taxes: 1.00 (0.8)
Output semi-elasticity of Social Security Contributions: 0.85 (1.1).
Output semi-elasticity of Total Revenue (i.e. weighted average of individual component elasticities): 1.07 (n.a).
Based on the aforementioned, we estimate the two separate values for the $\alpha_{\tau y}$ coefficient reported above. More information on our estimation method is available upon request.[28] Finally, as a required step to identify the structural shocks e_{gt} and $e_{\tau t}$ in equations (2') and

[27] See , Jan in 't Veld, Martin Larch and Marieke Vandeweyer, EC Economic Papers 452 | April 2012; *Paul van den Noord, OECD, ECO/WKP(2000)3.*

[28] See also Perotti (2004) for a more detailed treatment of this issue.

(3'), we have tried both orthogonalization, first $\beta_{g\tau} = 0$, then $\beta_{\tau g} = 0$. Our reported results (*Tables 3.1-3.12*) are based on the first orthogonalization above as both orthogonalizations lead to qualitatively similar results.

Annex 2

The STVAR model

The basic specification used in Auerbach and Gorodnichenko (2010) - henceforth, the Smooth Transition Vector Autoregressive model or STVAR in short - is as follows:

$$X_t = (1-F(z_{t-1}))\Pi_E(L)X_{t-1} + F(z_{t-1})\Pi_R(L)X_{t-1} + u_t \quad (1)$$

$$u_t \sim N(0, \Omega_t) \quad (2)$$

$$\Omega_t = \Omega_E(1 - F(z_{t-1})) + \Omega_R F(z_{t-1}) \quad (3)$$

$$F(z_t) = exp(-\gamma z_t)/(1+exp(-\gamma z_t)), \gamma>0 \quad (4)$$

where $X_t = [g_t, \tau_t, y_t]'$ is a vector of the of logs of real government purchases on goods and services (g_t), taxes net of transfers (τ_t) and real output (y_t), observed at a quarterly frequency; z is an indicator of the state of the economy, which in Auerbach and Gorodnichenko (2010) is normalized to have zero mean and unit variance; and the matrices $\Pi_i(L)$ **and** $\Omega_i(L)$ represent the VAR coefficients and variance-covariance matrices of disturbances in two regimes, ($i = R$ for recession and $i = E$ for expansion). The weights assigned to each regime for a given observation weighting function F(·) vary between 0 and 1 according to the contemporaneous state of the economy, z, which can be taken to be *e.g.* a moving average of real GDP growth.

The main advantages of the STVAR model relative to the classic SVAR approach for estimating fiscal multipliers are extensively discussed in Auerbach and Gorodnichenko (2010, 2011). One such advantage is that whereas the multipliers estimated within the classic SVAR framework may be "unstable and imprecise", given that there may actually be few observations available for a particular regime (say, recession), the STVAR model can effectively utilize more information "by exploiting variation in the degree of being in a particular regime so that the estimation and inference for each regime is based on a larger set of observations".

In their baseline specification, Auerbach and Gorodnichenko assume that $\gamma>0$, so that Ω_R and $\Pi_R(L)$ can be interpreted as describing the behavior of the system in a *sufficiently* deep recession (when $F(z_t)$ is close to 1). Similarly, Ω_E and $\Pi_E(L)$ can be taken as describing the behavior of the system in a sufficiently strong expansion (when $1-F(z_{t-1})$ is close to 1). The model also allows *time-* and *regime-varying contemporaneous* responses to structural shocks, given that Ω_t can vary over the business cycle. Furthermore, regime-dependent *dynamic* responses to shocks can be obtained by utilizing the estimated coefficients $\Pi_i(L)$ from the first equation above. Finally, the authors calibrate $\gamma = 1.5$, which is tantamount to assuming that the economy spends about 20 percent of time in a recessionary regime. The latter is broadly consistent with the duration of recessions in the U.S., as measured by the NBER business cycle dates since 1946.

The role of expectations of fiscal policy changes

As we noted earlier, the classic Blanchard and Perotti (2002) approach in estimating fiscal multipliers exploits institutional information about the tax and transfers system, the timing of tax collections and auxiliary estimates of fiscal output elasticities to identify *structural* government spending and revenue shocks in a VAR framework. In particular, a crucial assumption utilized in the aforementioned framework is that it typically takes more than one quarter for discretionary fiscal policy to respond to an innovation in any of the other VAR variables, say output. As noted in *Appendix 1* of the present document, this identifying assumption is tantamount to assuming that the systematic discretionary policy response is absent in a quarterly data frequency.

Yet, as emphasized in Perotti (2004), *"While decision lags help identification with high-frequency data, implementation lags make it more difficult"*. That is because, unlike monetary policy changes, changes to government spending and taxes are typically decided and announced well in advance of their implementation. As a consequence, their effect on interest rates and other financial variables can be broadly thought to be automatic, thus putting in doubt the validity of the key identifying assumption noted above.

Given the importance of expectations in identifying fiscal policy shocks, Auerbach and Gorodnichenko (2010) control for expectations (*i.e.,* not already accounted for by the VAR) by using real-time professional forecasts from a number of sources, including: a) the Survey of Professional Forecasters (SPF) for output and government spending variables, b) the University of Michigan RSQE econometric model for government revenue, and c) the government spending (Greenbook) forecasts prepared by the FRB staff for FOMC meetings. In practice, one of the approaches to account for private-sector expectations of fiscal policy changes presented in Auerbach and Gorodnichenko (2010) is to augment the system of equations (1)-(4) with a *direct* measure of the *unanticipated* component(s) of government revenue and/or expenditure, equal to the difference between actual purchases, $\boldsymbol{g_t}$ (or net tax revenue, $\boldsymbol{\tau_t}$) and the forecast of the corresponding variable one period earlier, $\boldsymbol{g_{t/t-1}}$ (or $\boldsymbol{\tau_{t/t-1}}$, respectively).

Using the notation and variable definitions presented earlier, the said framework is tantamount to estimating the system of equations (1)-(4) for $\boldsymbol{X\hat{}_t = [FEg_t, g_t, \tau_t, y_t]'}$ where $\boldsymbol{FEg_t}$ is the forecast error computed as the difference between the corresponding *forecast* series and the *actual* series of government purchases. In addition, Auerbach and Gorodnichenko (2011) extend their earlier paper by adopting an approach previously advocated by Jorda (2005), Stock and Watson (2007) and others to estimate impulse-response functions in their STVAR by directly projecting a (response) variable on its own lags and the lags of other variables entering the VAR. As note by Auerbach and Gorodnichenko, this direct projection approach for estimating impulse-responses provides a flexible estimation method, which does not impose dynamic restrictions implicitly embedded in VARs and which can conveniently accommodate nonlinearities in the response function. For instance, for a 3-variable vector $\boldsymbol{X\hat{}_t = [FEg_t, g_t, y_t]'}$ the response of output, $\boldsymbol{y_t}$, at horizon *h* can be estimated from the following regression:

$$\boldsymbol{y_{t+h} = a_h + F(z_t)\Pi_{R,h}(L)y_{t-1} + (1-F(z_t))\Pi_{E,h}(L)y_{t-1}}$$

$$\boldsymbol{+ F(z_t)\Psi_{R,h}(L)g_{t-1} + (1-F(z_t))\Psi_{E,h}(L)g_{t-1}}$$

$$\boldsymbol{+ F(z_t)\Phi_{R,h}(L)FEg_{t-1} + (1-F(z_t))\Phi_{E,h}(L)FEg_{t-1} + u_t} \qquad \textbf{(5)}$$

with $\boldsymbol{F(z_t) = exp(-\gamma z_t)/(1+exp(-\gamma z_t)),\ \gamma>0}$

The coefficients $\boldsymbol{\Phi_{R,h}}$ and $\boldsymbol{\Phi_{E,h}}$ (*h*=0,….N) above can be interpreted as multiplies showing the response of output to a *structural*, serially uncorrelated shock in government spending. Moreover, the linear analogue to (5) above is given by

$$\boldsymbol{y_{t+h} = a_h + \Pi_{lin\,h}(L)y_{t-1} + \Psi_{lin,h}(L)g_{t-1} + \Phi_{lin,h}(L)FEg_{t-1} + u_t} \qquad \textbf{(5')}$$

Finally, one way to estimate impulse-response functions, controlling for a certain key characteristic of the economy (say, the magnitude of public debt-to-GDP ratio, $\boldsymbol{DEBTRATIO_t}$) is to modify equation (5) as follows:

$$\boldsymbol{y_{t+h} = a_h + F(z_t)\Pi_{R,h}(L)y_{t-1} + (1-F(z_t))\Pi_{E,h}(L)y_{t-1}}$$

$$\boldsymbol{+ F(z_t)\Psi_{R,h}(L)g_{t-1} + (1-F(z_t))\Psi_{E,h}(L)g_{t-1}}$$

$$\boldsymbol{+ F(z_t)\Phi_{R,h}(L)FEg_{t-1} + (1-F(z_t))\Phi_{E,h}(L)FEg_{t-1} + u_t}$$

$$\boldsymbol{+ F(z_t)M_{R,h}(L)FEg_{t-1}*DEBTRATIO_t + (1-F(z_t))M_{E,h}(L)FEg_{t-1}*DEBTRATIO_t + \mu* DEBTRATIO_t + u_t} \qquad \textbf{(6)}$$

Again, with $\boldsymbol{F(z_t) = exp(-\gamma z_t)/(1+exp(-\gamma z_t)),\ \gamma>0}$

In equation **(6)**, the new impulse responses are the estimated series of $(\Phi_{R,h} + M_{R,h})$ ***and*** $(\Phi_{E,h} + M_{E,h})$ for $h = 1, \ldots..N$.

Annex 3 - Summary of Empirical Results

SVAR estimates of government spending and revenue multipliers

3 Variable SVAR (g_t τ_t, y_t)

Full sample (1Q 2000-1Q 2012)

Table 3.1 - α_{TY} = 1.05

		g-multipliers		τ-multipliers	
		$RGSPEND_{sa}$	$RGSPEND_{DM}$	$RTGREV2_{sa}$	$RTGREV2_{DM}$
RGDP	Impact	-0.02	0.05	-0.02	-0.02
	Cummulative	-0.05	0.03	-0.05	-0.07
	max	0.00 (1)	0.05 (0)	0.00 (1)	-0.02 (0)
RCON	Impact	0.16	0.20	0.01	0.01
	Cummulative	0.22	0.28	-0.04	-0.06
	max	0.16 (0)	0.20 (0)	0.01 (0)	0.01 (0)
RHCON	Impact	0.11	0.10	-0.03	-0.03
	Cummulative	0.16	0.16	-0.09	-0.10
	max	0.11 (0)	0.10 (0)	0.00 (0)	0.00 (1)
RGFKF	Impact	1.33	1.42	-0.57	-0.68
	Cummulative	1.62	1.73	-0.83	-0.96
	max	1.33 (0)	1.42 (0)	-0.02 (10)	-0.02 (3)
REXP	Impact	0.80	0.98	-0.76	-1.13
	Cummulative	0.83	0.99	-0.84	-1.23
	max	0.80 (0)	0.98 (0)	0.01 (9)	0.00 (4)
RIMP	Impact	0.46	0.68	-0.35	-0.48
	Cummulative	0.62	0.84	-0.34	-0.46
	max	0.46 (0)	0.68 (0)	0.02 (5)	0.01 (5)

Table 3.2 - α_{TY} = 0.80

		g-multipliers		τ-multipliers	
		$RGSPEND_{sa}$	$RGSPEND_{DM}$	$RTGREV2_{sa}$	$RTGREV2_{DM}$
RGDP	Impact	-0.03	0.04	-0.01	-0.01
	Cummulative	-0.06	0.02	-0.03	-0.06
RCON	Impact	0.15	0.20	0.02	0.01
	Cummulative	0.21	0.28	-0.03	-0.05
RHCON	Impact	0.10	0.09	-0.03	-0.02
	Cummulative	0.15	0.15	-0.09	-0.09
RGFKF	Impact	1.22	1.34	-0.46	-0.58
	Cummulative	1.51	1.65	-0.70	-0.84
REXP	Impact	0.59	0.75	-0.57	-0.85
	Cummulative	0.62	0.76	-0.64	-0.95
RIMP	Impact	0.36	0.62	-0.25	-0.36
	Cummulative	0.52	0.77	-0.24	-0.35

Table 3.3 - α_{TY} = 1.05

		g-multipliers		τ-multipliers	
		$RWEXP_{sa}$	$RWEXP_{DM}$	$RTGREV2_{sa}$	$RTGREV2_{DM}$
RGDP	Impact	0.07	0.12	-0.02	-0.03
	Cummulative	0.12	0.17	-0.08	-0.10
	max	0.07 (0)	0.12 (0)	0.00 (1)	0.00 (1)
RCON	Impact	0.23	0.32	0.02	0.02
	Cummulative	0.34	0.48	-0.04	-0.03
	max	0.23 (0)	0.32 (0)	0.02 (0)	0.02 (0)
RHCON	Impact	0.16	0.17	-0.01	-0.01
	Cummulative	0.24	0.27	-0.09	-0.07
	max	0.16 (0)	0.17 (0)	0.00 (0)	0.00 (0)
RGFKF	Impact	0.30	0.58	-0.44	-0.55
	Cummulative	0.56	0.80	-0.72	-0.83
	max	0.3 (0)	0.58 (0)	-0.02 (5)	-0.02 (3)

Table 3.4 - α_{TY} = 0.80

		g-multipliers		τ-multipliers	
		$RWEXP_{sa}$	$RWEXP_{DM}$	$RTGREV2_{sa}$	$RTGREV2_{DM}$
RGDP	Impact	0.08	0.13	-0.02	-0.03
	Cummulative	0.12	0.18	-0.07	-0.09
RCON	Impact	0.23	0.33	0.02	0.03
	Cummulative	0.24	0.48	0.02	-0.02
RHCON	Impact	0.16	0.17	-0.01	0.00
	Cummulative	0.24	0.27	-0.08	-0.06
RGFKF	Impact	0.31	0.57	-0.31	-0.43
	Cummulative	0.57	0.80	-0.55	-0.68

SVAR estimates of government spending and revenue multipliers

Change in Response Variable (in EURs) per 1 EUR Change in Impulse Variable

3 Variable SVAR (g_t τ_t, y_t)

Full sample (1Q 2000-1Q 2012)

Table 3.5 - a_{Ty} = 1.05

		g-multipliers		τ-multipliers	
		$RGSPEND_{sa}$	$RGSPEND_{DM}$	$RTGREV2_{sa}$	$RTGREV2_{DM}$
RGDP	Impact	-0.08	0.22	-0.07	-0.11
	Cummulative (12Q)	-0.22	0.15	-0.23	-0.36
	max	0.00	0.24	0.00	-0.10
RCON	Impact	0.71	0.88	0.04	0.02
	Cummulative (12Q)	0.97	1.23	-0.18	-0.25
	max	0.70	0.87	0.04	0.04
RHCON	Impact	0.39	0.35	-0.10	-0.10
	Cummulative (12Q)	0.56	0.55	-0.32	-0.34
	max	0.38	0.35	0.00	0.00
RGFKF	Impact	1.38	1.47	-0.58	-0.70
	Cummulative (12Q)	1.67	1.78	-0.86	-0.99
	max	1.37	1.47	-0.20	-0.02
REXP	Impact	0.86	1.06	-0.83	-1.22
	Cummulative (12Q)	0.90	1.07	-0.91	-1.33
	max	0.87	1.06	0.01	0.00
RIMP	Impact	0.76	1.14	-0.59	-0.80
	Cummulative (12Q)	1.03	1.41	-0.58	-0.77
	max	0.77	1.14	0.03	0.02

Table 3.6 - a_{Ty} = 0.80

		g-multipliers		τ-multipliers	
		$RGSPEND_{sa}$	$RGSPEND_{DM}$	$RTGREV2_{sa}$	$RTGREV2_{DM}$
RGDP	Impact	-0.13	0.18	-0.03	-0.06
	Cummulative	-0.27	0.11	-0.16	-0.28
RCON	Impact	0.67	0.86	0.07	0.05
	Cummulative	0.93	1.20	-0.13	-0.22
RHCON	Impact	0.36	0.32	-0.09	-0.07
	Cummulative	0.53	0.52	-0.30	-0.30
RGFKF	Impact	1.27	1.38	-0.47	-0.59
	Cummulative	1.56	1.70	-0.72	-0.86
REXP	Impact	0.64	0.82	-0.62	-0.92
	Cummulative	0.67	0.82	-0.69	-1.02
RIMP	Impact	0.61	1.03	-0.41	-0.61
	Cummulative	0.87	1.30	-0.40	-0.58

Table 3.7 - a_{Ty} = 1.05

		g-multipliers		τ-multipliers	
		$RWEXP_{sa}$	$RWEXP_{DM}$	$RTGREV2_{sa}$	$RTGREV2_{DM}$
RGDP	Impact	0.64	1.04	-0.12	-0.16
	Cummulative	1.00	1.49	-0.38	-0.48
	max	0.60	1.04	0.00	0.00
RCON	Impact	1.82	2.55	0.07	0.10
	Cummulative	2.68	3.76	-0.19	-0.13
	max	1.81	2.52	0.09	0.09
RHCON	Impact	1.02	1.06	-0.04	-0.02
	Cummulative	1.54	1.69	-0.31	-0.26
	max	1.01	1.07	0.00	0.00
RGFKF	Impact	0.56	1.07	-0.45	-0.56
	Cummulative	1.04	1.49	-0.74	-0.85
	max	0.56	1.08	-0.02	-0.02

Table 3.8 - a_{Ty} = 0.80

		g-multipliers		τ-multipliers	
		$RWEXP_{sa}$	$RWEXP_{DM}$	$RTGREV2_{sa}$	$RTGREV2_{DM}$
RGDP	Impact	0.67	1.11	-0.08	-0.12
	Cummulative	1.03	1.55	-0.31	-0.41
RCON	Impact	1.81	2.57	0.10	0.12
	Cummulative	1.91	3.78	0.07	-0.09
RHCON	Impact	1.02	1.08	-0.02	0.00
	Cummulative	1.54	1.71	-0.28	-0.22
RGFKF	Impact	0.57	1.07	-0.32	-0.44
	Cummulative	1.06	1.49	-0.57	-0.70

Explanatory notes to *Tables 3.1-3.8*

1. Model estimates for variables in seasonally adjusted terms are depicted in columns headed by the respective government spending and revenue variables followed by the "***sa***" subscript. Model estimates for variables in non-seasonally adjusted series are depicted in columns headed by government revenue and spending variables followed by the "***DM***" subscript.
2. Numbers in red suggest respective multiplier estimates are not statistically significant at the 10% confidence level.
3. Model specifications estimated for seasonally adjusted variables include a constant term, a time trend and a dummy variable, ***D2009***, which takes the value of 1 for ***t*** = Q1 2009 onwards and 0 otherwise. Model specifications for non-seasonally adjusted series include a constant term, a time trend, the ***D2009*** dummy and quarterly dummies ***QD1***, ***QD2***, ***QD3***, ***QD4***, taking the value of one when ***t*** is the 1st, 2nd, 3rd and 4th quarter of a certain year, respectively.
4. We use 4 lags for each of the endogenous variables in all SVAR model depicted in *Tables 3.1-3.8*. Interestingly, all order selection criteria indicate that 6 lags are appropriate, but since we find no autocorrelation and the residuals are normally distributed, we stick to 4 lags in order to save degrees of freedom.
5. The use of the 2009 dummy, ***D2009***, is appropriate to correct for the break in the tax revenue series that occurred that year. Inclusion of the said dummy also makes the SVAR residuals normally distributed.
6. In all SVAR results presented in *Tables 3.1-3.8*, we report the *impact* multiplier (***t*** = t_0) and the *cumulative* multiplier over a horizon of 12 quarters (***t*** = t_0 **+ *12***). In some tables, we also report the peak (*maximum*) multiplier, again over a 12 quarter horizon, with the accompanying numbers within the parentheses showing the specific quarter the maximum multiplier value is attained.
7. To convert an estimated multiplier to a derivative expressed in euro terms, we multiply the estimated multiplier value by the ratio of the *mean* of the *response* variable (in euros) to the *mean* of the respective *impulse* variable (in euros). For instance, as *Tables 3.1* & *3.3* demonstrate, the estimated real household consumption (***RHCON***$_{sa}$) multipliers of real government primary spending (***RGSPEND***$_{sa}$) and real government wage expenditure (***RWEXP***$_{sa}$) are 0.11 and 0.16, respectively. The ratio of the mean of ***RHCON***$_{sa}$ to the mean of ***RGSPEND***$_{sa}$ is 3.49 and that of the mean of ***RHCON***$_{sa}$ to the mean of ***RWEXP***$_{sa}$ is 6.31. Therefore, the estimated *impact* response of real household consumption to a one euro increase (decrease) in real government primary spending is an increase (decrease) of 0.38 euros (=+/-0.11*3.49). Similarly, a one euro rise (decline) in real government wage expenditure increases (reduces) real household consumption by slightly more than one euro (=+/-0.16*6.31).

Table 3.1.1 - Three-variable STVAR model estimates (regime-switching; *z=z1*)

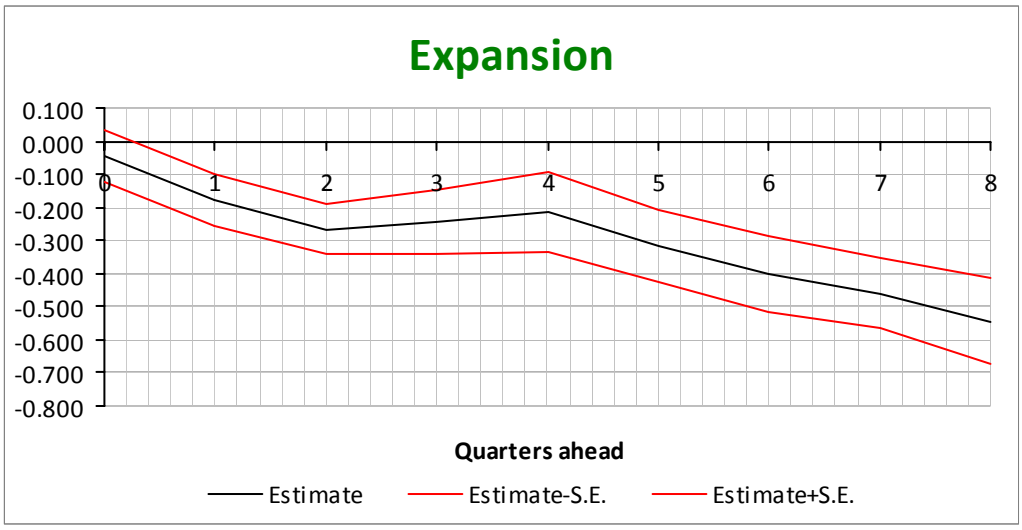
Endogenous variables: y_t ($RGDP_{sa}$); g_t ($RGSPEND_{sa}$); FEg_t ($RGSPEND_{sa}/FRGSPEND_{sa}$)

RGDPSA with RGSPENDSA									
	Expansion					Recession			
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.	Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	-0.045	0.080	-0.125	0.035	0	0.130	0.085	0.045	0.215
1	-0.179	0.078	-0.258	-0.101	1	0.235	0.083	0.152	0.319
2	-0.267	0.075	-0.343	-0.192	2	0.248	0.080	0.168	0.328
3	-0.245	0.098	-0.343	-0.146	3	0.356	0.104	0.252	0.461
4	-0.215	0.121	-0.336	-0.095	4	0.284	0.128	0.156	0.412
5	-0.318	0.108	-0.426	-0.210	5	0.415	0.121	0.293	0.536
6	-0.401	0.113	-0.515	-0.288	6	0.295	0.131	0.164	0.427
7	-0.459	0.104	-0.563	-0.355	7	0.368	0.120	0.248	0.489
8	-0.543	0.128	-0.672	-0.415	8	0.156	0.189	-0.033	0.344
Average	**-0.297**	**0.051**				**0.276**	**0.032**		
Max	**-0.045**					**0.415**			

Average (quarterly) response of real output (in euros) to one euro change in real government primary spending on goods and services

Expansion	**-1.42**
Contraction	**1.32**

Multiplier – graphical representation



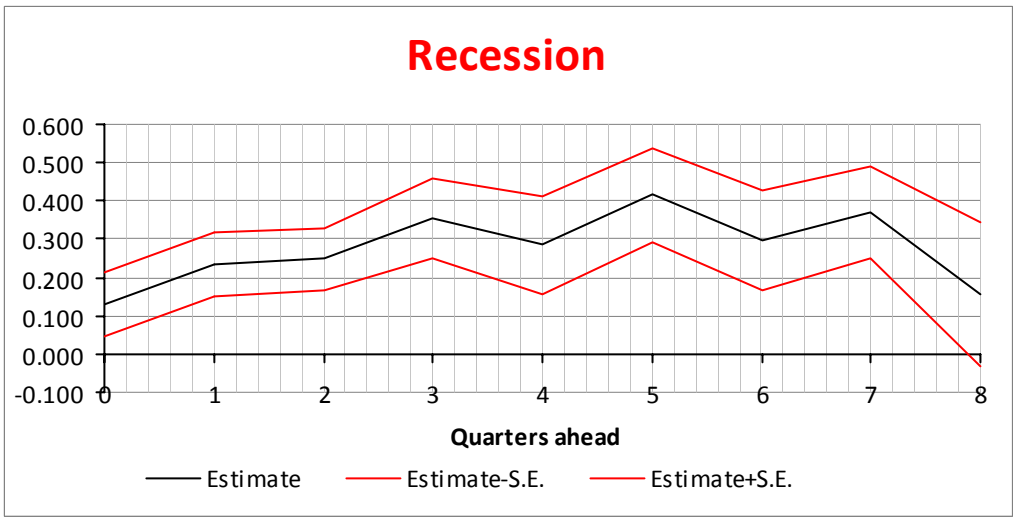


Table 3.1.2 - Three-variable STVAR model estimates (no regime-switching; *z=z1)*

Endogenous variables: y_t ($RGDP_{sa}$); g_t ($RGSPEND_{sa}$); FEg_t ($RGSPEND_{sa}/FRGSPEND_{sa}$)

RGDPSA with RGSPENDSA				
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	0.061	0.046	0.015	0.107
1	0.110	0.061	0.049	0.171
2	0.142	0.080	0.062	0.222
3	0.208	0.092	0.116	0.300
4	0.173	0.098	0.075	0.271
5	0.167	0.100	0.067	0.267
6	0.067	0.110	-0.043	0.177
7	0.077	0.115	-0.038	0.192
8	-0.122	0.132	-0.254	0.010
Average	**0.098**	**0.093**		

Average (quarterly) response of real output (in euros) to one euro change in real government primary spending on goods and services

Linear model	**0.47**

Multiplier – graphical representation

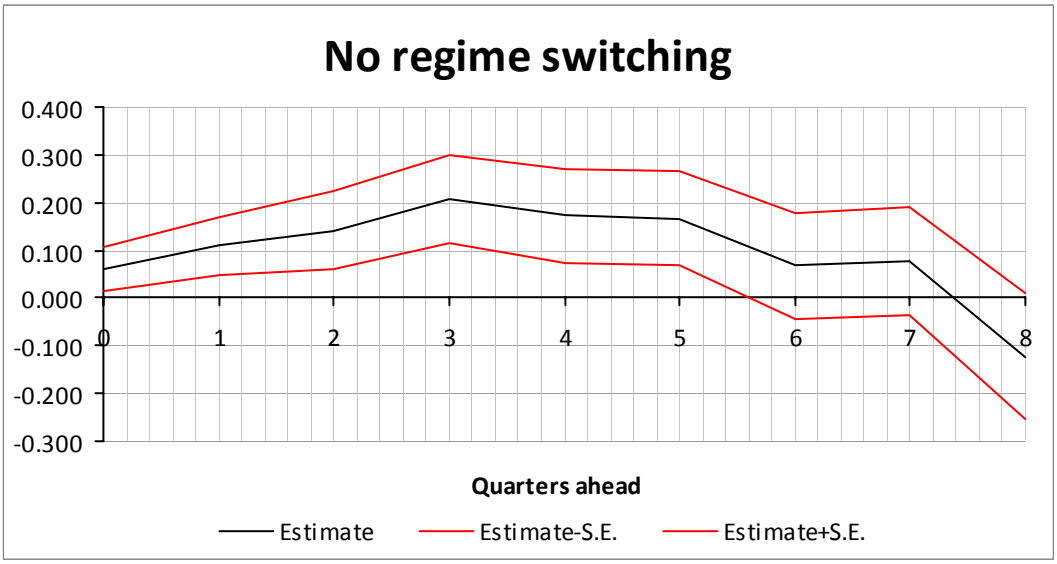


Table 3.2.1 - Three-variable STVAR model estimates (regime-switching; *z=z1*)

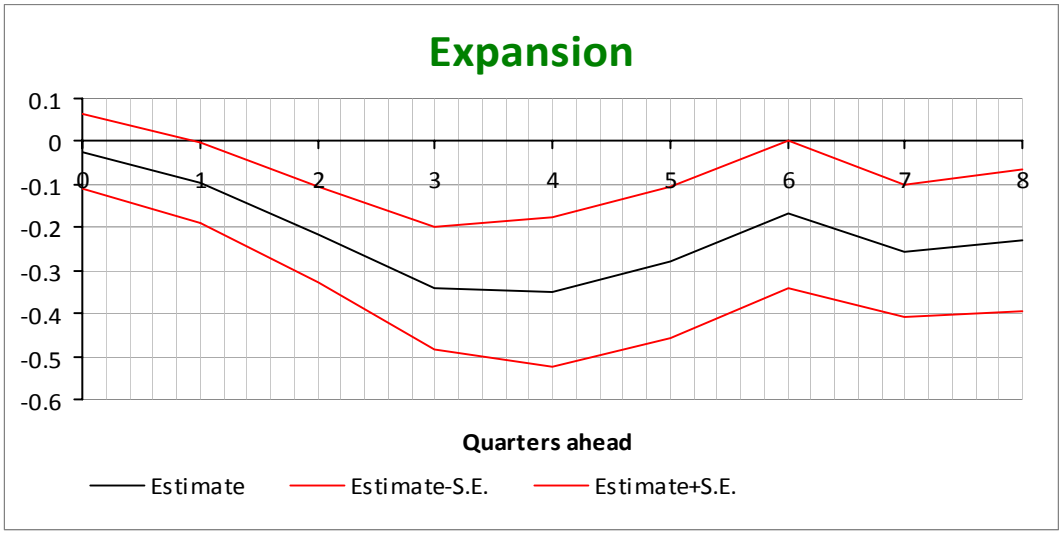
Endogenous variables: y_t ($RGDP_{sa}$); g_t ($RWEXP_{sa}$); FEg_t ($RWEXP_{sa}/FRWEXP_{sa}$)

RGDPSA with RWEXPSA									
	Expansion					Recession			
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.	Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	-0.023	0.086	-0.109	0.063	0	0.137	0.064	0.073	0.201
1	-0.096	0.094	-0.19	-0.002	1	0.203	0.07	0.133	0.273
2	-0.217	0.112	-0.329	-0.105	2	0.325	0.103	0.222	0.428
3	-0.341	0.142	-0.483	-0.199	3	0.426	0.129	0.297	0.555
4	-0.352	0.174	-0.526	-0.178	4	0.237	0.16	0.077	0.397
5	-0.281	0.176	-0.457	-0.105	5	0.379	0.161	0.218	0.54
6	-0.168	0.172	-0.34	0.004	6	0.213	0.184	0.029	0.397
7	-0.255	0.154	-0.409	-0.101	7	0.549	0.181	0.368	0.73
8	-0.23	0.164	-0.394	-0.066	8	-0.024	0.241	-0.265	0.217
Average	-0.218	0.036				0.272	0.057		
Max	-0.023					0.549			

Average (quarterly) response of real output (in euros) to one euro change in real government wage expenditure

Expansion	-1.88
Contraction	2.35

Multiplier – graphical representation



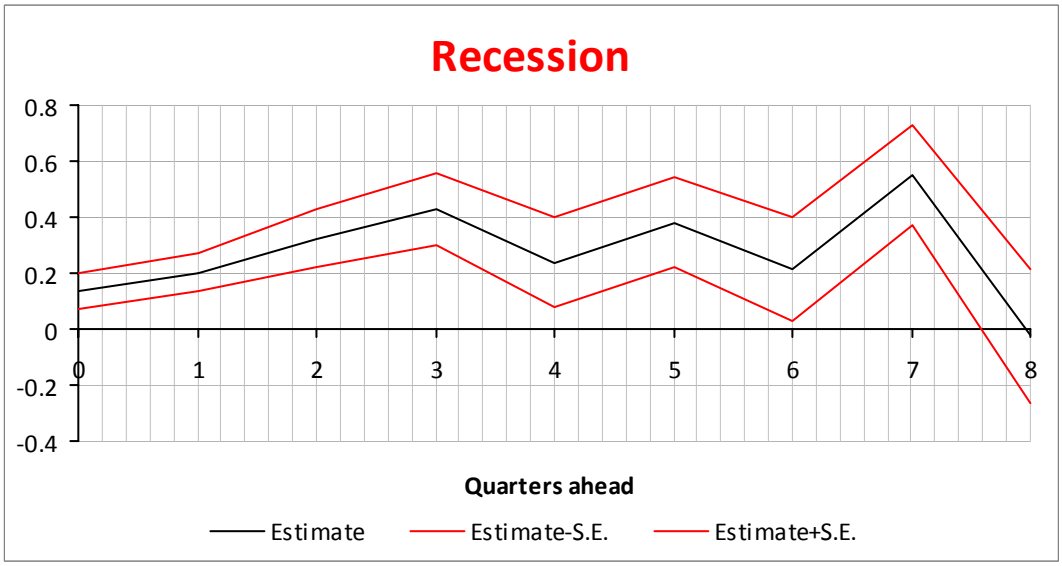


Table 3.2.2 - Three-variable STVAR model estimates (no regime-switching; *z=z1*)

Endogenous variables: y_t ($RGDP_{sa}$); g_t ($RWEXP_{sa}$); FEg_t ($RWEXP_{sa}/FRWEXP_{sa}$)

RGDPSA with RWEXPSA				
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	0.106	0.047	0.059	0.153
1	0.148	0.067	0.081	0.215
2	0.176	0.091	0.085	0.267
3	0.139	0.105	0.034	0.244
4	0.028	0.111	-0.083	0.139
5	0.067	0.117	-0.050	0.184
6	0.018	0.130	-0.112	0.148
7	0.057	0.142	-0.085	0.199
8	-0.208	0.173	-0.381	-0.035
Average	**0.059**	**0.109**		

Average (quarterly) response of real output (in euros) to one euro change in real government wage expenditure

Linear model	**0.51**

Multiplier – graphical representation

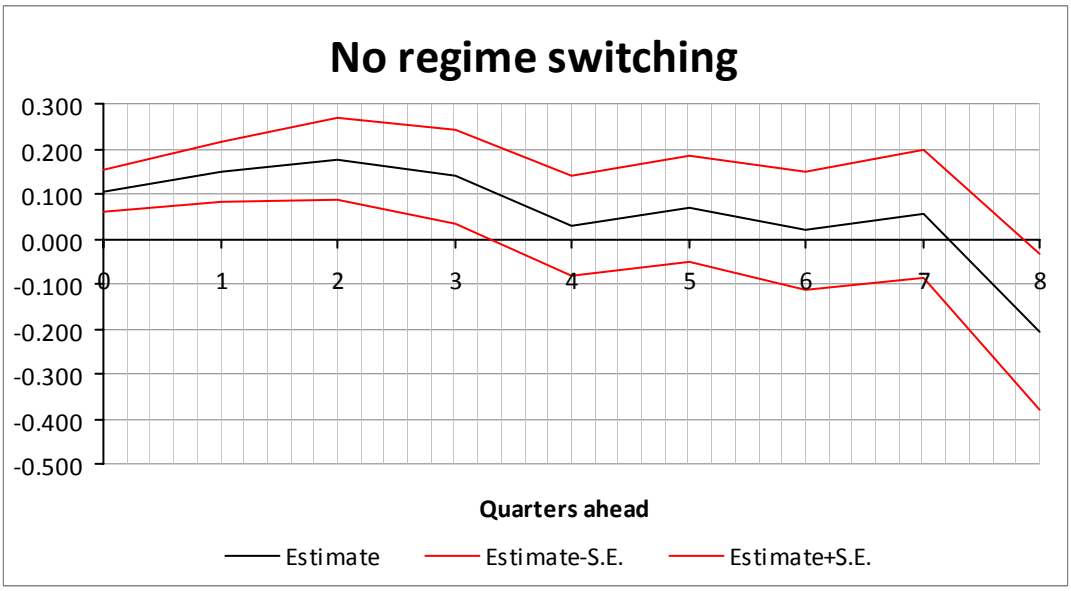


Table 3.3.1 - Three-variable STVAR model estimates (regime-switching; *z=z1*)

Endogenous variables: y_t ($RCON_{sa}$); g_t ($RGSPEND_{sa}$); FEg_t ($RGSPEND_{sa}/FRGSPEND_{sa}$)

RCONSA with RGSPENDSA									
Expansion					Recession				
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.	Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	-0.022	0.097	-0.119	0.075	0	0.218	0.104	0.114	0.322
1	-0.116	0.094	-0.210	-0.022	1	0.335	0.100	0.235	0.435
2	-0.228	0.118	-0.346	-0.110	2	0.364	0.125	0.239	0.489
3	-0.110	0.133	-0.243	0.023	3	0.483	0.140	0.343	0.623
4	-0.077	0.136	-0.213	0.059	4	0.298	0.143	0.155	0.441
5	-0.153	0.117	-0.270	-0.036	5	0.423	0.134	0.289	0.557
6	-0.354	0.122	-0.476	-0.232	6	0.285	0.141	0.144	0.426
7	-0.304	0.129	-0.433	-0.175	7	0.434	0.150	0.284	0.584
8	-0.461	0.144	-0.605	-0.317	8	0.138	0.206	-0.068	0.344
Average	-0.203	0.048			Average	0.331	0.037		
Max	-0.022				Max	0.483			

Average (quarterly) response of real total (private & public) consumption (in euros) to one euro change in real government primary expenditure on goods and services

Expansion	-0.88
Contraction	1.44

Table 3.3.2 - Three-variable STVAR model estimates (no regime-switching; *z=z1*)

Endogenous variables: y_t ($RCON_{sa}$); g_t ($RGSPEND_{sa}$); FEg_t ($RGSPEND_{sa}/FRGSPEND_{sa}$)

No regine-switching				
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	0.125	0.060	0.065	0.185
1	0.190	0.082	0.108	0.272
2	0.172	0.103	0.069	0.275
3	0.277	0.105	0.172	0.382
4	0.198	0.100	0.098	0.298
5	0.225	0.099	0.126	0.324
6	0.048	0.111	-0.063	0.159
7	0.151	0.127	0.024	0.278
8	-0.081	0.153	-0.234	0.072
Average	0.145	0.104		

Average (quarterly) response of real total (private & public) consumption (in euros) to one euro change in real government primary expenditure on goods and services

Linear model	0.63

Table 3.4.1 - Three-variable STVAR model estimates (regime-switching; *z=z1*)

Endogenous variables: y_t ($RGFKF_{sa}$); g_t ($RGSPEND_{sa}$); FEg_t ($RGSPEND_{sa}/FRGSPEND_{sa}$)

RGFKFSA with RGSPENDSA									
Expansion					Recession				
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.	Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	-0.292	0.293	-0.585	0.001	0	0.157	0.244	-0.087	0.401
1	-0.258	0.365	-0.623	0.107	1	0.655	0.304	0.351	0.959
2	-0.697	0.422	-1.119	-0.275	2	0.914	0.370	0.544	1.284
3	-0.754	0.480	-1.234	-0.274	3	1.061	0.420	0.641	1.481
4	-0.605	0.484	-1.089	-0.121	4	1.026	0.431	0.595	1.457
5	-0.810	0.484	-1.294	-0.326	5	1.155	0.430	0.725	1.585
6	-1.033	0.419	-1.452	-0.614	6	1.456	0.375	1.081	1.831
7	-1.198	0.488	-1.686	-0.710	7	1.392	0.439	0.953	1.831
8	-1.348	0.563	-1.911	-0.785	8	1.009	0.729	0.280	1.738
Average	**-0.777**	**0.124**				**0.981**	**0.130**		
Max	**-0.258**					**1.456**			

Average (quarterly) response of real gross fixed capital formation (in euros) to one euro change in real government primary expenditure on goods and services

Expansion	**-0.80**
Contraction	**1.01**

Table 3.4.2 - Three-variable STVAR model estimates (no regime-switching; *z=z1*)

Endogenous variables: y_t ($RGFKF_{sa}$); g_t ($RGSPEND_{sa}$); FEg_t ($RGSPEND_{sa}/FRGSPEND_{sa}$)

No regime-switching				
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	0.235	0.148	0.087	0.383
1	0.323	0.216	0.107	0.539
2	0.315	0.289	0.026	0.604
3	0.373	0.329	0.044	0.702
4	0.366	0.373	-0.007	0.739
5	0.313	0.404	-0.091	0.717
6	0.335	0.428	-0.093	0.763
7	0.202	0.448	-0.246	0.650
8	-0.244	0.488	-0.732	0.244
Average	**0.246**	**0.347**		

Average (quarterly) response of real gross fixed capital formation (in euros) to one euro change in real government primary expenditure on goods and services

Linear model	**0.25**

Table 3.5.1 - Three-variable STVAR model estimates (regime-switching; *z=z1*)

Endogenous variables: y_t ($RHCON_{sa}$); g_t ($RGSPEND_{sa}$); FEg_t ($RGSPEND_{sa}/FRGSPEND_{sa}$)

RHCONSA with RGSPENDSA									
Expansion					Recession				
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.	**Horizon**	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	-0.096	0.099	-0.195	0.003	0	0.074	0.102	-0.028	0.176
1	-0.102	0.103	-0.205	0.001	1	0.295	0.106	0.189	0.401
2	-0.256	0.111	-0.367	-0.145	2	0.279	0.115	0.164	0.394
3	-0.095	0.131	-0.226	0.036	3	0.350	0.135	0.215	0.485
4	-0.091	0.132	-0.223	0.041	4	0.315	0.136	0.179	0.451
5	-0.115	0.106	-0.221	-0.009	5	0.300	0.116	0.184	0.416
6	-0.278	0.115	-0.393	-0.163	6	0.333	0.129	0.204	0.462
7	-0.227	0.141	-0.368	-0.086	7	0.313	0.158	0.155	0.471
8	-0.427	0.143	-0.570	-0.284	8	0.248	0.202	0.046	0.450
Average	-0.187	0.039			**Average**	0.279	0.027		
Max	-0.091				**Max**	0.350			

Average (quarterly) response of real household consumption (in euros) to one euro change in real government primary expenditure on goods and services

Expansion	**-0.65**
Contraction	**0.97**

Table 3.5.2 - Three-variable STVAR model estimates (no regime-switching; *z=z1*)

Endogenous variables: y_t ($RHCON_{sa}$); g_t ($RGSPEND_{sa}$); FEg_t ($RGSPEND_{sa}/FRGSPEND_{sa}$)

Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	0.010	0.055	-0.045	0.065
1	0.166	0.073	0.093	0.239
2	0.116	0.091	0.025	0.207
3	0.223	0.093	0.130	0.316
4	0.192	0.091	0.101	0.283
5	0.187	0.089	0.098	0.276
6	0.109	0.103	0.006	0.212
7	0.142	0.123	0.019	0.265
8	-0.005	0.152	-0.157	0.147
Average	**0.127**	**0.097**		

Average (quarterly) response of real household consumption (in euros) to one euro change in real government primary expenditure on goods and services

Linear model	**0.44**

Table 3.6.1 - Three-variable STVAR model estimates (regime-switching; *z=z1*)

Endogenous variables: y_t ($RCON_{sa}$); g_t ($RWEXP_{sa}$); FEg_t ($RWEXP_{sa}/FRWEXP_{sa}$)

RCONSA with RWEXPSA									
Expansion					Recession				
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.	Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	-0.029	0.099	-0.128	0.070	0	0.225	0.074	0.151	0.299
1	-0.038	0.125	-0.163	0.087	1	0.214	0.094	0.120	0.308
2	-0.168	0.171	-0.339	0.003	2	0.291	0.160	0.131	0.451
3	-0.163	0.192	-0.354	0.029	3	0.375	0.179	0.196	0.554
4	-0.188	0.186	-0.374	-0.002	4	0.172	0.174	-0.002	0.346
5	-0.133	0.171	-0.304	0.038	5	0.332	0.160	0.173	0.492
6	-0.172	0.178	-0.351	0.006	6	0.166	0.195	-0.028	0.361
7	-0.391	0.160	-0.551	-0.232	7	0.691	0.199	0.492	0.891
8	-0.449	0.152	-0.600	-0.297	8	0.058	0.226	-0.169	0.284
Average	-0.192	0.047				0.281	0.060		
Max	-0.029					0.691			

Average (quarterly) response of real total (private and public) consumption (in euros) to one euro change in real government wage expenditure

Expansion	**-1.51**
Contraction	**2.20**

Table 3.6.2 - Three-variable STVAR model estimates (no regime-switching; *z=z1*)

Endogenous variables: y_t ($RCON_{sa}$); g_t ($RWEXP_{sa}$); FEg_t ($RWEXP_{sa}/FRWEXP_{sa}$)

No regime switching				
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	0.135	0.057	0.078	0.192
1	0.132	0.088	0.044	0.220
2	0.121	0.114	0.007	0.235
3	0.109	0.117	-0.009	0.226
4	0.006	0.160	-0.153	0.166
5	0.007	0.110	-0.103	0.117
6	-0.024	0.120	-0.144	0.096
7	-0.009	0.141	-0.150	0.131
8	-0.355	0.158	-0.513	-0.198
Average	0.014	0.118		

Average (quarterly) response of real total (private and public) consumption (in euros) to one euro change in real government wage expenditure

Linear model	**0.11**

Table 3.7.1 - Three-variable STVAR model estimates (regime-switching; *z=z1*)

Endogenous variables: y_t ($RHCON_{sa}$); g_t ($RWEXP_{sa}$); FEg_t ($RWEXP_{sa}/FRWEXP_{sa}$)

RHCON with RWEXPSA									
Expansion					Recession				
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.	Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	-0.095	0.103	-0.198	0.007	0	0.075	0.076	-0.002	0.151
1	-0.052	0.131	-0.183	0.079	1	0.179	0.097	0.082	0.276
2	-0.169	0.163	-0.332	-0.006	2	0.260	0.155	0.105	0.414
3	-0.123	0.181	-0.304	0.059	3	0.330	0.171	0.159	0.501
4	-0.123	0.183	-0.306	0.060	4	0.244	0.173	0.071	0.417
5	-0.065	0.151	-0.216	0.087	5	0.239	0.143	0.096	0.382
6	-0.153	0.163	-0.316	0.010	6	0.239	0.180	0.059	0.419
7	-0.385	0.167	-0.553	-0.218	7	0.523	0.207	0.316	0.730
8	-0.479	0.146	-0.624	-0.333	8	0.230	0.222	0.007	0.452
Average	-0.183	0.049				0.258	0.040		
Max	-0.052					0.523			

Average (quarterly) response of real household consumption (in euros) to one euro change in real government wage expenditure

Expansion	**-1.15**
Contraction	**1.62**

Table 3.7.2- Three-variable STVAR model estimates (no regime-switching; *z=z1*)

Endogenous variables: y_t ($RHCON_{sa}$); g_t ($RWEXP_{sa}$); FEg_t ($RWEXP_{sa}/FRWEXP_{sa}$)

No regime switching				
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	0.043	0.054	-0.011	0.097
1	0.110	0.081	0.029	0.191
2	0.090	0.105	-0.015	0.194
3	0.112	0.109	0.003	0.222
4	0.054	0.105	-0.051	0.159
5	0.080	0.102	-0.022	0.182
6	0.038	0.118	-0.079	0.156
7	-0.016	0.139	-0.155	0.123
8	-0.296	0.164	-0.460	-0.132
Average	**0.024**	**0.109**		

Average (quarterly) response of real household consumption (in euros) to one euro change in real government wage expenditure

Linear model	**0.15**

Table 3.8.1 - Three-variable STVAR model estimates (regime-switching; *z=z1*)

Endogenous variables: y_t ($RGFKF_{sa}$); g_t ($RWEXP_{sa}$); FEg_t ($RWEXP_{sa}/FRWEXP_{sa}$)

RGFKF with RWEXPSA									
	Expansion					Recession			
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.	Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	-0.220	0.300	-0.520	0.080	0	0.306	0.217	0.089	0.523
1	-0.393	0.377	-0.770	-0.016	1	0.576	0.273	0.303	0.849
2	-0.920	0.438	-1.358	-0.481	2	0.966	0.399	0.567	1.365
3	-1.523	0.417	-1.940	-1.106	3	1.167	0.171	0.996	1.338
4	-1.539	0.406	-1.945	-1.132	4	1.063	0.173	0.890	1.236
5	-0.927	0.455	-1.382	-0.472	5	0.964	0.412	0.552	1.376
6	-0.514	0.417	-0.931	-0.097	6	1.222	0.180	1.042	1.402
7	-0.048	0.489	-0.537	0.441	7	1.042	0.456	0.586	1.498
8	0.180	0.601	-0.421	0.781	8	0.043	0.879	-0.836	0.921
Average	-0.656	0.205				0.816	0.137		
Max	0.180					1.222			

Average (quarterly) response of real gross fixed capital formation (in euros) to one euro change in real government wage expenditure

Expansion	**-1.22**
Contraction	**1.52**

Table 3.8.2 - Three-variable STVAR model estimates (no regime-switching; *z=z1*)

Endogenous variables: y_t ($RGFKF_{sa}$); g_t ($RWEXP_{sa}$); FEg_t ($RWEXP_{sa}/FRWEXP_{sa}$)

No regime switching				
Horizon	Estimate	S.E.	Estimate-S.E.	Estimate+S.E.
0	0.114	0.152	-0.038	0.267
1	0.183	0.219	-0.036	0.402
2	0.116	0.306	-0.190	0.422
3	-0.024	0.352	-0.375	0.328
4	-0.093	0.391	-0.484	0.298
5	0.047	0.431	-0.384	0.478
6	0.172	0.465	-0.293	0.636
7	0.227	0.492	-0.265	0.719
8	-0.299	0.584	-0.883	0.285
Average	0.049	0.377		

Linear model	**0.09**

Table 6.1 – Descriptive statistics of raw data

	RCON	RCONSA	RGCON	RGCONA	RGCONASA	RGCONSA	RGDP	RGDPSA	RGFKF
Means	371.8082	371.6118	68.79787	72.69049	72.6645	68.79558	408.3657	408.763	88.14913
Median	376.1518	374.5752	68.26861	71.46005	71.48608	68.32021	410.2507	410.8925	88.69974
Max	426.8631	433.6734	88.24007	108.5333	100.6702	86.14117	478.8568	459.2212	118.2026
Min	303.8945	305.6901	61.30884	57.97297	60.92666	61.02051	326.9889	343.9372	47.75812
Std. Dev.	35.75415	35.27227	5.434355	9.551562	8.570429	5.259905	40.62047	36.65728	17.60453
Skewness	-0.118774	-0.11134	0.869333	1.075017	0.836235	0.674067	-0.115552	-0.243164	-0.269299
Kurtosis	1.909231	1.944328	4.47313	5.26052	3.747115	3.678716	1.999807	1.837937	2.409926
Jarque-Bera	2.596265	2.425064	10.8189	19.87071	6.850477	4.746078	2.195407	3.306052	1.32974
Probability	0.273041	0.297443	0.004474	0.000048	0.032542	0.093197	0.333636	0.19147	0.51434
Sum	18590.41	18580.59	3439.894	3561.834	3560.561	3439.779	20418.28	20438.15	4407.456
Sum Sq. Dev.	62639.6	60962.51	1447.079	4379.152	3525.708	1355.664	80851.11	65844.06	15186.06
Observations	50	50	50	49	49	50	50	50	50

	RGFKFSA	RGSPEND	RGSPENDSA	RHCON	RHCONSA	RTGREV2	RTGREV2SA	RWEXP	RWEXPSA
Means	88.2123	85.38015	85.38609	298.5192	298.3285	85.647	85.6209	47.28367	47.29792
Median	90.29182	83.81866	83.60748	302.1334	302.1717	88.20307	85.24999	48.61765	48.05189
Max	121.4676	122.8444	109.5649	348.9272	343.5654	103.6957	105.7798	66.39259	63.61648
Min	50.95252	61.57658	70.4248	238.5522	241.4021	51.22918	58.73408	29.09737	29.28663
Std. Dev.	17.00683	11.53067	9.951644	30.67533	30.01679	12.48692	9.693558	7.120669	6.864554
Skewness	-0.293082	0.55017	0.51319	-0.154638	-0.164472	-1.105023	-0.613935	-0.062071	-0.269277
Kurtosis	2.54572	3.931611	2.375016	1.931303	1.922327	3.744377	3.659708	3.193659	3.012665
Jarque-Bera	1.145749	4.243903	2.948296	2.578676	2.644963	11.1034	3.966709	0.108035	0.592493
Probability	0.563902	0.119798	0.228974	0.275453	0.266473	0.003881	0.137607	0.947416	0.743604
Sum	4410.615	4183.628	4183.919	14925.96	14916.43	4196.703	4195.424	2316.9	2317.598
Sum Sq. Dev.	14172.38	6381.907	4753.69	46107.82	44149.39	7484.307	4510.323	2433.789	2261.861
Observations	50	49	49	50	50	49	49	49	49

Source: Eurostat

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