WP/12/190

IMF Working Paper

Successful Austerity in the United States, Europe and Japan

Nicoletta Batini, Giovanni Callegari and Giovanni Melina

INTERNATIONAL MONETARY FUND

 WP/12/190

IMF Working Paper

EUR

Successful Austerity in the United States, Europe and Japan[1]

Prepared by Nicoletta Batini*, Giovanni Callegari and Giovanni Melina*****

Authorized for distribution by Peter Doyle

July 2012

Abstract

The output effects of 2009 fiscal expansions have been hotly debated. But the discussion of fiscal multipliers is even more relevant now that several European countries have had to quickly retract their stimulus measures in an effort to regain market confidence. Using regime-switching VARs we estimate the impact of fiscal adjustment on the United States, Europe and Japan allowing for fiscal multipliers to vary across recessions and booms. We also estimate ex ante probabilities of recessions derived in association with different-sized and different types of consolidation shocks (expenditure- versus tax-based). We use these estimates to understand how consolidations should be designed to be most effective in terms of permanently and rapidly reducing a country's debt-to-GDP ratio. The main finding is that smooth and gradual consolidations are to be preferred to frontloaded or aggressive consolidations, especially for economies in recession facing high risk premia on public debt, because sheltering growth is key to the success of fiscal consolidation in these cases.

JEL Classification Numbers: E62; F41; H30; H63

Keywords: Fiscal consolidation, fiscal multipliers, growth-friendly fiscal policy

(*) Corresponding Authors' E-Mail Address: NBatini@imf.org;giovanni.callegari@gmail.com; giovanni.melina@gmail.com.

[1] We are grateful to Anja Baum, Fabio Canova, Peter Doyle, Paul Levine, Anke Weber and seminar participants at the International Monetay Fund and University of Surrey for useful comments. We thank Nathan Balke for sharing his RATS codes and Thomas Warmedinger for sharing his debt simulation tool, which forms the basis of our debt simulations. Brian Cho provided very valuable research assistance. We are also indebted to Bruno Chiarini for sharing Italian accrual-based fiscal data and to Anke Weber for sharing Japanese revenue data. Giovanni Melina acknowledges financial support from ESRC project RES-062-23-2451. Work on this paper was done while Callegari was an Economist at the International Monetary Fund.

Contents Page

Abstract 1

I. Introduction 4

II. Literature Review 9
- A. Empirical Literature on The Effects of Fiscal Shocks 9
- B. The Effects of Fiscal Policy: What do Models Say? 12
- C. Fiscal Policy Under Special Conditions 15

III. Econometric Methodology 16
- A. The Model 16
- B. Testing for the TVAR Structure 18
- C. Non-Linear Impulse Response Functions 19
- D. Regime-Dependent Fiscal Multipliers 19
- E. Conditional Probabilities of a Recession 20

IV. Results 20
- A. Non-Linear IRFS 21
- B. Fiscal Multipliers 23
- C. Conditional Probabilities of a Recession Following a Fiscal Shock 25

V. What Does This Mean in Practice? 26
- A. Model Used for The Debt Simulations 27
- B. Debt simulations 30

VI. Concluding Remarks 32

VII. References 33

VIII. Data Appendix 58
- A. Euro Area (1985 Q1– 2009 Q4): 58
- B. France (1970 Q1 – 2010 Q4): 58
- C. Italy (1981 Q1– 2007 Q4): 59
- D. Japan (1981Q1– 2009 Q4): 59
- E. United States (1975 Q1– 2010 Q2): 60

Tables

1. Tests for threshold VAR 54
2. Cumulative Fiscal Multipliers....................55
3. Conditional Probabilities of a Recession (Expenditure Cut) 56
4. Conditional Probabilities of a Recession (Tax Hike) 57

Figures

1. Average Responses to Shocks to Government Spending–Euro Area....................38
2. Average Responses to Shocks to Government Spending–France 39
3. Average Responses to Shocks to Government Spending–Italy....................40
4. Average Responses to Shocks to Government Spending–Japan 41
5. Average Responses to Shocks to Government Spending–United States....................42
6. Average Responses to Shocks to Net Taxes–Euro Area 43
7. Average Responses to Shocks to Net Taxes–France 44
8. Average Responses to Shocks to Net Taxes–Italy....................45
9. Average Responses to Shocks to Net Taxes–Japan....................46
10. Average Responses to Shocks to Net Taxes–United States....................47
11. Average Cumulative Government Spending and Tax Multipliers 48
12 . Baseline Scenario (Adverse Growth Shock, No Fiscal Consolidation)....................49
13. Debt-to-GDP Ratio Following a Smooth Fiscal Consolidation (Scenario I)....................50
14. Debt-to-GDP Ratio Following a Frontloaded Fiscal Consolidation (Scenario II) 51
15. Debt-to-GDP Ratio—Difference Between Frontloaded and Smooth Fiscal 52
16. Debt-To-Gdp Ratio—Difference Between Frontloaded (Spending-Cuts-Only Based) 52
17. Debt-to-GDP Ratio—Difference Between Frontloaded and Smooth Fiscal 53
18 . Debt-to-Gdp Ratio—Difference Between Frontloaded and Smooth Fiscal 53

I. INTRODUCTION

With the U.S., Europe's and Japan's public debt at historic levels, concerns are rising over the growth impact of needed fiscal adjustment. The severe recession, the significant capital interventions in the financial markets and the fiscal stimulus measures have pushed up the joint public debt to levels not seen since the end of World War II. Reducing the public debt ratio to more comfortable levels would require a large and sustained adjustment that could most likely weaken aggregate demand. In the United States and Japan, the conventional monetary policy support to fiscal consolidation is limited by the fact that interest rates are near their effective floor, while everywhere population aging and currently low trend growth provide little room to absorb falling demand. As most of the advanced countries are called to adjust, external demand will provide very little support to U.S., Europe's and Japan's growth prospects.

On the other hand, consolidation cannot be postponed indefinitely. In the United States, the debt ceiling deal reached just before August 2, 2011 followed a painful negotiation and was quickly followed by a downgrade of the U.S. credit rating by a major rating agency. And although, unlike in some countries in Europe, the United States is currently not facing market pressures to signal immediate consolidation plans, these could mount eventually, now that the 12-member super committee tasked with finding $1.2 trillion in deficit-reduction measures failed in delivering a viable solution by late Fall 2011, and the federal government is again expected to near its new borrowing limit in early 2013. In Europe, especially in countries where sovereign debts have increased sharply due to bank bailouts, a crisis of confidence has emerged with the widening of bond yield spreads and risk insurance on credit default swaps between these countries and other euro zone members, most importantly Germany. While the sovereign debt increases have been most pronounced in only a few euro zone countries (notably in Greece, Ireland and Portugal, and more recently Spain and Italy), they have become a perceived problem for the area as a whole because of the potentially severe contagion effects.

Thus, if consolidations are delayed there is a real risk of debt downgrades or defaults. But frontloading consolidation risks bringing recoveries to a halt, hindering the same fiscal adjustment or making it too costly in terms of jobs and output. One immediate question then is: what is the pace of fiscal consolidation in the United States, the euro area and Japan that would achieve maximum adjustment given low growth, while preserving the recovery?

To answer this question it is necessary to estimate fiscal multipliers for various stages of the business cycle. It is also important to account for the fact that a too-abrupt consolidation that begins while the economy is expanding can push the economy into a recession. In other words, the success of a fiscal consolidation (in absolute and GDP terms) ultimately depends on how the consolidation affects the economic cycle given a set of specific starting conditions. For this we need an empirical methodology that makes the stages of the business cycle endogenous to the computation of the fiscal multipliers; and we need a tool to quantify the likelihood that a fiscal consolidation (of a given size) occurring in a certain stage of the cycle drives the economy into another stage.

Unfortunately, most of the literature of fiscal multipliers is based on linear structural vector auto regressions (SVARs) or linearized dynamic stochastic general equilibrium (DSGE) models which by construction rule out state-dependent multipliers. Auerbach and Gorodnichenko (2012a, 'AG' hereafter), developed a methodology that allows multipliers to vary between expansion and recession. Building on their framework, we want to study how fiscal shocks can shift the economy from one regime (expansion, say) to another (recession). Different from AG and other related papers, we define the regimes in terms of the sign of real GDP growth and not as output gaps (or as deviations from the trend) as, we believe, the growth rate better captures the state of the economy. A country, for instance, could be in better shape when growing out of a negative output gap rather than when contracting after a period of economic boom. Moreover, the use of the GDP growth sign makes endogenizing the regimes much easier. Furthermore, we want also to take explicitly into account the role of the monetary policy stance, which has been indicated as an important additional determinant of how output responds to fiscal adjustments.

To achieve these objectives, we use a similar methodology to that of AG which yields results that are richer along three important dimensions:

- First, we estimate fiscal multipliers conditional on monetary policy by expanding the regime-dependent VAR with a real short-term interest rate. Traditional VARs used to estimate fiscal multipliers – and rooted in the Blanchard-Perotti (2002, 'BP' hereafter) framework – contain only three endogenous variables, namely real GDP, public expenditure and tax revenues. However, fiscal multipliers can vary depending on the stance of monetary policy and, actually, subsequent analyses in the BP tradition do include variables capturing monetary policy. A recent study by the IMF (2010) that examined the effects on U.S. output of changes in monetary policy and tax rates in the United States, for example, shows that reductions in interest rates usually support output during episodes of fiscal consolidation. Central banks offset some of the contractionary pressures by cutting policy interest rates, and longer-term rates also typically decline, cushioning the impact on consumption and investment. And if interest rates are near their effective floor, the effects of fiscal consolidation are more costly in terms of lost output. Theoretical work by Hall (2009), Woodford (2011) and Christiano et al. (2011) and empirical work by Ahrend et al. (2006) and Canova and Pappa (2011) also indicate that the monetary policy stance is an important determinant of the fiscal multiplier.[2] Thus including a variable to capture the stance of monetary policy should help us control for the simultaneous effect on output that may come from monetary conditions.

- Second, we endogenize the regime into the estimation: in essence, a fiscal shock can push the economy away from the initial regime into an alternative one (e.g. move from an expansion to a recession) depending on the size, the sign and the nature (tax vs. expenditure) of the initial shock.[3] In other words, our impulse responses are a function of history and the expansion or recession regimes are not fixed ex ante.
- Third, we estimate the probability with which fiscal shocks of a certain size, sign or nature can push the economy into a different regime.

Despite these improvements, our paper is still subject to some of the problems to affecting the VAR literature. In particular, the size of the response to fiscal policy shocks might be conditional to other variables other than the business cycle like historical conditions, political uncertainty, for which we do not control explicitely, for lack of data and the need to work with a parsimonious model to avoid loosing estimating power. For example, fiscal shocks in times of severe crisis (like the recent financial crisis) might have affected by particular political and social conditions typical to those periods.

Our analysis focuses on a number of countries that allows us to condition on group-specific features. In particular, we estimate regime-dependent multipliers for several countries in addition to the United States, including: (i) the Euro Area (EA) as a whole and two core-EA countries facing the current or prospective need of fiscal adjustments (Italy and France); and (ii) Japan (high debt non-EA, non-EU). Our choice of countries, mainly driven by data availability[4], helps us to understand how the magnitude of fiscal multipliers may vary in relation to either the level of debt, trend growth, or the level of tax and expenditure

[2] Woodford (2011) and Christiano et al. (2011) theoretical analysis focuses on government spending multipliers when zero lower bound (ZLB) on nominal interest rates is binding. However, empirically it is practically impossible to estimate multipliers for periods of binding ZLB episodes during recessions since, with the exception of Japan, these have been very rare in modern history. We therefore include a real interest rate to capture the ex-post monetary stance more generally.

[3] Baum and Koester (2011) and IMF (2012) estimate a Blanchard-Perotti TVAR without monetary policy which changes structure with the sign of the output gap. In their case the output gap is not part of the set of endogenous variables, but the gap is *de facto* endogenized by one-side HP-filtering the impulse response functions of GDP at each simulation, constructing the gap and using this as a new starting observation.

[4] Data for this exercise is also readily available for Australia and Canada in addition to the countries in our sample, but we have opted not to extend the analysis to these countries since they have low public debt and are thus less interesting cases from the point of view of studying the impact of fiscal consolidation. Data for the United Kingdom are also available for this exercise but we have chosen to pursue estimates on UK data in future research.

burdens, all which differ markedly in our sample group of countries. We plan to expand the estimation to other countries in future research as data becomes available.

The multipliers that we find are broadly in line with Auerbach and Gorodnichenko (2012a, 2012b) prior empirical estimates, and reaffirm their finding that fiscal multipliers tend to be considerably larger in recessions than in expansions. Importantly, recent research by Caldara and Kamps (2012) shows that the identification scheme we employ to disentangle nondiscretionary policy responses to output from discretionary policy choices, based on the classical approach of Blanchard and Perotti (2002), imply fiscal output elasticities consistent with plausible auxiliary estimates. Alongside, our estimates of the government spending multiplier in recessions and expansions are largely consistent with the theoretical arguments in both (old) Keynesian and (new) modern business cycle models.

The main findings from the analysis can be summarized as follows:

1. Fiscal expenditure multipliers are significantly larger in downturns than in upturns;[5]

2. While it is plausible to conjecture that confidence effects have been at play in our sample of consolidations, during downturns they do not seem to have ever been strong enough to make the consolidations expansionary at least in the short run;

3. Expenditure multipliers (where expenditure is defined as public consumption and investment only) are significantly larger than tax multipliers (where tax is defined as tax minus transfers) in downturns;

4. Monetary policy does not seem to have a strong cushioning effect on economic activity against fiscal withdrawals implemented during downturns—possibly reflecting the fact that during the actual downturns experienced by the countries of our sample, over our estimation horizon, interest rates may not have been cut sufficiently (or cut sufficiently fast) to counteract the drop in output that accompanied the episodes of fiscal consolidation.[6] The weak cushioning effect of monetary policy may also be due to the fact that some of the downturns in our sample might actually be induced by the monetary authorities in an effort to lower inflation;

---

[5] When referring to upturns and downturns, we refer to the sign of the growth rate of real GDP. In our analysis. we abstract from the sign and size of the output gap.

[6] Zero bounds on nominal rates may not fully explain this result in that when at the zero bound, central banks in Europe, Japan and the United States have generally made use of quantitative and qualitative easing measures which have the potential effect of lowering the real interest rate at various maturities.

5. The probability that a fiscal consolidation initiated in a downturn deepens or extends the downturn is almost twice as large as the probability that a consolidation started in an upturn triggers a downturn;

6. "Strong" (defined as 2 standard deviation fiscal shocks) consolidations are 20 percent more likely to trigger or extend downturns than "mild" (defined as 1 standard deviation fiscal shocks) consolidations. In other words, the same fiscal adjustment is less recessionary if made via an extended adjustment as opposed to a more abrupt one;

7. The exact size of the 1-year cumulative fiscal multiplier is country-, time-, and circumstance-specific, with ranges in our sample countries (in downturns) between 1.6 and 2.6 for expenditure shocks, and 0.16 and 0.35 for tax shocks.

8. The peak effect on output of fiscal consolidations is within the first year from the shock.

9. Frontloaded consolidations tend to be more contractionary and, hence, delay the reduction in the debt-to-GDP ratio relative to smoother consolidations.

The key policy implications from the analysis are thus:

- Implementing fiscal consolidations during periods of positive output growth reduces significantly the impact on output;
- If consolidations need to be implemented during downturns (for instance, to regain market confidence), they should prioritize increases in net taxes (defined as taxes minus transfers);
- If consolidations have to occur during downturns and prioritize cuts in public consumption and investment, they should be smooth and gradual and be accompanied by increases in net taxes. When the fiscal adjustment relies more heavily on net tax increases than on expenditure cuts, and is gradual, the debt-to-GDP ratio falls by more, while affecting output less adversely;
- Monetary policy should be used more proactively to mitigate the output costs of consolidations;
- Measures that improve the credibility and durability of consolidations may boost positive confidence effects, alleviating the cost of future consolidations. In the European context, for example, a strong commitment to a responsible implementation of the European Union's "Fiscal Compact" may be warranted in this regard;
- Last but not least, more empirical research is needed to understand the size and regime-dependency of multipliers of subcomponents of expenditure, since it is likely that some expenditure cuts are more output-costly than others (our estimates suggest

that, historically, the kind of expenditure cuts used were costly in terms of foregone output);[7] moreover, our analysis abstracts from the role of debt levels, which have been shown to significantly reduce growth, especially when they exceeds a specific threshold, usually estimated around 90 percent of GDP (see Kumar and Woo, 2011, and Baum, Checherita and Rother, 2012). Extending the research in this direction could give us further information on the appropriate policy mix in highly-indebted countries and, indirectly, in situations where fiscal consolidation is implemented in conditions of near-default.

The paper is organized as follows. Section II provides a brief overview of the literature on fiscal multipliers. Section III describes the methodology used. Section IV presents the results and contrasts them with findings in the literature, focusing in particular on earlier IMF results on multipliers. Section V uses estimated multipliers and probabilities to compute the likely evolution of the debt-to-GDP ratios in the sample countries under planned fiscal adjustments. Concluding remarks and policy implications follow. A description of the data employed in the analysis is appended to the paper.

II. Literature Review

Fiscal multipliers have long been the object of theoretical and empirical investigations. Our analysis relates directly to the empirical literature on the effects of fiscal shocks (and thus can be used to check the predictions of models like DSGE ones) and indirectly to at least another two avenues of research on multipliers, namely the literature on the effects of fiscal policy in a DSGE context, and the analysis of fiscal policy at special times. Each of these literatures is extensive, and is only briefly summarized below.

A. Empirical Literature on The Effects of Fiscal Shocks

The early empirical literature on fiscal multiplier dates back to the late 1990s.[8] At least qualitatively, these studies generally reach the same conclusions and support the neoclassical business cycle view of the impact of fiscal policy: in response to a discretionary positive government spending shock, output increases, consumption and wages decline, non-residential investment rises, while residential investment falls.

[7] By the same reasoning one cannot exclude that cuts to some other subcomponents of public expenditure are actually expansionary, in which case one could infer from our analysis that these subcomponents were never the subject of fiscal consolidation, or else, they were part of consolidations dominated by cuts to subcomponents of expenditure that are costly to cut in terms of output.

[8] Among others, this includes seminal works by Ramey and Shapiro (1998) and Edelberg et al. (1999) which employ a narrative ore dummy-variable approach to identify discretionary fiscal policy shocks in a univariate context or in vector autoregressions (VAR).

However, more recent empirical studies, starting from Fatás and Mihov (2001) and Blanchard and Perotti (2002), adopt structural VARs (SVAR) for the purpose of identification, and obtain results more in line with Keynesian claims on the impact of fiscal policy.[9] Under the BP approach government spending shocks affect output, consumption and the real wage positively, while they tend to have a negative effect on investment.[10] In addition, Perotti (2007) and Monacelli and Perotti (2008), propose a variant to the narrative approach that yields similar results to the SVAR literature. In a cross-country context, work by Ilzetzki, Mendoza and Vegh (2010) find that multipliers tend to be larger in industrial than in developing countries; the multiplier for countries with a flexible exchange regime or high-debt countries is close to zero; the multiplier in open economies is typically smaller than in closed economies; and finally, the multiplier on government investment is similar to the multiplier for government consumption. Krichner, Cimadomo, Hauptmeier (2010) (in line with Perotti, 2004) find that the impact of government spending on output has been increasing until the 1980s and falling thereafter, showing that the impact significantly depends on the GDP ratio of household credit and the composition of spending.

In general, quantitative estimates of the multiplier vary widely depending on the assumptions and techniques used.[11] These include: (i) the sample used in estimation; (ii) the estimation technique; (iii) whether the measuring accounts of automatic stabilizers or not; (iv) whether the economy is going through a particular phase of the business cycle times (expansion or recession, high unemployment); or (v) whether spending (or spending withdrawal) is anticipated or not.

The main results can be summarized as follows:

Low estimates of the output multiplier (below one) can be found in Barro and Redlick (2011), and IMF (2010), among others. Ramey (2009), and Hall (2009), among others,

---

[9] Fragetta and Melina (2011) support the assumptions underlying the Blanchard-Perotti approach by using a graphical modeling approach. Ramey (2009) criticizes the Blanchard-Perotti approach on the grounds that it fails to take into account anticipation effects of fiscal policy. Mertens and Ravn (2011) on one hand show that anticipation effects may invalidate SVAR estimates of impulse responses; on the other hand they fail to find evidence that anticipation effects overturn the existing findings from the fiscal SVAR literature.However, as also Auerbach and Gorodnichenko (2010) argue, the narrative approach imposes a constraint on its own, i.e. that the effects of only a very specific class of shocks can be evaluated, such as military spending build-ups and tax changes unrelated to short-term considerations.

[10] Pappa (2009), for example, finds that the real wage increases following an increase in government spending.

[11] Spilimbergo et al. (2009) and Hebous (2009) provide excellent summaries of findings on fiscal multipliers reviewing literature up to 2009.

estimate multipliers around one; while Blanchard and Perotti (2002), Monacelli et al. (2010), Blinder and Zandi (2010), Acconcia et al. (2011), Fragetta and Melina (2011), among others, report values above one. Auerbach and Gorodnichenko (2012a) study asymmetries in the propagation of fiscal shocks in booms and downturns and report output fiscal multipliers of up to 2.5 during recessions. Auerbach and Gorodnichenko (2012b) estimate spending multipliers for a lage number of OECD countries, and systematically relying on real-time forecast data to purge policy innovations of their predictable component; their results confirm those of their previous paper. IMF (2012) also employ a regime-switching VAR to control for differences in the impacts of fiscal shocks during periods of positive and negative output gaps and find multipliers of up to 1.3 during downturns. Mountford and Uhlig (2009) find large multipliers (up to 5) for deficit-financed tax-cuts using Uhlig (2005)'s sign restrictions method to identify a government revenue shock as well as a government spending shock, when explicitly allowing for the possibility of announcement effects, i.e., that a current fiscal policy shock changes fiscal policy variables in the future, but not at present. Corsetti, Meier and Mueller (2010) analyze the determinants of the fiscal multiplier confirming AG's and our finding that the multiplier greatly depends on the economic environment at the time of the fiscal shock.

Finally, a few studies have focused systematically on the outcomes of fiscal retrenchments. Most old and new studies conclude that consolidations are not expansionary in the short run. For example, a recent IMF study (IMF, 2010) focusing on the history of fiscal retrenchment in 15 advanced economies over the past 30 years, finds that on average a cut of 1 percent of GDP typically reduces GDP by ½ percent within two years (i.e. a spending multiplier of ½). Results in Coenen et al (2008), and Forni at al.(2010), also lead to the conclusion that debt consolidations typically have a contractionary effect on output in the short run, (Afonso, 2010, however, shows results that provide support to the opposite view).

However, starting with Giavazzi and Pagano (1990) and Bertola and Drazen (1991), a smaller stream of studies focusing on a handful of country cases finds that consolidations can be expansionary: if consolidations are interpreted as a signal that the share of government spending in GDP is being permanently reduced, the private sector may revise upwards its estimate of its permanent income, raising current and planned consumption. Recent work reappraising the impact of confidence effects on the sign and size of fiscal multipliers supports the view that fiscal contractions can be expansionary in the presence of strong expectational effects. Inspired by work from Corsetti et al. (2009, 2010), for example, Cimadomo, Hauptmeier and Sola (2012) show, estimating a structural (non-cycle-dependent) VAR on U.S. data and the Ramey (2011)'s time series of military build-ups to measure exogenous spending shocks, that expectations about the future fiscal policy stance play a key role in shaping the macroeconomic responses to fiscal shocks. As a consequence, a fiscal contraction may turn out to be expansionary if the expectation channel becomes sufficiently strong.[12]

Why are results on multipliers so dispersed in the literature? Caldara and Kamps (2008) demonstrate that, once differences in specification of the reduced-form VAR model are accounted for, all identification approaches used in the literature yield qualitatively and quantitatively very similar results as regards the effects of government spending shocks. Caldara and Kamps (2012) extend their earlier analysis to show—using U.S. data-- that differences in priors on elasticities implicit in alternative identification schemes translate into large differences in fiscal multipliers. Some of the identification schemes appear very dogmatic, selecting a single value of the relevant output elasticity. Others appear quite loose, imposing almost no restriction on the relevant elasticity. They then survey the existing literature on automatic stabilizers to derive distributions on elasticities that encompass the existing empirical evidence and estimate fiscal multipliers based on these prior distributions. They conclude that there is no evidence to support the view that tax policy provides a larger stimulus to output than spending policy—for plausible priors on output elasticities of fiscal variables, tax multipliers are smaller than spending multipliers.[13]

B. The Effects of Fiscal Policy: What do Models Say?

In the traditional Keynesian model, fiscal shocks were considered the main tool to stabilize output. For the shock to have a real impact it had to be deficit financed, otherwise it did not have an impact on the income of economic agents. The main mechanism is that of the fiscal multiplier, according to which the increase in income that follows the fiscal shocks is much higher than the size of the initial shock because part of it (depending on the marginal propensity to consume or invest) is used to further increase aggregate demand through consumption or investment. Spending shocks were thought to have a bigger impact because the multiplier operated after a one-to-one increase in aggregate demand. Tax shocks had a

[12] See also Perotti (2011).

[13] More specifically, Caldara and Kamps (2012) demonstrate that empirical estimates of fiscal multipliers obtained via SVARs that identify fiscal shocks using a BP or a BP-like recursive approach (like we do) are likely to produce larger spending multipliers than tax multipliers. This is because this identification approach (correctly) implies a smaller (more plausible) elasticity of output to taxes (around 1.5) compared to e.g. the narrative or the sign-restriction approach (where the implied elasticity is 3 or larger)—which in turn affects univocally the relative size of spending and tax multipliers in this direction.

slightly smaller impact because the multiplier operated on an increase in demand that was proportional to the marginal propensity to consume.

The key tenet of the neoclassical real business cycle doctrine is that deficit-financed fiscal shocks (e.g. a fiscal expansion) generate a small positive multiplier (i.e. output changes less than proportionally to the shock measured in real terms). This is because a positive government spending shock increases the present discounted value of tax payments and this triggers a negative wealth effect that dampens consumption, fosters labor supply and curbs real wages (e.g. Baxter and King, 1993). Tax shocks do not have any impact on output because, keeping spending constant, a change in current taxes will need to be offset by future, higher taxes, which leaves the present discounted value of taxes unchanged (the so-called Ricardian equivalence). The introduction of frictions, however, can change the size and sign of the impact. Linnemann (2006) demonstrates that with a no additively separable utility function and a small intertemporal consumption elasticity, higher fiscal spending can raise consumption and lower investment, consistently with the results of SVAR estimation based on the BP methodology. Callegari (2007) shows that the introducing of borrowing constraints in an otherwise standard RBC model can generate positive (albeit small) multipliers to tax shocks and while amplifying the negative wealth effect that follows positive spending shocks. Leeper et al. (2010) introduces implementation delays in the analysis of government investments shocks in a RBC model and find that implementation delays can produce small or even negative labor and output responses in the short run.

Based on the same fundamental assumptions of RBC model, new-Keynesian (NK) models introduced real and nominal rigidities in a dynamic and stochastic general equilibrium model. In the absence of additional frictions, the predictions of NK and RBC models on the impact of fiscal policy shocks were not so dissimilar, because the wealth effect tended to prevail over the other propagation channels. The general finding is that the multiplier of a (temporary) increase in government expenditure is much less than one (see for example, Coenen and Straub, 2008; Cogan et al., 2010; and Cwik and Wieland, 2009). The introduction of further frictions into the model can amplify the impact of fiscal shocks. The introduction of myopic, rule-of-thumb consumers increases the multiplier because limits the share of agents on which the negative wealth effect works. Given the lack of forward-looking behavior and a Unitarian marginal propensity of consumption, rule-of-thumb consumers respond quite strongly to changes in taxes, especially if they are lump-sum. Galí, Lopez-Salido and Valles (2007), however, show that, in order to generate multipliers in line with the SVAR literature, one also needs to introduce labor market frictions, like unionized wage bargaining. This dampens the drop of real wage that follows the increase in labor supply of forward-looking agents, which would compress the income of rule-of-thumb consumers. Ravn, Schmitt-Grohe and Uribe (2007) show that the presence of deep habits can increase the spending multiplier given the positive response of consumption, and Cantore, Levine, Melina and Yang (2012) manage to match a series of empirical regularities in the SVAR literature in a DSGE model with unemployment and deep habit formation.

The predictions of the theoretical models changes quite substantially depending on whether we are in an open- or in a closed-economy set up, and whether the exchange rate is fixed or not. In an open economy with a fixed exchange rate, the fiscal multiplier is generally bigger, because of the smaller offsetting wealth effect due to the peg of the interest rate to its world value. With a flexible exchange rate, however, the impact might be smaller (and even negative for tax cuts) because of the real appreciation that follows increase in aggregate demand.

The introduction of distortionary taxation generally reduced the impact of spending shocks (because of the increased distortion triggered by higher future taxes). Concerning tax cuts, it all depends on the policy mix; a reduction in lump-sum taxes rebalanced by future higher distortionary taxes, for instance, can generate a negative output response or greatly reduce the size of the positive multiplier.

Recent work by Hall (2009) and Woodford (2011) tries to establish the conditions under which the multiplier is large in simple models. Woodford shows that the government spending multiplier is (i) necessarily below one in a neoclassical Real Business Cycle (RBC) model and exactly the same both in an RBC with monopolistic competition and in a sticky-price NK model with strict inflation targeting; (ii) exactly one in an NK model with fixed real interest rate; (iii) somewhere between the two values in a model featuring a Taylor rule. In general, the more accommodative the monetary policy, the higher the fiscal multiplier. Moreover, substantially larger-than-one multipliers can be obtained in standard NK models if the ZLB binds (Woodford, 2011).

The way the labor market is modeled plays a crucial role in the propagation mechanism of fiscal shocks. Monacelli et al. (2011) simulate the effects of fiscal policy on the labor market using a standard RBC model with search-match frictions and show that the model largely fails in reproducing the size of the output multiplier whereas it can produce a realistic unemployment multiplier but only under a special parameterization. Extending the model to embed New Keynesian features (e.g. unemployment benefits, real wage rigidity and/or debt financing with distortionary taxation) only worsens the picture. When complementarity is coupled with price stickiness, however, the magnification effect can be large. Likewise, Cantore et al. (2011) manage to match a series of empirical regularities in the SVAR literature in a DSGE model with unemployment and deep habit formation.

C. Fiscal Policy Under Special Conditions

Most papers that focus on "normal" times find multipliers to be close or below one. Hall (2009) estimates a spending multiplier of around one for the United States; while Barro and Redlick (2011) estimates of the spending multiplier are in the 0.6–0.7 range. Ramey (2011) finds a multiplier of military spending 0.6–1.1 (controlling for potential anticipation effects). Not controlling for anticipation effects, the multiplier drops to 0.5. Zandi and Blinder (2010) find a general multiplier of 1.5 (ranging from 1.13 for spending on energy assistance to 1.7 for spending on food stamps). While Blanchard and Perotti (2002), Perotti (2007), Canova and Pappa (2007), Montford and Uhlig (2009) (VARs) estimates of the impact multiplier all tend to fall between 0.4 and 1 (although occasionally a larger multiplier is obtained). Corsetti et al (2011) also find estimate point estimates of the multiplier in the range 1.2–1.4 on impact with confidence intervals however including 1 using data on spending in infrastructure at provincial level in Italy, and an instrument identifying changes that are large and exogenous to local cyclical conditions.

By contrast, most papers that focus on "special" times find multipliers to be at or above 1, especially when the focus is on periods similar to the current one. Barro and Redlick (2011), for instance, show that the fiscal multiplier of government spending onto output when unemployment rate is over 12 percent is about 1. Fishback and Kachanovskaya (2010), focusing on the period of the New Deal when the unemployment rate was between 9 and 25 percent, find that the personal income multiplier ranges from 0.91 to 1.67 depending on which part of government spending is increased. They also find that multipliers for a more production-based measure of state income-per-capita is about 10 to 15 percent smaller; and that the impact of the federal spending on employment is negligible (or even negative).

Romer and Burstein (2009) estimate a multiplier during the global financial crisis at about 3 or even larger—a finding that validates model results in Corsetti, Meier and Muller (2010) who show that multipliers tend to be larger during financial crises. Auerbach and Gorodnichenko (2012b) estimate government purchase multipliers for a large number of OECD countries, allowing these multipliers to vary smoothly according to the state of the economy and using real-time forecast data to purge policy innovations of their predictable components. They adapt their previous methodology (Auerbach and Gorodnichenko, 2010) to use direct projections rather than the SVAR approach to estimate multipliers, to economize on degrees of freedom and to relax the assumptions on impulse response functions imposed by the SVAR method. Their findings confirm those of their earlier paper. In particular, GDP multipliers of government purchases are larger in recession, and controlling for real-time predictions of government purchases tends to increase the estimated multipliers of government purchases in recession. Multipliers are found to vary also when other economic conditions vary beyond the cycle or the state of the financial sector.[14]

Another debate surrounds whether the spending multiplier is larger when monetary policy is highly accommodative, like now that the monetary policy rate of many central banks is at its effective lower bound. Both Christiano et al. (2011) and Woodford (2011) demonstrate—in a theoretical context—that when interest rates are at their effective low, like during the recent global financial crisis, fiscal shocks tend to have magnified effects (with multipliers as large as 10) because governments spending cannot crowd out private spending, notably business capital expenditure.

III. Econometric Methodology

The methodology that we use is an adaptation of the approach proposed by Balke (2000). Similar approaches have recently been adopted also by Calza and Sousa (2006), Afonso et al. (2011) and Baum and Koester (2011). We follow four steps. First, we test for and estimate a threshold vector-autoregressive model that changes "structure" if growth crosses a critical threshold. Here, growth changes are endogenous in the sense that shocks — such as government expenditure or tax revenue — can result in a switch between different regimes of the business cycle. Second, using nonlinear impulse-response analysis, we isolate the relative effects of shocks and the nonlinear structure on the time-series behavior of output. Third, we compute regime-dependent multipliers. Finally, we run stochastic simulations to compute the probabilities of regime switching. These steps are described in more detail below.

A. The Model

We specify a threshold vector-autoregressive (TVAR) model with endogenous regimes. The TVAR model is desirable on a number of grounds. First, it allows us to capture possible nonlinearities such as asymmetric reactions to shocks in a simple way. Because the effects of the shocks are allowed to depend on the size and the sign of the shock, and also on the initial conditions, the impulse response functions are no longer linear, and it is possible to distinguish, for instance, between the effects of fiscal developments during an expansionary

---

[14] Galí et al. (2007) quantify the multiplier at 1.9 if share of rule-of-thumb consumers is 0.75 (such high proportion of rule-of-thumb consumers could be interpreted as a consequence of the fact that a large share of households have no access to financial markets or decide not to participate in them). Uhlig (2010) shows that the way in which government expenditure is financed matters for the size of multipliers. If debt is contained increases in distorting taxes could lead to a negative multiplier. Canova and Pappa (2006) show that negative multipliers emerge in U.S. states with strict balance budget requirements.

phase and those during a recessionary phase. Second, in a TVAR shocks can trigger switches between one regime (e.g. expansion) and another (e.g. recession) since the threshold variable is in turn a function of one of the endogenous variables.

Our "structural" TVAR can be expressed as follows:

$$Y_t = I_{\{c_{t-d}<\gamma\}}\,[A^1 Y_t + B^1(L)Y_{t-1}] + I_{\{c_{t-d}\geq\gamma\}}\,[A^2 Y_t + B^2(L)Y_{t-1}] + U_t \quad (1)$$

Where $Y_t = (g_t\ y_t\ \tau_t\ r_t)^T$ is a vector containing total government expenditures, real output, net taxes (all in log real per capita terms) and the short-term real interest rate, respectively. So our model includes the classical Blanchard-Perotti variables but also a synthetic measure of the *ex-post* monetary stance to condition on the non-fiscal component of the policy mix. Using taxes net of transfers to compute tax multipliers not only keeps with the bulk of the literature, but it also makes economic sense in that tax and transfers should have similar multiplicative effects on activity, as they affect disposable income in a similar way—while they plausibly have a rather different impact on activity than public consumption and investment.[15] $B^1(L)$ and $B^2(L)$ are lag polynomial matrices, while U_t are structural disturbances. Variable c_{t-d} is the threshold that determines which regime the system is in, and $I_{\{c_{t-d}\geq\gamma\}}$ is an indicator function that equals 1 when $c_{t-d} > \gamma$ and 0 otherwise. The threshold variable, c_t, is real output growth—defined as log-difference, $100 \times (y_t - y_{t-1})$—i.e. a function of real output itself (which, in turn, is an element of Y_t). At least one lag of the threshold variable is needed in order it to recursively feed into the VAR dynamics. We thus set $d = 1$.[16] In addition, we set the critical value for the threshold, γ, equal to zero in order to distinguish clearly between periods of positive growth and periods of negative growth. However, (i) we test for this restriction and (ii) if we estimate the threshold itself with some variants of a Wald test in a grid-search fashion, as proposed by Balke (2000), we obtain a

[15] In principle social security contributions could have a different GDP impact than personal income taxes or transfers (because households perceive a link between payroll and pension benefits) but this effect is likely to be small. In addition, inasmuch transfers are not well or perfectly targeted, their effect on GDP may be smaller than the effect of taxes, which would diminish the augmented effect that transfers may have over an above taxes, considering perceived links between payroll and pension benefits.

[16] Generally *d* is an unknown parameter, and Hansen (1997) proposes a single-equation estimation procedure that allows to estimate it besides the other unknown parameters of a TVAR model. Extending this procedure to the multivariate case may in principle lead to a longer delay with which regime-switches affect VAR dynamics. However, we opt for following related studies (see e.g. Balke, 2000; Calza and Sousa, 2006; and Afonso et al., 2011) and setting the delay to one quarter as here we are not interested in the response to fiscal shocks when a regime switch occurred long ago, but rather when it has just occurred.

threshold very close to zero.[17] As a result, two regimes govern the dynamics of the TVAR: output expansions and output contractions. The TVAR describes both the evolution of Y_t and the output growth regimes.

This implies that shocks to total government expenditures, real output, net taxes and the short-term real interest rate can determine whether the economy is in a positive or negative output growth regime. In addition to the lag polynomials changing across regimes, contemporaneous relationships between variables may change as well. In other words A^1 and A^2, which reflect the "structural" contemporaneous relationships in the two regimes, may differ. We assume that A^1 and A^2 have a recursive structure in a standard Choleski fashion. We use the assumption proposed by Blanchard and Perotti (2002) that government spending is unable to react to output and other shocks within a quarter due to implementation and decision lags typical of the budgeting process. If identification is achieved via a Choleski decomposition, this assumption translates into ordering government spending first. The same approach to identification has been employed by Monacelli et al. (2010). The variable ordering is thus: total government expenditures, real output, net taxes and the short-term real interest rate. While this recursive structure is not without controversy, much of the recent fiscal VAR literature uses a similar recursive ordering (see Caldara and Kamps, 2006; 2012 for a discussion). In particular, the Choleski approach implies a possibly restrictive zero impact response of output to net taxes. However, Caldara and Kamps (2012) show that the output elasticity of net taxes implied by the pure BP approach is only slightly larger than the elasticity implied by the recursive approach, this entailing that the impact BP tax multiplier is only slightly larger than zero. Lastly, as we use quarterly data, we impose a lag structure of 4.[18]

B. Testing for the TVAR Structure

We test for the TVAR structure by imposing the null hypothesis of a linear VAR against a threshold alternative with $\gamma = 0$. The test is conducted by constructing a likelihood-

[17] In all cases considered below, this choice allows us to isolate regimes with negative real output growth containing at least 20 percent of observations. This satisfies the recommendation made by Hansen (1999) that each regime should contain at least 10 percent of observations.

[18] The selection of the number of lags in this literature is necessarily arbitrary because typically, lag-selection critiera tend to suggest different lag truncations. In a non-linear context, testing for the optimal lag length is even more cumbersome. We then chose a specification with 4 lags on the following ground: (i) standard lag-selection criteria on our data using linear VARs indicate an optimal lag length of 3 to 4 lags; (ii) 4-lag VARs are a common choice in the empirical fiscal literature (see, for instance, the many contributions by Perotti) ; (iii) the consequences of overestimation of the order are less serious than underestimation (Kilian, 2001); (iv) since the estimation of the VAR coefficients in OLS is done equation by equation even a 4-lag specification does not lead to severe overparametrization in our case (the parameters to be estimated are 17 in our case, per each country data set).

ratio χ^2 test statistic for the multivariate case as in Doornik and Hendry (1997). As mentioned, imposing a zero threshold does not turn out to be a strong assumption as variants of the Wald test, such as the sup-Wald with methods of inference proposed by Hansen (1996), select a threshold in the vicinity of zero in all cases considered.

C. Non-Linear Impulse Response Functions

To evaluate the effects of fiscal consolidations and then compute regime-dependent fiscal multipliers, we conduct impulse-response analysis. The nonlinear structure of the model makes this task more complex than in the linear case as in TVARs the moving-average representation is not linear in the disturbances U_t (as some shocks may lead to regime switches), hence the necessity to resort to numerical methods.

The impulse response function at horizon k, IRF_{t+k}, can be thought of as the revision in the conditional expectation of Y_{t+k} as a result of knowing the value of an exogenous shock u_t. In other words, IRF_{t+k}, can be expressed as the difference between the expectation of Y_{t+k} conditional on a particular history Ω_{t-1} and a particular realization of the shock u_t, i.e. $E[Y_{t+k}|\Omega_{t-1}, u_t]$, and the analogous conditional expectation in which shocks are purely stochastic, i.e. $E[Y_{t+k}|\Omega_{t-1}]$.

In order to isolate the effect of a single exogenous shock, say to government expenditures or net taxes, the value of just one element at a time in u_t is set to a specific value while the remaining elements are randomly drawn. It follows that (a) unlike in linear models, the impulse-response function for the nonlinear model is conditional on (i) the past history of the variables, (ii) the size, and (iii) the direction of the shocks; and (b) calculating a nonlinear impulse-response function requires specifying the nature of the shock (its size and sign) and an initial condition. Such computations can only be made by resorting to numerical simulations. These are carried out by randomly drawing vectors of shocks u_{t+j}, $j = 1, \ldots, k$, and then simulating the model conditional on an initial condition Ω_{t-1} and a given realization of u_t. As the choice of a starting value would be arbitrary, the procedure takes every data point in a given regime as the initial condition and runs 500 stochastic simulations for a 15 quarter horizon starting from each of them. Then, the average of these will represent the conditional expectation.

D. Regime-Dependent Fiscal Multipliers

Based on the nonlinear impulse responses we can compute regime dependent multipliers of fiscal consolidations, i.e. the quantitative effect that a fiscal consolidation has on real output, conditional on taking place in a given regime. As we allow for endogenous regime switches in the nonlinear impulse responses, these are translated also in the size, sign and dynamic patterns of implied fiscal multipliers.

We report average cumulative multipliers based on negative shocks to government spending and positive shocks to net tax shocks of size one standard deviation. We use the definition of cumulative fiscal multiplier reported by Spilimbergo et al. (2009). The authors argue that this is an appropriate measure of the fiscal multiplier. In fact it summarizes the effects that a fiscal measure has over a certain time horizon. The cumulative expenditure consolidation multiplier at horizon *N*, CEM_{t+N}, is defined as $CEM_{t+N} = -\frac{\sum_{j=0}^{N} \Delta Y_{t+k}}{\sum_{j=0}^{N} \Delta G_{t+k}}$, where ΔY_{t+k} is the change in output with respect to baseline *j* periods ahead of the fiscal shock, and ΔG_{t+k} is the change in government expenditures at the same time horizon. Analogously, the cumulative net tax multiplier at horizon *N*, CTM_{t+N}, is defined as $CTM_{t+N} = \frac{\sum_{j=0}^{N} \Delta Y_{t+k}}{\sum_{j=0}^{N} \Delta T_{t+k}}$, where ΔT_{t+k} is the change in net taxes *j* periods ahead of the shock.

E. Conditional Probabilities of a Recession

Based on stochastic simulations, we compute the *ex-ante* probabilities of being in a recession regime conditional on starting the simulations in a recession regime or in an expansion regime. We allow for three alternative policy options: (i) no consolidation; (ii) "mild" consolidation (contraction of government expenditures or hike in net taxes by one standard deviation); and (iii) "strong" consolidation (contraction of government expenditures or hike in net taxes by two standard deviations).

In particular, we run 500 stochastic simulations and we save the percentage of cases in which output contracts at given time horizons. In order to condition on a particular regime we choose, as starting values of the 500 stochastic simulations, all points in the sample (one at a time) that fall in that particular regime and then we report the average outcome. In order to condition on the three alternative policy options we: (i) assume that all shocks are purely random in the case of no consolidation; (ii) condition on a realization of the government expenditure shock (or the net tax shock) of minus (plus) one standard deviation for the case of "mild" consolidation; and (iii) condition on a realization of the government expenditure shock (or the net tax shock) of minus (plus) two standard deviations for the case of "strong consolidation".

IV. Results

This Section discusses the results obtained by following the procedure outlined in Section III. Table 1 reports the results of a likelihood ratio test for the nonlinear VAR structure. In all cases considered, the null hypothesis of a linear VAR is rejected in favor of the TVAR specification.

A. Non-Linear IRFS

Figures 1-10 report the (non-linear) average impulse responses of output, government expenditure, net taxes and the short term real interest rate to a government spending shock for the Euro Area[19], France, Italy, Japan and the United States.[20]

To better highlight the potential implications of the nonlinear structure of the model, we report results for: (i) the two regimes; (ii) negative and positive shocks (as they are not necessarily symmetric); and for (iii) a one standard deviation shock and a two standard deviation shock since results are not necessarily proportional when the scale of the initial shock is augmented. It follows that, in each figure, the left-hand-side column reports the IRFs corresponding to the expansion regime; the right-hand-side column reports those relative to the recession regime; and each subplot contains four lines, which correspond to positive and negative fiscal shocks that can be as big as one or two standard deviations. The main findings are the following:

- Independently of the state of the economic cycle, fiscal consolidations operated via spending cuts reduce output in the short run. In both regimes, output contracts (expands) following a negative (positive) spending shock. Thus, if confidence effects have been at play in our sample over the short term, they have not been strong enough to undo the contractionary effects of fiscal withdrawals.
- Spending cuts initiated during recessions are contractionary over the entire simulation horizon.
- However, in Japan, the United States and to a lesser extent in the Euro Area spending cuts that begin during expansions are contractionary only in the short run, becoming expansionary in the long run. One explanation for this is that agents anticipate a fall in the tax burden (as government spending has contracted and the economy is expanding and vice versa)—a phenomenon dubbed in the literature "confidence effect". Our empirical estimates thus support the expansionary implications of confidence effects, but only in the long run, and only when consolidations are initiated during expansionary phases of the economic cycle.

---

[19] Euro Area here refers to a single unit coming from the aggregation of national data into one single entity. Please refer to the data appendix for details on the data sources.

[20] Strictly speaking, the non-linear impulse responses reported in the figures are averages of stochastic simulations as explained in Section III.C. Given that the nonlinear procedure does not allow computing proper confidence intervals as in linear VAR models, we prefer not to report or discuss statistical significance.

- With the exception of France, the Euro Area and Japan (in the recession regime), fiscal consolidations operated via cuts in spending reduce net taxes in the short run. Both in recession and in expansion, a spending contraction (expansion) makes net taxes decrease (increase). This reflects the drop (rise) in tax revenues that follows a drop (rise) in output. Subsequently, net taxes increase (decrease) but for different reasons: in a recession tax rates increase (decrease) and/or are accompanied by a(n) reduction (increase) in transfer payments; in an expansion net taxes increase (decrease) in line with the medium-term expansionary (contractionary) effect of the government spending cut (rise).

- Consolidations operated via cuts in spending during recessions tend to raise the real interest rate in the Euro Area, Japan and the United States. During a recession, a government spending cut (rise) puts downward pressure on prices and inflation, pushing up the real interest rate. This finding contradicts in part findings from simulated models (e.g. IMF, 2010) embedding calibrated Taylor-type rules where by assumption the nominal rate falls by more than inflation expectations during a recession, as the central bank tries to alleviate the negative consequences of a fiscal consolidation. It also suggests that in practice, monetary policy may not have been "proactive" enough during consolidations that originate in a recession. This may be related to longer-than-expected lags in the effect of monetary policy, but also an overestimation of inflation and/or an underestimation of the recessionary effects of fiscal consolidation on economic activity. The weak cushioning effect of monetary policy may also be due to the fact that some of the downturns in our sample might actually be induced by the monetary authorities in an effort to lower inflation. By contrast, during an expansion, monetary policy seems more "proactive": an increase in government spending elicits a stronger reaction of the central bank than in a recession, likely a result of the central bank to limit the inflationary consequences of the shock.

- In the euro area, Italy and the United States, in response to a tax hike, the real interest rate increases in the expansion regime and falls in the recession regime**.** This gives an indication that monetary policy has been somewhat more accommodative during recessions in response to tax based consolidations.

- Finally, for Japan, France and the euro area (in the expansion regime), a tax increase initially (and for France persistently) raises output marginally, although for Japan and the Euro Area the long-run cumulative output effect of tax hikes **is negative** as expected and as in other countries in our sample. One reason may be that the tax hike is accompanied by a rise in government expenditure in the short run that propels output momentarily.

B. Fiscal Multipliers

In Table 2 and Figure 11, we report average cumulative multipliers based on consolidation shocks of size 1 standard deviation. The key results are as follows:

- In all countries, a fiscal consolidation is substantially more contractionary if made during a recession than during an expansion. Spending multipliers in recessions are up to 10 times larger than spending multipliers when economies are expanding. (Auerbach and Gorodnichenko 2012a, 2012b find even larger ratios, while IMF, 2012, finds slightly smaller ratios than us).

- The exact sizes of 1- and 2-year cumulative fiscal multipliers are country-specific, but cumulative multipliers are rather homogenously-sized across countries. In our sample of countries, 1-year cumulative multipliers of consolidations begun during downturns range between 1.6 and 2.6 for expenditure shocks, and 0.16 and 0.35 for tax shocks (France and Japan present the opposite sign).[21] 2-year cumulative multipliers have similar sizes to 1-year multipliers, implying that the large part of the impact of fiscal shocks on output materializes within 4 quarters. The absolute sizes of these multipliers are thus broadly in line with IMF (2012) and Auerbach and Gorodnichenko (2012a, 2012b). Since none of these works controls for the role of monetary policy in attenuating the business cycle effect of spending shocks (which is less relevant for tax shocks), finding similar-sized multipliers to those found in these works is an indication that, historically, real interest rates changes have not been sufficient to undo the adverse impact of fiscal withdrawal on economic activity. One reason may be that during and beyond the Great Moderation, the Fed, the ECB and the Bank of Japan have controlled inflation tightly and thus changes in real interest rates have tended to be limited even during recessionary episodes—even when nominal rates have been actually slashed to their effective low in support of economic activity.

  The size of the multipliers is also compatible with the response of the economies to fiscal stimuli in the countries of estimation. Japan is a case in kind: for several years since the early 1990s, fiscal stimuli have been used in association with monetary stimuli to revive growth following the collapse of an asset price bubble and a long period of deflation. During most of these years (19 out of 22 looking at the

[21] Italy's multipliers tend to be smaller than in other countries in our sample in line with the view that the consumption smoothing effect is likely to be strong given that private wealth is very large (Italy has one of the highest household wealth-to-income ratios among advanced economies).

1990– 2012 sample), Japan was expanding, albeit modestly, meaning that only the smaller (expansion) multipliers would have been at play apart from during strictly recessionary year. And even during recession years, when the larger multipliers would have been at play these only capture the impact on output of discretionary fiscal policy: but Japan's extraordinary fiscal stimuli may have failed to lead to larger gains in output also if antithetic shocks—for example a trend real appreciation of the yen, or a trend increase in net saving from continuous household and corporate deleveraging—have been at work, undoing the beneficial effects of fiscal expansion. Finally, it is widely accepted that fiscal policy in Japan will have limited impact on the economy as long as structural impediments on the supply side remain. And results are not necessarily at odds with the episode of fiscal expansion in the United States during the global financial crisis. True, U.S. growth did not experience a visibly immediate recovery in the four quarters following the 2008-09 fiscal expansion—as our estimated impulse responses would suggest, the size of the stimulus itself is debated (see Taylor, 2011 and CBO, 2012)—when measured in terms of changes in the cyclically-adjusted balance of the general government. More importantly, —the severity of the recession, low global demand and historically-low confidence in the United States may have acted as headwinds on growth while the fiscal expansion was at play, undoing or delaying some of the positive effects of the stimulus .

- Expenditure multipliers are significantly larger than tax multipliers in downturns (up to 10 times larger) but less so during expansions (up to 6 times larger)—a finding broadly in line with IMF (2012); and Auerbach and Gorodnichenko (2012a, 2012b).

  The finding that spending multipliers are larger—sometimes considerably—than tax multipliers already exist in the literature employing linear VARs. This difference is magnified further when regime switches are taken into account as the spending multiplier becomes bigger in downturns while the tax multiplier remains small. However, it is quite difficult to reconcile the whole set of results with a single theoretical approach. A tax multiplier bigger than zero but smaller than the spending multiplier seems to conform with the prediction of the traditional Keynesian model. They can also be reconciled with a New-Keynesian model with rule-of-thumb consumers and distortionary taxation, where the tax cuts are mostly on lump-sum payments but the resulting increase in debt is repaid in the future by an increase in distortionary taxation.

  The asymmetric response of the multipliers to the cycle is much more difficult to reconcile with the existing theoretical models. Canzoneri, Collard, Dellas and Diba (2011) try to rationalize this result by introducing financial frictions based on the models of Woodford and Curdia (2009, 2010). They show that allowing for countercyclical financial frictions (in this case, costly financial intermediation) can generate bigger multipliers during recessions. According to their model, in time of negative output gaps financial intermediation is less efficient and more costly; positive spending, then, generates a more-than-proportional impact on GDP thanks to the reduction in the inefficiencies linked to the intermediation costs.

The asymmetric response to the different stages of the cycle can also be due to an increase in the share of agents with limited asset participation. Bilbiie, Meier and Mueller (2008), for example, show that an increase in the share of these agents can change the propagation mechanism of fiscal shocks increasing the size of the multiplier.

In line with the existing literature that does not control for the state of the business cycle when estimating the response of output to fiscal shocks, multipliers estimated on the same sample of data using linear VARs are generally smaller than multipliers estimated specifically over downturns (see Table 2), apart from those estimated on Japanese and French data which remain very sizeable. However, even on linear estimates, expenditure multipliers remain in the majority of cases much larger than tax multipliers.

C. Conditional Probabilities of a Recession Following a Fiscal Shock

Based on the stochastic simulations, in Tables 3 and 4, we report the probability of a recession regime conditional on starting the simulations in a recession regime or an expansion regime in the case (i) of no consolidation; (ii) of a mild consolidation (1 SD) and (iii) of a strong consolidation (2 SD).

The results are as follows:

- A spending-based consolidation, on average, delays the transition to an expansion regime as it makes a recession more likely in the next quarter, especially if big. In the first quarter after the shock, the probability of being in the recession regime is increased by about 20 percentage points in the United States and by about 15 percentage points in Japan and the euro area, if the shock is big.

- But a spending-based consolidation policy may also considerably affect the probability of going into a recession regime if the consolidation occurs in an expansion regime, especially with a big shock and in the short run. In the baseline scenario of no consolidation, the probability of being in a recession, obtained by simulating the model from a typical starting point drawn from the expansion regime, converges to around 30 percent. In the quarter following the shock, the probability of being in a recession increases by up to 20 percent with a big shock. In those countries where we detect confidence effects in the expansion regime, consolidations may make recessions less likely over longer horizons. It must be said that these simulations yield "average" scenarios. We may conjecture that if the shock occurred at a time of positive, though very low growth, the probability of the fiscal consolidation sending the economy into a recession would be even higher.

- Consistent with the finding of small tax multipliers, tax-based consolidations generally do not greatly affect the probabilities of recessions.

V. What Does This Mean in Practice?

The results of the TVAR described in the previous sections show that an identical fiscal shock can have quite different impacts on economic activity depending on whether the economy is in a period of expansion or recession, depending on the nature of the shock (expenditure versus taxes) and depending on the intensity of the shock. To give a sense of how this translates into practical prescriptions for the design of fiscal consolidation plans, in this section, by using the estimated regime-dependent multipliers on Italy, we derive the impact of two alternative consolidation plans onto the debt-to-GDP ratio: a smooth consolidation versus a frontloaded (i.e. more aggressive) consolidation plan.[22]

The simulations (Figures 12–17) show that frontloading fiscal consolidations tends to have harsher and more protracted adverse effects on output, without accelerating the drop in the debt-to-GDP ratio relative to a more evenly-distributed consolidation. This can be problematic in periods of low confidence in the sovereign because failure of fiscal adjustment to have immediate visible effects on debt may further reduce credibility, pushing further up risk premia on government paper and ultimately making the consolidation more costly and less effective. Alongside, the simulations indicate that if a frontloaded consolidation is based primarily (60 percent and over) on cuts to expenditure, the debt-to-GDP ratio increases relative to the case in which a more gradual consolidation path is adopted. Therefore, the compositional design of consolidations (in terms of its taxes versus spending components) is a key determinant of the ultimate change in the debt-to-GDP ratio both in absolute terms and in relation to smoother consolidations.

Finally, the ability of curbing the debt-to-GDP ratio depends strongly on the size of risk premia embedded in the interest cost of servicing the public debt. When risk premia depend on the level of the stock of debt (for example, assuming that every percentage point

---

[22] In this sense, this exercise can be considered the reverse of what Favero and Giavazzi (2012) do. While they include the flow government budget constraint into a fiscal VAR, we include the estimated IRFs from the TVAR described above into the government budget constraint.

of additional debt in terms of GDP relative to a level of 60 percent augments the risk premium by 1 basis point), or even when they are exogenous to the level of debt but are equal or larger 0.6 percentage points per quarter (around 2 ½ percentage points per year), frontloaded consolidations deliver even worse results in terms of debt-to-GDP ratios relative to gradual consolidations (Figures 17 and 18).

Hence, the main implication is that, during recessions, smooth consolidations based primarily on tax measures may deliver a similar, if not better, debt reduction than more aggressive consolidations, while affecting output less adversely. This is even more true when the initial conditions of a consolidation are adverse (the stock of debt is elevated and public debt yields contain a high and/or rising risk premium component). On the other hand, aggressive consolidations have the ability to deliver swifter improvements in the primary cyclically-adjusted balance. The merits of an aggressive consolidation versus a gradual one thus lie in whether market confidence is faster and more steadily secured by improving rapidly the structural balance, the debt-to-GDP ratio and/or shielding activity from the most virulent effects of fiscal adjustment.

A. Model Used for The Debt Simulations

The simulations are based on a stylized growth model and a fiscal bloc. Fiscal shocks to both spending and taxes are assumed to affect output in line with our estimated TVAR impulse-response functions (IRFs), which in turn are contingent on the state of the business cycle. For ease of exposition, the model assumes that the impact of anticipated fiscal shocks is the same as those of unanticipated shocks. This assumption is not harmless: it tends to underestimate the announcement effect, reducing the initial impact of shocks that are distributed over time. (During a recession, however, the impact of this assumption might be less strong, given the more binding borrowing constraint that makes economic agents more sensible to current economic conditions and thus less forward-looking).

The growth model generates a baseline path for GDP growth that abstracts from the impact of the fiscal policy shock. In the baseline, output growth depends on the assumed path for potential GDP, some exogenous demand shock and the size of the output gap. An endogenous feedback rule from interest rates to output “closes” the model, thereby accounting for the role of monetary policy as well.

Based on the baseline scenario, we construct an initial scenario which embeds a gradual fiscal consolidation that curbs output in line with our estimated IRFs. We then shock this initial scenario with a more frontloaded fiscal consolidation path, combined with a higher initial level of debt and different assumption on the way the interest rate is assumed to evolve over time.

The baseline growth model is described by the following equation:

$$y_t = y_{t-1}\left(1 + y_t^P - \theta_1 gap_t + \theta_2(i_t - i_t^{RF})\right)(1 + d_t^{EX} - d_{t-1}^{EX})$$

where y_t is the level of output at times *t,* y^P is the level of potential GDP, *gap* is the output gap, $i\text{-}i^{RF}$ is the spread from the risk-free rate and θ_1 and θ_2 are the respective elasticities, both set equal to -0.1.[23] d^{EX} is a variable capturing the role of external demand in propelling or lowering the level of output. Thus d^{EX} accounts for exogenous shocks that are not fiscally related and that can temporarily reduce the level of output. The model also includes an endogenous response of output whenever the interest rates are above its risk-free level, where the risk-free level is set equal to the rate of potential growth (which we assume constant in this simulation).[24]

On the fiscal sector front, the public debt-to-GDP ratio is assumed to evolve in line with the standard debt dynamics equation:

$$\Delta d_t = \frac{i - g}{1 + g} d_{t-1} - pb_t$$

where *i* is the interest rate, *g* the nominal GDP growth rate, *d* is the debt-to-GDP ratio and *pb* is the primary balance-to-GDP ratio. The first term on the right-hand side describes the contribution of the interest-growth differential to debt accumulation, also indentified as *snowball effect*. The second term describes the contribution of the primary balance.[25] The primary balance, in turn, is the sum of a structural and cyclical component:

$$pb_t = spb_t + cpb_t$$

with the cyclical component defined as:

$$cpb_t = \gamma \times gap_t$$

[23] When θ_1 takes a negative value the equation above implies that, in absence of other shocks, the output gap is closed mechanically as GDP grows above its potential level until the gap approaches zero.

[24] This last assumption implies that, in a steady state with a zero primary balance and output growing at its potential rate, the “snowball effect” (i.e. the difference between the nominal GDP growth and the debt interest rate multiplied by the previous year debt-to-GDP ratio) is zero and the debt-to-GDP ratio remains constant. This assumption is made in order to simplify the analysis, and ensure that each deviations of the debt level from its starting value is an effect of the shocks hitting the economy and not a consequence of steady-state dynamics Of course, alongside an exogenous (i.e. constant) we could introduce endogenous risk premia (or vice versa), but this would simply reinforce our result.

[25] In this model, we assume zero debt-deficit adjustments.

For the purpose of these simulations, a fiscal shock is defined as a change in the structural primary balance. It can be realized through a change in taxes or in government spending. In presence of a fiscal consolidation shock, the baseline output level is reduced each period by the cumulative impact of the shock.[26] Formally, this can be expressed as:

$$y_t^S = y_t(1 + timp_t)(1 + gimp_t)$$

where *timp* and *gimp* are the total tax and spending multipliers, respectively, (coming from current and past shocks) applied to output on period *t*. They are the weighted averages of the impulse responses of the shocks originated during period of recessions and the impulse responses of the shocks originated during period of expansion, where the weights are given by the probabilities of recessions and expansions endogenous to the TVAR.

In turn, the two total output multipliers are defined as follows:

$$timp_t = \alpha_t \, timp_t^R + (1 - \alpha_t) \, timp_t^E$$

$$gimp_t = \alpha_t \, gimp_t^R + (1 - \alpha_t) \, gimp_t^E$$

where α_t is the probability of being in the recession regime. Each element in the right-hand side of the two equations above represent the contemporaneous or delayed impact of fiscal shocks initiated in periods of recession (*R,* identified with the periods with negative output growth) or expansion (*E*). They can be then defined as follows:

$$timp_t^J = \overrightarrow{IRF}_t^J \times \varepsilon_t^{T,J}$$

$$gimp_t^J = \overrightarrow{IRF}_t^J \times \varepsilon_t^{G,J}$$

[26] In other words, the impact on GDP is measured applying the path of the cumulative multipliers on the *additional (1st differences)* of the consolidation path across periods. Let us assume that the total structural consolidation targeted by a country amounts to 3 percentage points of GDP. Let us also assume that the consolidation is distributed equally across the periods, implying an adjustment of 1 percentage point of GDP every period. This means that, compared to the pre-consolidation baseline, we have a structural primary balance improvement of 1 percentage point of GDP in the first period, of 2 percentage points in the second period, and of 3 percentage points of GDP in the third period. In the third period, the impact on GDP would amount to the first quarter cumulative multiplier (generated by the 1 percentage point of GDP shock in the third period) plus the second quarter cumulative multiplier (generated by the 1 percentage point of GDP shock in the second period) plus the third quarter cumulative multiplier (generated by the 1 percentage point of GDP shock in the first period). This way we consider as shocks only the changes in the structural balance (not the level of the balance itself). As specified in the paper, this assumes that pre-announced shocks will have the same impact as the announced ones.

where $J=E, R$, IRF_t is the Tx1 vector of impulse responses of shocks on tax or spending in the state E or R on output and the ε are the 1xT vector of shocks occurred in the T periods before period t.

B. Debt simulations

This section presents simulations of debt following consolidation shocks relative to a model economy.

On the macroeconomic side, we assume that the country has a potential quarter-on-quarter growth rate of 0.4 per cent, consistent with a annual growth rate of about 1.8 percent. Starting from this baseline scenario, we then assume that the economy is hit by a negative shock due to a contraction of the exogenous demand component. The contraction is assumed to generate an output gap of 3 percentage points of GDP in 4 quarters. This type of shock could be the result of a drop in the country's external demand or a financial crisis that restricts credit availability domestically. In line with the output gap feedback rule, following the adverse shock the economy is expected to accelerate its rate of growth, and gradually converge to its long-run potential output level and growth rate.

Figure 12 shows the dynamics of GDP growth and how the debt-to-GDP ratio and its components would evolve in the baseline scenario described above. The demand shock reduces growth, which contracts for 3 periods. Thereafter the economy resumes growth at a rate above its potential in order to gradually close the output gap. The adverse output shock increases the debt-to-GDP ratio through two different channels: the denominator effect, which increases the "snowball effect", and the increase in the primary deficit, due to a larger negative cyclical balance component.

On the fiscal policy side, we assume that the country has an initial stock of debt equal to 120 per cent of GDP and a zero primary deficit. The interest rate is assumed equal to its risk-free benchmark, which implies a zero "snowball effect" in the absence of shocks.[27] Throughout we use the fiscal multipliers estimated for Italy in this paper. We then consider two alternative fiscal consolidation scenarios: a smooth consolidation scenario (Scenario I) and a front-loaded consolidation scenario (Scenario II). These are described below.

Scenario I. Under this scenario the fiscal authorities implement a consolidation plan including an ¼ percentage point of GDP adjustment every quarter for five year (20 quarters) delivering a total structural consolidation of about 5 percentage points of GDP (see Figure 13). Let us also assume that the consolidation is equally divided across tax and spending measures. Because of the model structure, the shock occurring during periods of contraction propagates (both in the initial and in the following periods) according to the IRFs

[27] Thus, as discussed, in the absence of shocks, the debt-to-GDP ratio would remain constant.

estimated during a period of output contraction.[28] Since the fiscal shock is not too large in any given period, its impact on output is contained and the economy remains in recession for a period equal to the length of the recession in the (no-fiscal-shock) baseline scenario (3 quarters), although with larger contraction rates.[29]

Scenario II. Let us now imagine a different type of consolidation strategy (scenario II), where the same amount of total consolidation of Scenario I is now achieved in a shorter period of time, say 6 quarters. Figure 14 shows that in this case the impact on output is quite strong and more persistent, as expected given our estimated impulse responses. The output gap now opens up to a full 5 percentage points and the recession lasts longer. In fact, the impact on output under Scenario II is so strong that the decline in the debt-to-GDP ratio is not faster when compared to the scenario of smooth fiscal consolidation in the first year and a half of the consolidation, although the primary cyclically-adjusted balance improves faster when the consolidation is aggressive than when it is gradual. Beyond that point, the aggressive consolidation reduces the debt-to-GDP ratio more than the gradual consolidation. (See Figure 15).

In addition, as shown in Figure 16 and in line with our estimates of multipliers and probabilities of recession, the composition of the fiscal shock can perversely affect the success of consolidation effort. Assuming, for example, that, in the frontloading scenario, the entire consolidation is implemented through cuts of public spending, the debt ratio remains permanently higher than the ratio delivered by the more evenly-distributed consolidation strategy. Besides, with frontloading, the level of debt would fall below the initial debt ratio of 120 percent only 16 periods after the beginning of the adjustment, while with an evenly-distributed adjustment this would happen after 12 periods.

Last but not least, the ability of curbing the debt-to-GDP ratio depends strongly on the size of risk premia embedded in the interest cost of servicing the public debt. When risk premia depend on the level of the stock of debt (for example, assuming that every percentage point of additional debt in terms of GDP relative to a level of 60 percent augments the risk premium by 1 basis point), or even when they are exogenous to the level of debt but are equal or larger 0.6 percentage points per quarter (around 2 ½ percentage points per year),

---

[28] Note that the IRFs estimated for period of recession are conditional on output contracting at the time of the shock, not during the subsequent periods.

[29] Note that in this scenario, following the fiscal consolidation, the debt level is always below the level of debt in the baseline scenario. Note also that although the debt level increases in the first period, reflecting the "snowball effect ", it then rapidly reverses its course and starts declining from period 7 onwards.

frontlodaded consolidations deliver even worse results in terms of debt-to-GDP ratios relative to gradual consolidations (Figures 17 and 18).

VI. Concluding Remarks

The large fiscal legacies of the global financial crisis have reignited the debate around the impact of fiscal policy onto economic activity during fiscal consolidations. The analysis in this paper shows that withdrawing fiscal stimuli too quickly in economies where output is already contracting can prolong their recessions without generating the expected fiscal saving. This is particularly true if the consolidation is centred around cuts to public expenditure—likely reflecting the fact that reductions in public spending have powerful effects on the consumption of financially-constrained agents in the economy—and if the size of the consolidation is large. Large consolidations make recessions more likely even when made at an expansion time. From a policy perspective this is especially relevant for periods of positive, though low growth. Accordingly, frontloading consolidations during a recession seems to aggravate the costs of fiscal adjustment in terms of output loss, while it seems to greatly delay the reduction in the debt-to-GDP ratio—which, in turn, can exacerbate market sentiment in a sovereign at times of low confidence, defying fiscal austerity efforts altogether. Again this is even truer in the case of consolidations based prominently on cuts to public spending.

Thus, a gradual fiscal adjustment, with a balanced composition of cuts to expenditure and tax increases boosts the chances that the consolidation will successfully (and rapidly) translate into lower debt-to-GDP ratios. Monetary policy can likely help alleviate further the pain of fiscal withdrawal if it is used proactively via reduction in the real interest rate.

VII. References

Afonso, A., Baxa, J., and Slavík, M., 2011, "Fiscal Developments and Financial Stress: A Threshold VAR Analysis", *ECB Working Paper Series*, 1319, European Central Bank.

Ahrend, R., P. Catte and R. Price, 2006, "Interactions Between Monetary and Fiscal Policy: How Monetary Conditions Affect Fiscal Consolidation", OECD Economics Department Working Papers No. 521.

Ardagna, Silvia. 2004, "Fiscal Stabilizations: When Do They Work and Why?" *European* Economic Review 48(5), pp.1047–1074.

Auerbach, A., and Y. Gorodnichenko, 2012a, "Measuring the Output Responses to Fiscal Policy," forthcoming in *American Economic Journal: Economic Policy*.

_____, 2012b. "Fiscal Multipliers in Expansion and Recession", paper prepared for the NBER conference, Fiscal Policy after the Financial Crisis, held in Milan, December, 2011.

Balke, N. S. (2000), "Credit and Economic Activity: Credit Regimes and Nonlinear Propagation of Shocks". *The Review of Economics and Statistics*, 82(2), pp. 344-349.

Basile R., Chiarini B. and Marzano, E. (2011), Can we Rely upon Fiscal Policy Estimates in Countries with Unreported Production of 15 Per Cent (or more) of GDP?, *CESifo Working Paper Series*, 3521, CESifo Group Munich

Barro, R. J. and C. J. Redlick. 2009, "Macroeconomic Effects from Government Purchases and Taxes," NBER Working Paper 15369.

Baum, A., C. Checherita and P. Rother, 2012, "Non-Linear Growth Effects of Public Debt: New Evidence for the Euro Area", paper presented at the MPSA panel on EU Legislative Politics.

Baum, A. and G.B. Koester, 2011, "The impact of fiscal policy on economic activityover the business cycle – evidence from a threshold VAR analysis", DeutscheBundesbank. Discussion Paper Series 1: Economic Studies No 3/2011.

Baum, A., M. Poplawski-Ribeiro and A. Weber (2012), "Fiscal Multipliers and the State of the Economy," IMF Working Paper (forthcoming; Washington: International Monetary Fund).

______, 2012, "Fiscal Multipliers", in Post-*Crisis Fiscal Policy*, C. Cottarelli, P. Gerson, and A. Senhadji (eds.) (forthcoming; Washington, International Monetary Fund).

Bilbiie, F. O, A. Meier and G. J. Müller, 2008, "What Accounts for the Changes in U.S. Fiscal Policy Transmission?," *Journal of Money, Credit and Banking*, 40(7): pp. 1439–1470.

Blanchard, O., 2011, “The future of macroeconomic policy”, blogpost, March.

_______, 2012, “Driving the Global Economy with the brakes on”, blogpost, January.

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

Caldara, D. and Kamps, C., 2008, ‘What are the Effects of Fiscal Shocks? A VAR-based Comparative Analysis’, *ECB Working Paper Series*, 877, European Central Bank.

______, 2012, “The Analytics of SVARs: A Unified Framework to Measure Fiscal Multipliers”, mimeo, Federal Reserve Board of Governors and European Central Bank.

Calza, A., Sousa, J., 2006, “Output and Inflation Responses to Credit Shocks: Are There Threshold Effects in the Euro Area ?”, *Studies in Nonlinear Dynamics & Econoetrics*, 10(2), pp. 3.

Canzoneri, M., F. Collard, H. Dellas, and B. Diba, 2011, “Fiscal Multipliers in Recessions” manuscript.

Chernozhukov, V., and H. Hong. 2003, “An MCMC Approach to Classical Estimation,” *Journal of Econometrics* 115(2), pp. 293–346.

Christiano, L., M. Eichenbaum, and S. Rebelo. 2011, “When is the Government Spending Multiplier Large?” *Journal of Political Economy* 119(1), pp 78–121.

Cogan, J. F., T. Cwik, J. B. Taylor, and V. Wieland. 2009, “New Keynesian versus Old Keynesian Government Spending Multipliers,” NBER Working Paper 14782.

Congressional Budget Office. 2009, “Estimated Macroeconomic Impacts of the American Recovery and Reinvestment Act of 2009,” March 2.

_____, 2012, “Estimated Impact of the American Recovery and Reinvestment Act on Employment and Economic Output from January 2012 Through March 2012”, http://www.cbo.gov/publication/43274

Corsetti, G., A. Acconcia and S. Simonelli, 2011, “Mafia and Public Spending: Evidence on the Fiscal Multiplier from a Quasi-experiment ”.

Doornik, J. A. and Hendry, D. F. (1997), ‘Modelling Dynamic Systems Using PcFiml 9.0 for Windows’. International Thomson Business Press, London.

Eggertsson, G.B. 2008, “Can Tax Cuts Deepen Recessions?” Federal Reserve Bank of New York, December.

Fagan, G., Henry, G. and R. Mestre (2001), An Area-wide Model (AWM) for the euro area, *ECB Working Paper Series*, 42, European Central Bank.

Gelman, A., J. B. Carlin, H. S. Stern, and D. B. Rubin. 2004, *Bayesian Data Analysis*, Chapman and Hall/CRC.

Government Spending on Consumption," *Journal of the European Economic Association* 5(1), pp. 227–270.

Granger, C. W. and T. Terasvirta, 1993, *Modelling Nonlinear Economic Relationships*. Oxford University Press.

Guajardo, J., D Leigh, and A. Pescatori (2010), "Expansionary Austerity: New International Evidence", IMF Working Paper 11/158, Research Department, International Monetary Fund.

Hall, R. E. 2009, "By How Much Does GDP Rise If the Government Buys More Output?" *Brookings Papers on Economic Activity*, Fall, pp 183–231.

Hamilton, J. D. 1994, *Time Series Analysis,* Princeton University Press.

Hansen, B.E., 1996, "Inference When a Nuisance Parameter is Not Identified Under the Null Hypothesis". *Econometrica*, 64(2), pp. 413–430.

_____, (1999), 'Testing for linearity", Journal of Economic Surveys, 13(5), pp. 551–576.

Hebous, S., 2011, "The Effects Of Discretionary Fiscal Policy On Macroeconomic Aggregates: A Reappraisal, *Journal of Economic Surveys*, Wiley Blackwell, vol. 25(4), pp. 674–707, 09.

Johnson, D. S., J. A. Parker and N. S. Souleles, 2006, "Household Expenditure and the Income Tax Rebates of 2001", *American Economic Review* 96(5), pp1589–1610.

Kirchner, M., J. Cimadomo and S. Hauptmeier, 2010, "Transmission of government spending shocks in the euro area: Time variation and driving forces," Working Paper Series 1219, European Central Bank.

International Monetary Fund, 2012, *Fiscal Monitor*, April (Washington: International Monetary Fund).

Koop, G., M. H. Pesaran, and S. M., Potter, 1996, "Impulse Response Analysis in Nonlinear Multivariate Models," *Journal of Econometrics* 74(1), pp 119–147.

Kumar, M. S. and J. Woo, 2010, "Public Debt and Growth," IMF Working Papers 10/174, International Monetary Fund.

Leduc, S., K. Sill, and T. Stark. 2007 “Self-fulfilling expectations and the inflation of the 1970s: Evidence from the Livingston Survey,” *Journal of Monetary Economics* 54(2), 433–459.

Leeper, E. M., T. B. Walker, and S. S. Yang, 2009, “Government Investment and Fiscal Stimulus in the Short and Long Runs,” NBER Working Paper 15153.

Leigh, D, P Devries, C Freedman, J Guajardo, D Laxton, and A Pescatori (2010), "Will it hurt? Macroeconomic effects of fiscal consolidation", *World Economic Outlook*, October, International Monetary Fund.

Mertens, K., and M. O. Ravn. 2009, “Understanding the Aggregate Effects of Anticipated and Unanticipated Tax Policy Shocks,” manuscript.

______, 2010, “Measuring the Impact of Fiscal Policy in the Face of Anticipation: A Structural VAR Approach,” *Economic Journal* 120 (May), pp. 393–413.

Monacelli, T., Perotti, R., and Trigari, A. (2010), ‘Unemployment fiscal multipliers’. *Journal of Monetary Economics*, 57(5), pp. 531–553.

Paredes, J., Pedregal, D. J. and J. J. Pérez (2009), A quarterly fiscal database for the euro area based on intra-annual fiscal information, *ECB Working Paper Series*, 1132, European Central Bank.

Perotti, R., 1999, “Fiscal Policy in Good Times and Bad,” *Quarterly Journal of Economics* 114(4), pp. 1399–1436.

_____, 2010. “The Effects of Tax Shocks: Negative and Large,” manuscript.

_____, 2011, “The "Austerity Myth",Gain Without Pain? ”, NBER Working Paper Series, w1757.

Ramey, V. A. 2011, “Identifying Government Spending Shocks: It’s All in the Timing”, *Quarterly Journal of Economics* 126(1), pp. 1–50.

Ramey, V. A. and M. Shapiro. 1997, “Costly Capital Reallocation and the Effects of Government Spending,” *Carnegie-Rochester Conference on Public Policy* 48, June, pp. 145–194.

Romer, C., and J. Bernstein. 2009, “The Job Impact of the American Recovery and Reinvestment Plan,” Council of Economic Advisors, January 9.

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

Shapiro, M. D. and J. Slemrod, 2003, “Consumer Response to Tax Rebates,” *American Economic Review* 93(1), pp. 381–396.

Spilimbergo, A., Symansky, S., and Schindler, M. (2009). 'Fiscal multipliers'. IMF Staff Position Note SPN/09/11, International Monetary Fund.

Stock, J., and M. Watson. 1989, "New indexes of coincident and leading economic indicators," *NBER Macroeconomics Annual* 4, pp. 351–409.

_____, and M. Watson, 2007, "Why Has U.S. Inflation Become Harder to Forecast?"*Journal of Money, Credit and Banking* 39(1), pp. 3–33.

Taylor, J. B. 2011, "An Empirical Analysis of the Revivalof Fiscal Activism in the 2000s", Journal of Economic Literature, 49(3): pp. 686–702.

Woodford, M., 2011, "Simple Analytics of the Government Expenditure Multiplier," American Economic Journal: Macroeconomics 3(1), pp.135.

Figure 1: Average Responses to Shocks to Government Spending–Euro Area

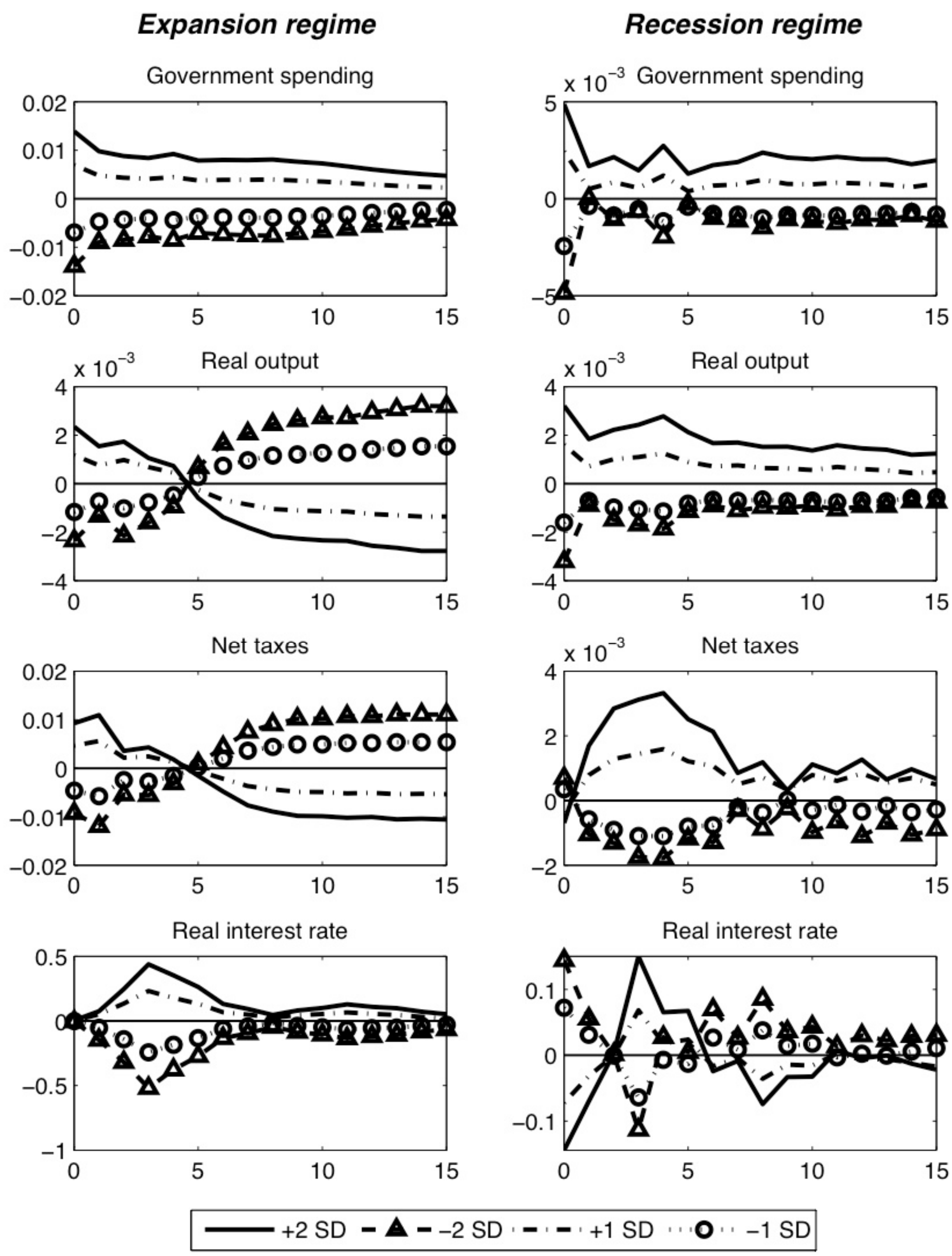

Figure 2: Average Responses to Shocks to Government Spending–France

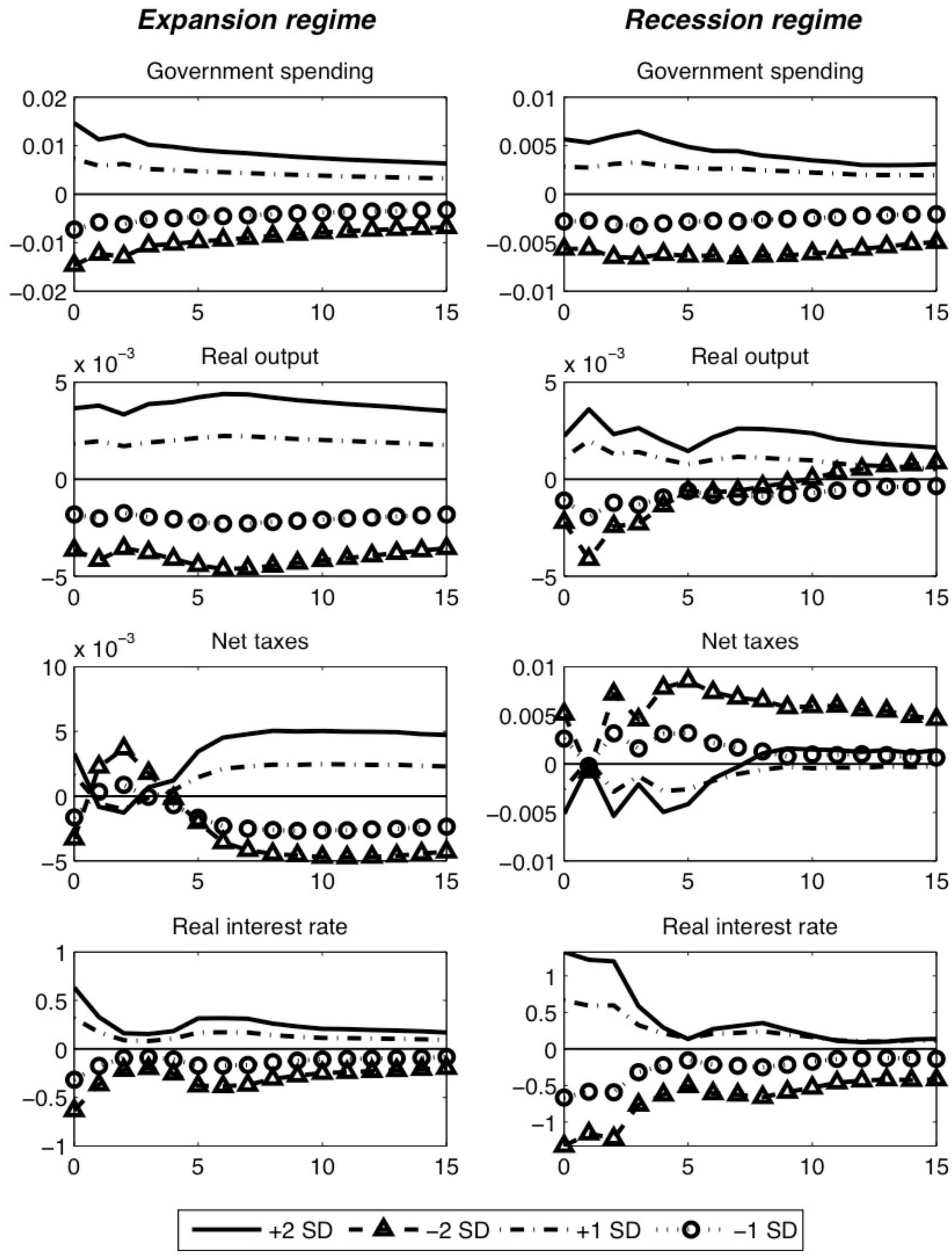

Figure 3: Average Responses to Shocks to Government Spending–Italy

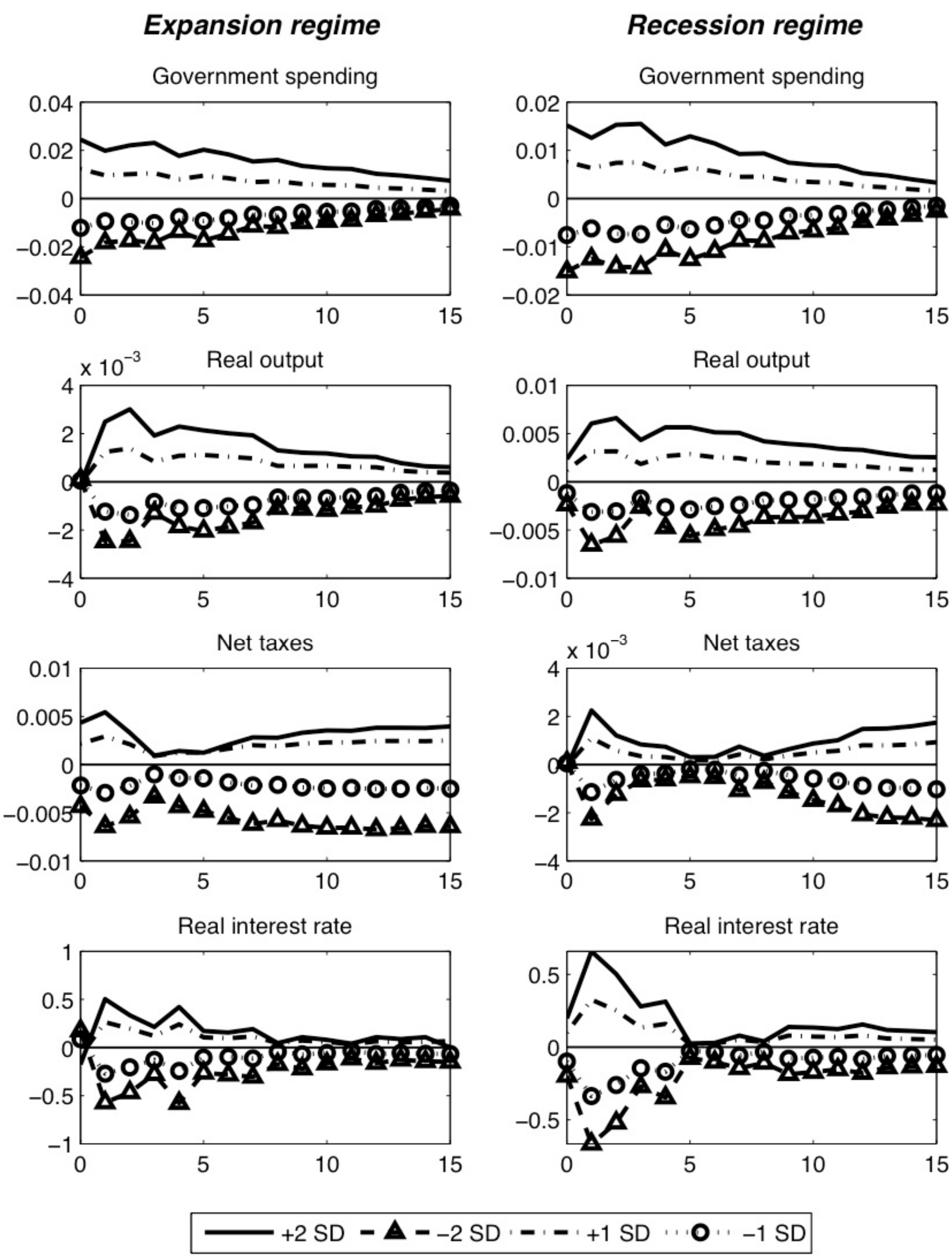

Figure 4: Average Responses to Shocks to Government Spending–Japan

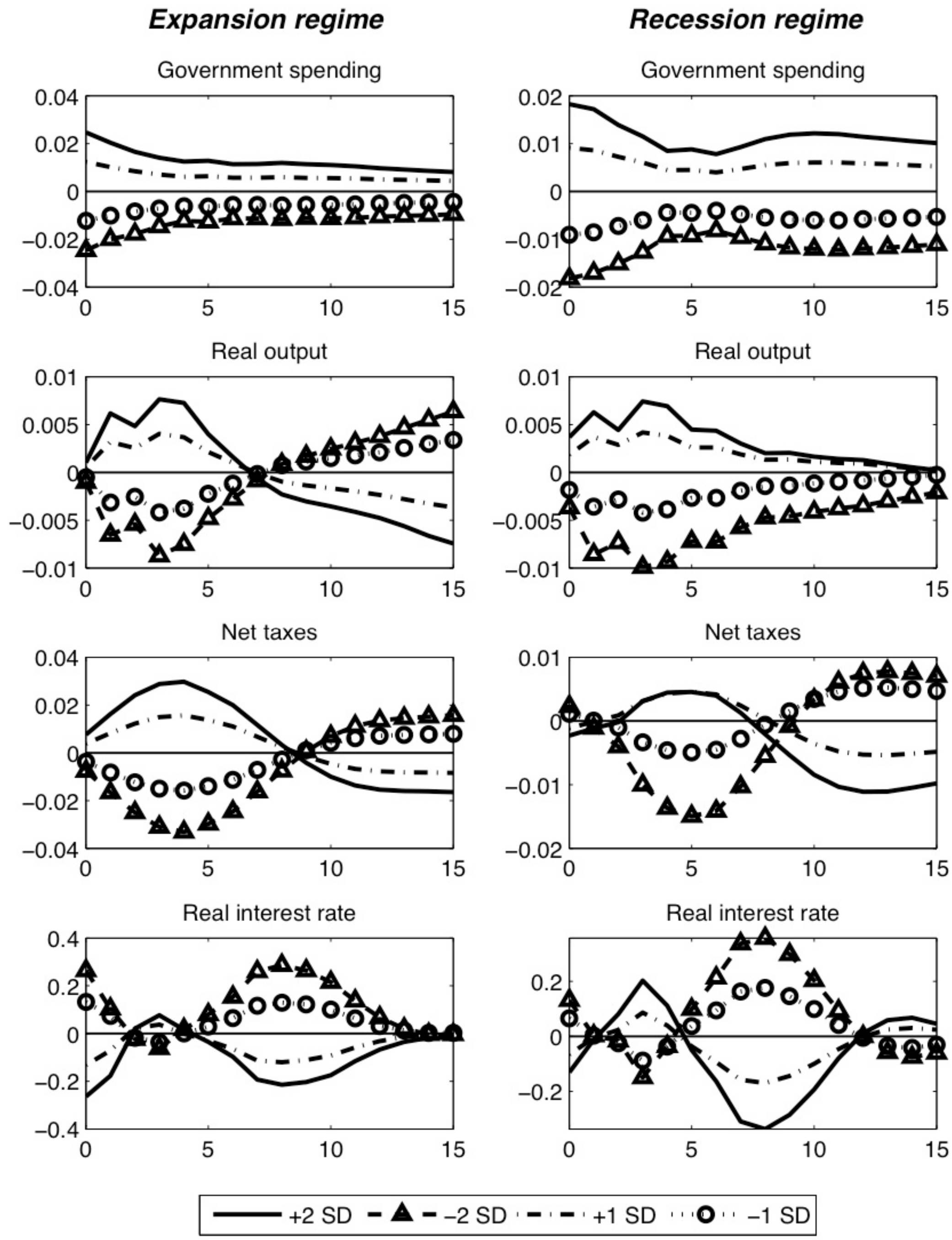

Figure 5: Average Responses to Shocks to Government Spending–United States

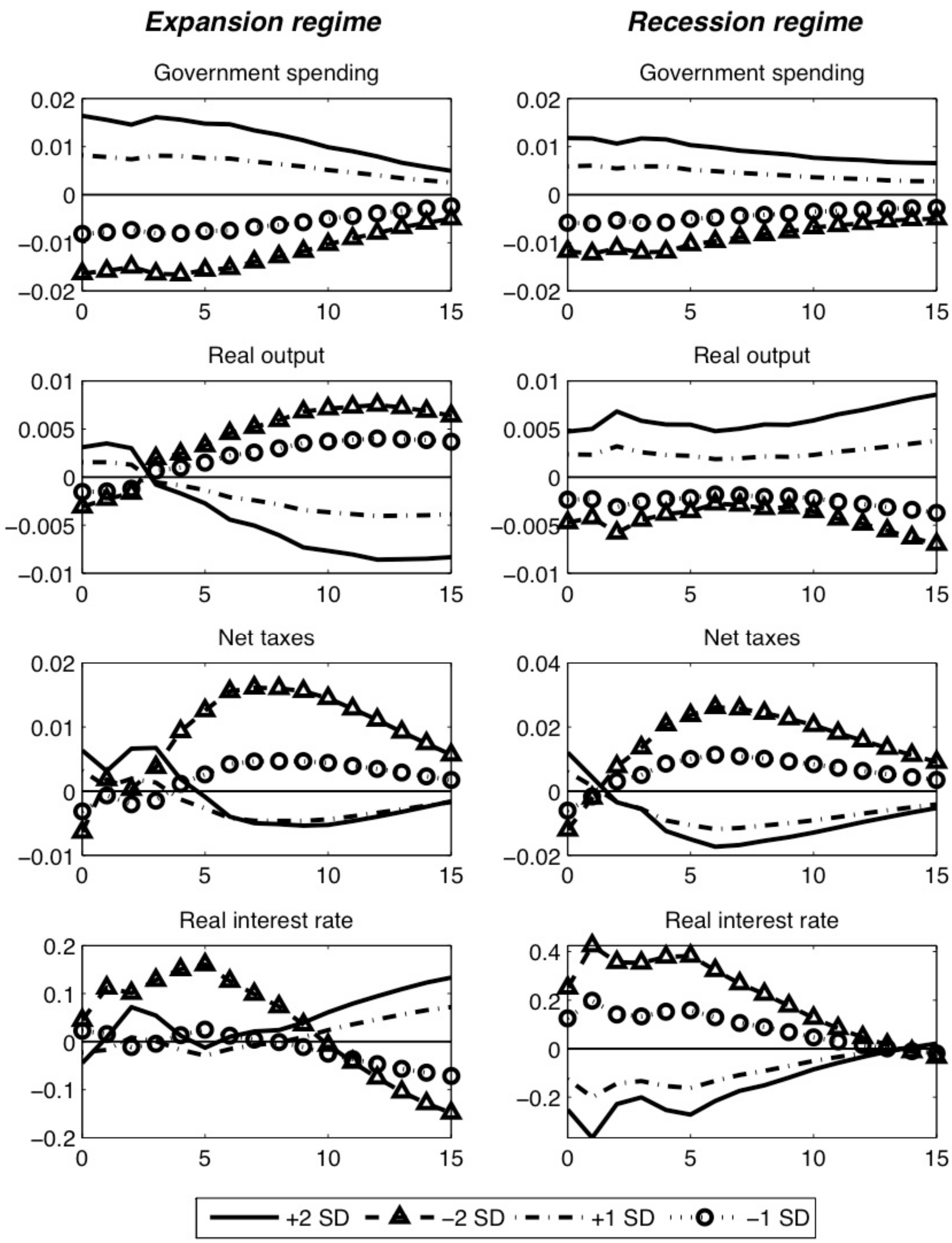

Figure 6: Average Responses to Shocks to Net Taxes–Euro Area

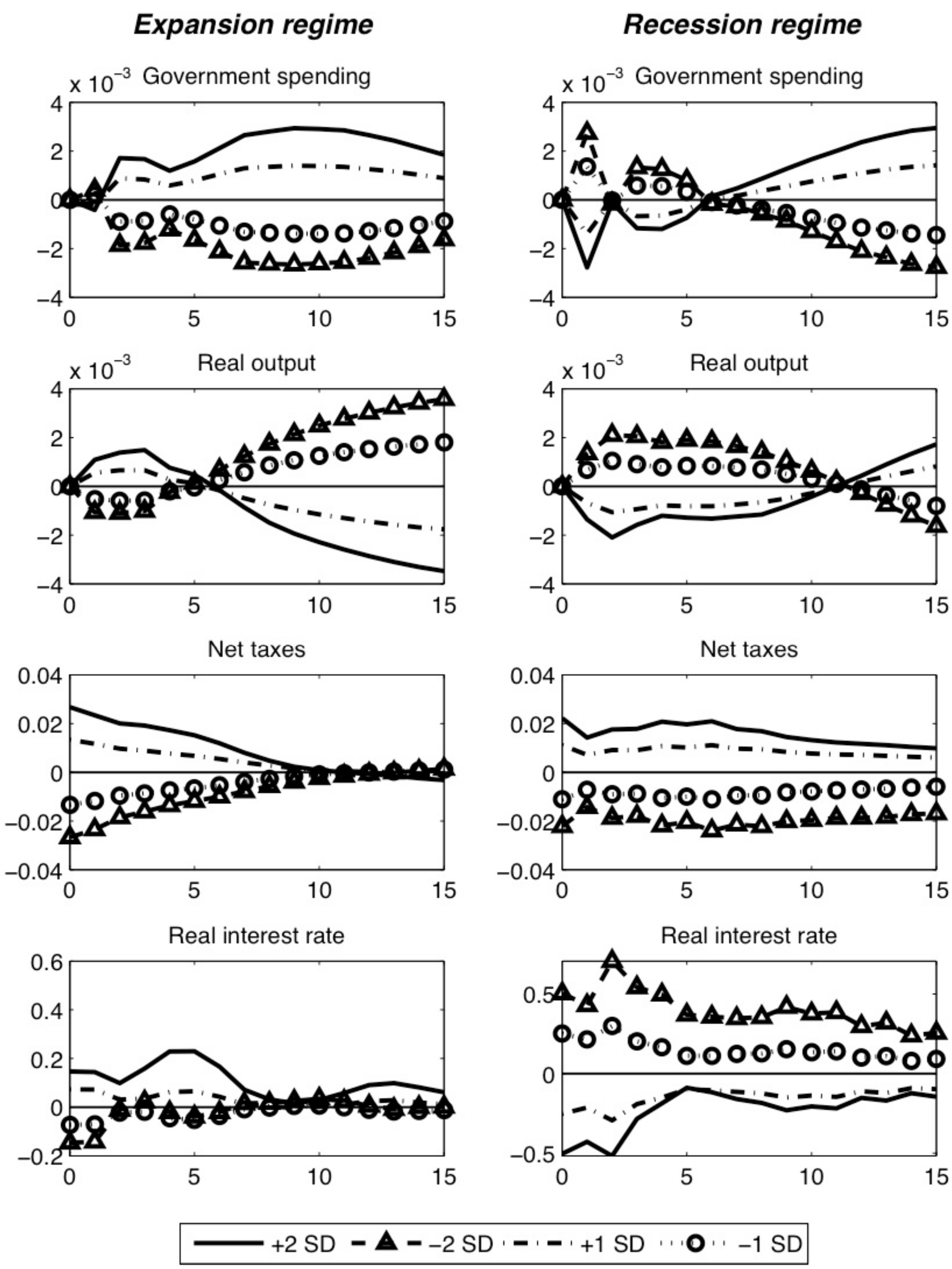

Figure 7. Average Responses to Shocks to Net Taxes–France

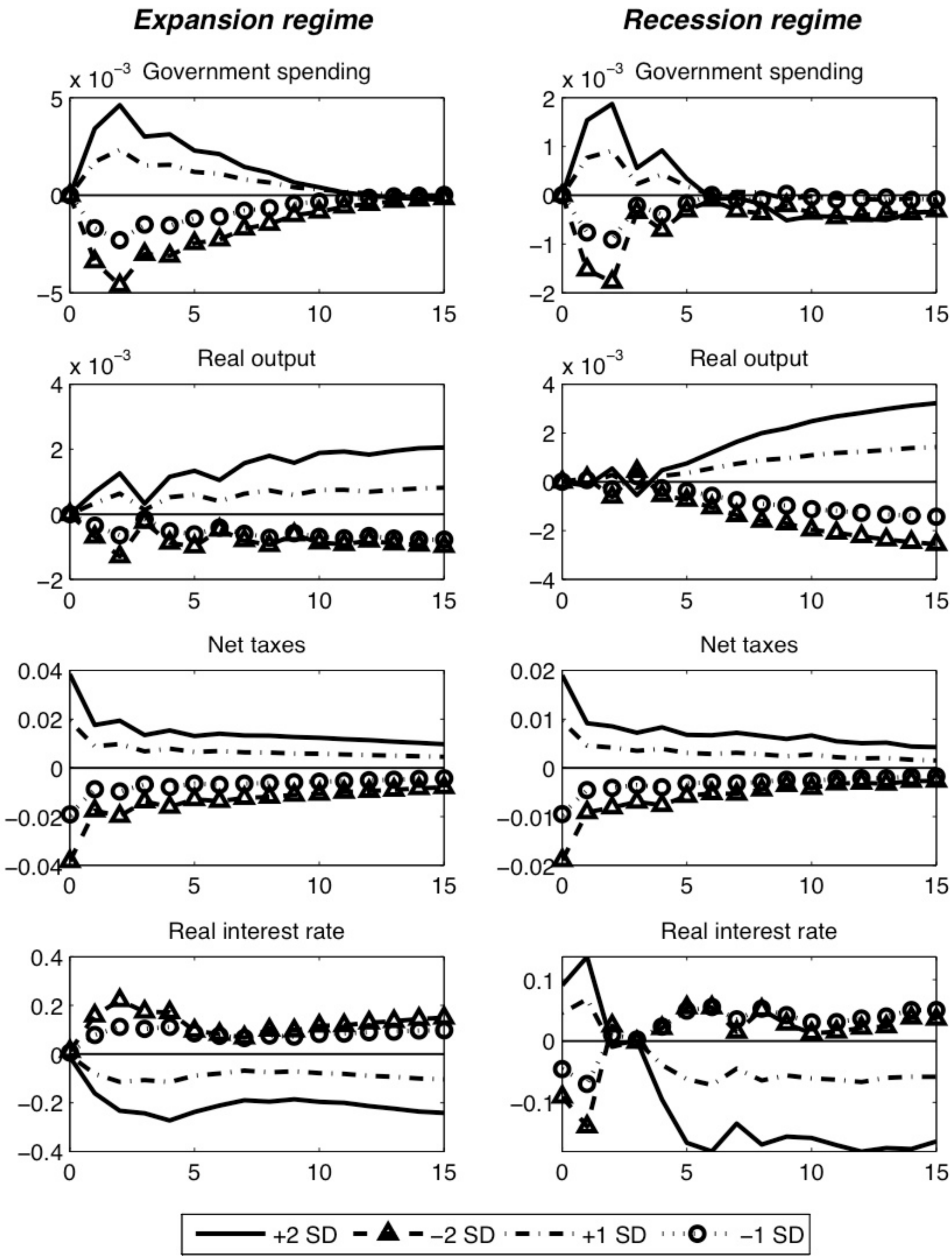

Figure 8. Average Responses to Shocks to Net Taxes–Italy

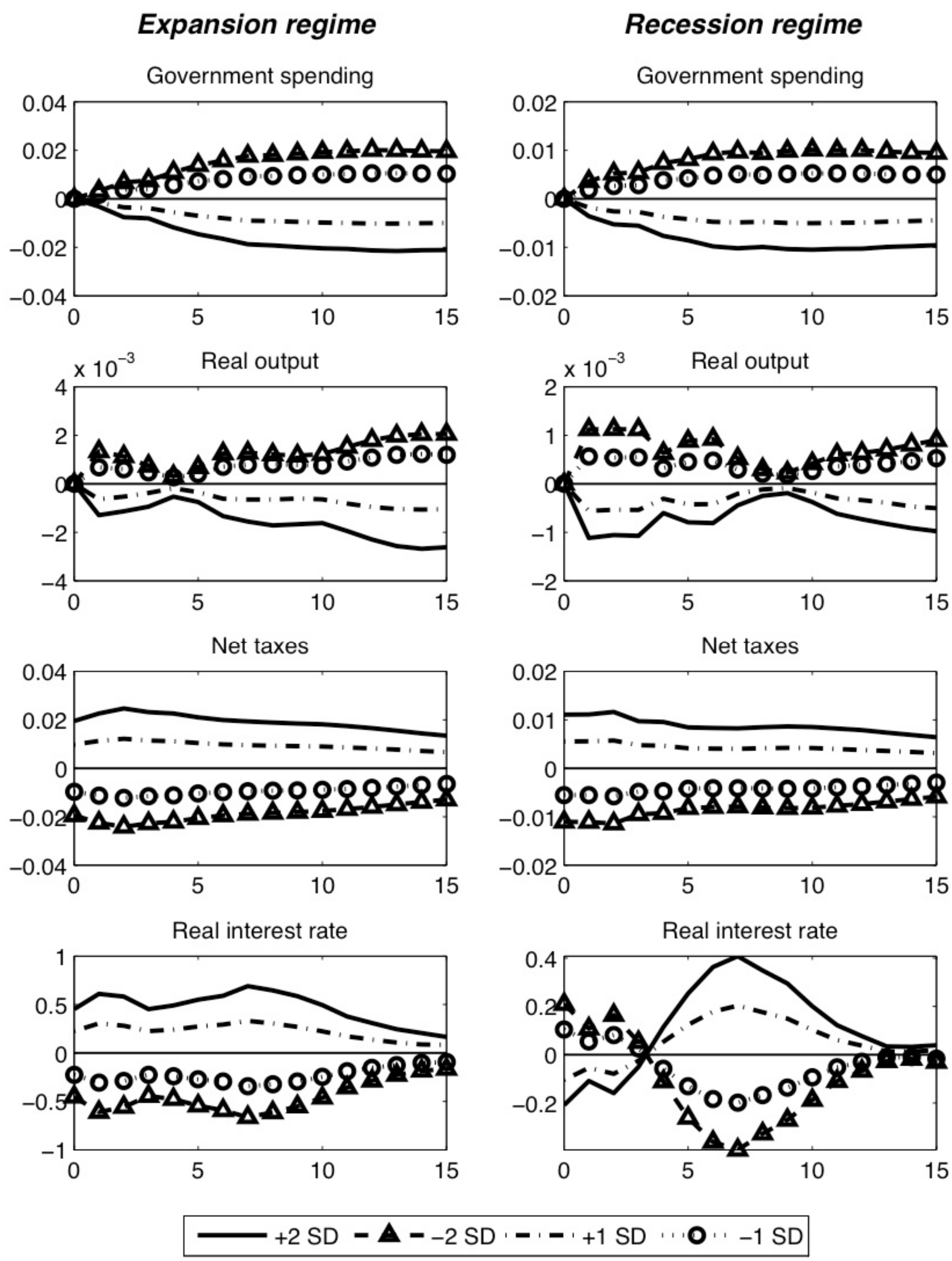

Figure 9. Average Responses to Shocks to Net Taxes–Japan

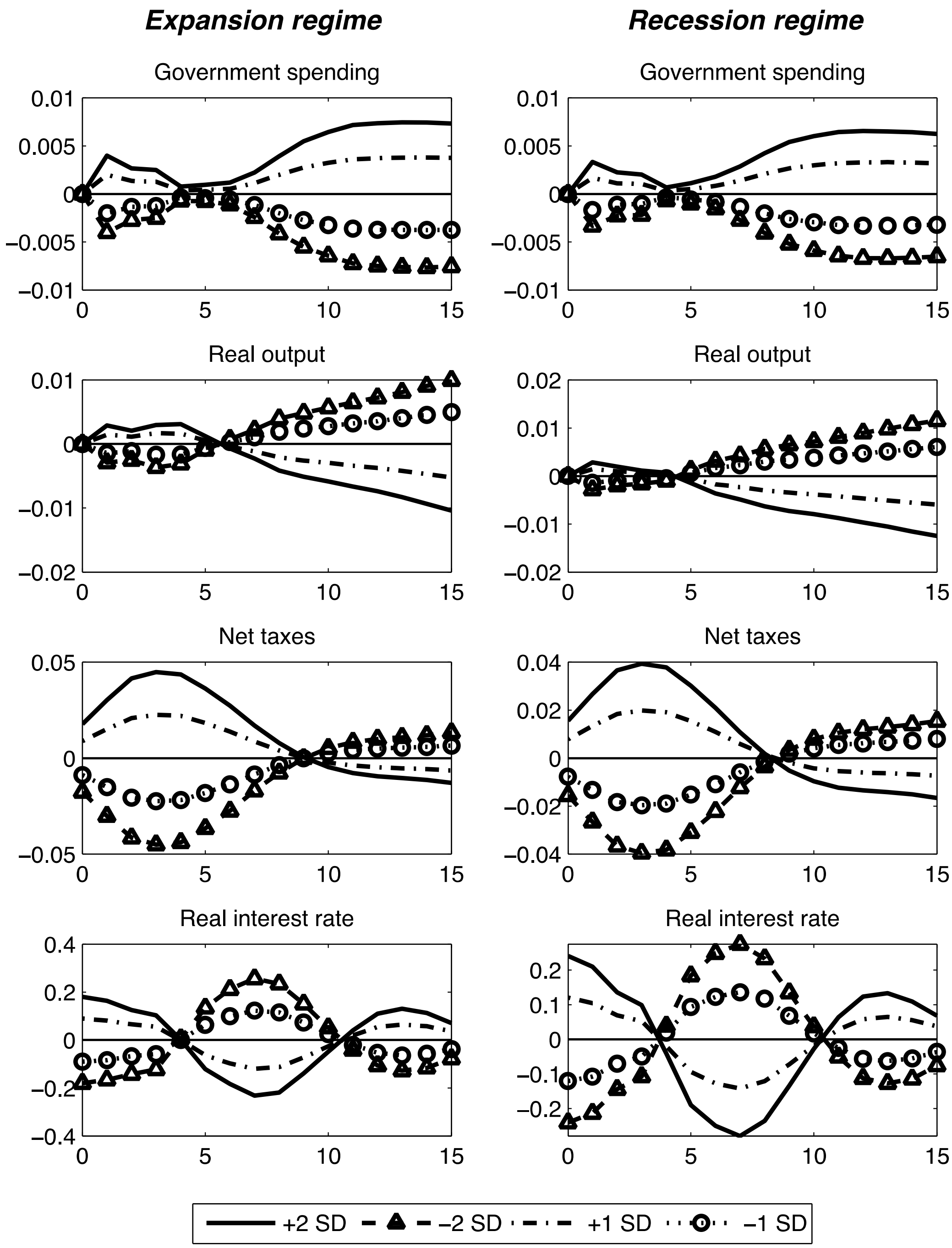

Figure 10: Average Responses to Shocks to Net Taxes–United States

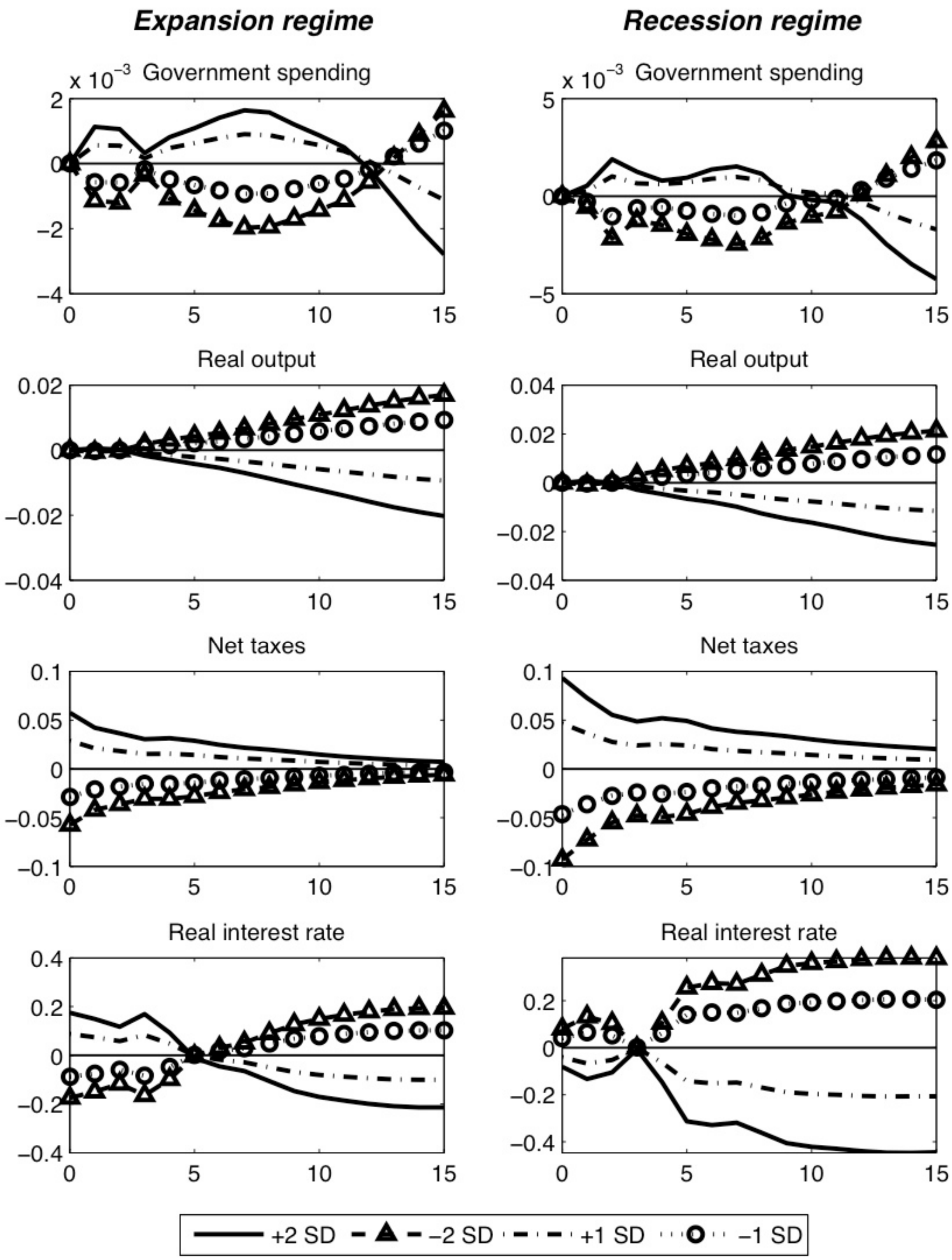

Figure 11. Average Cumulative Government Spending and Tax Multipliers (Based on a Spending Contraction or Net Revenue Hike of Size One Standard Deviation)

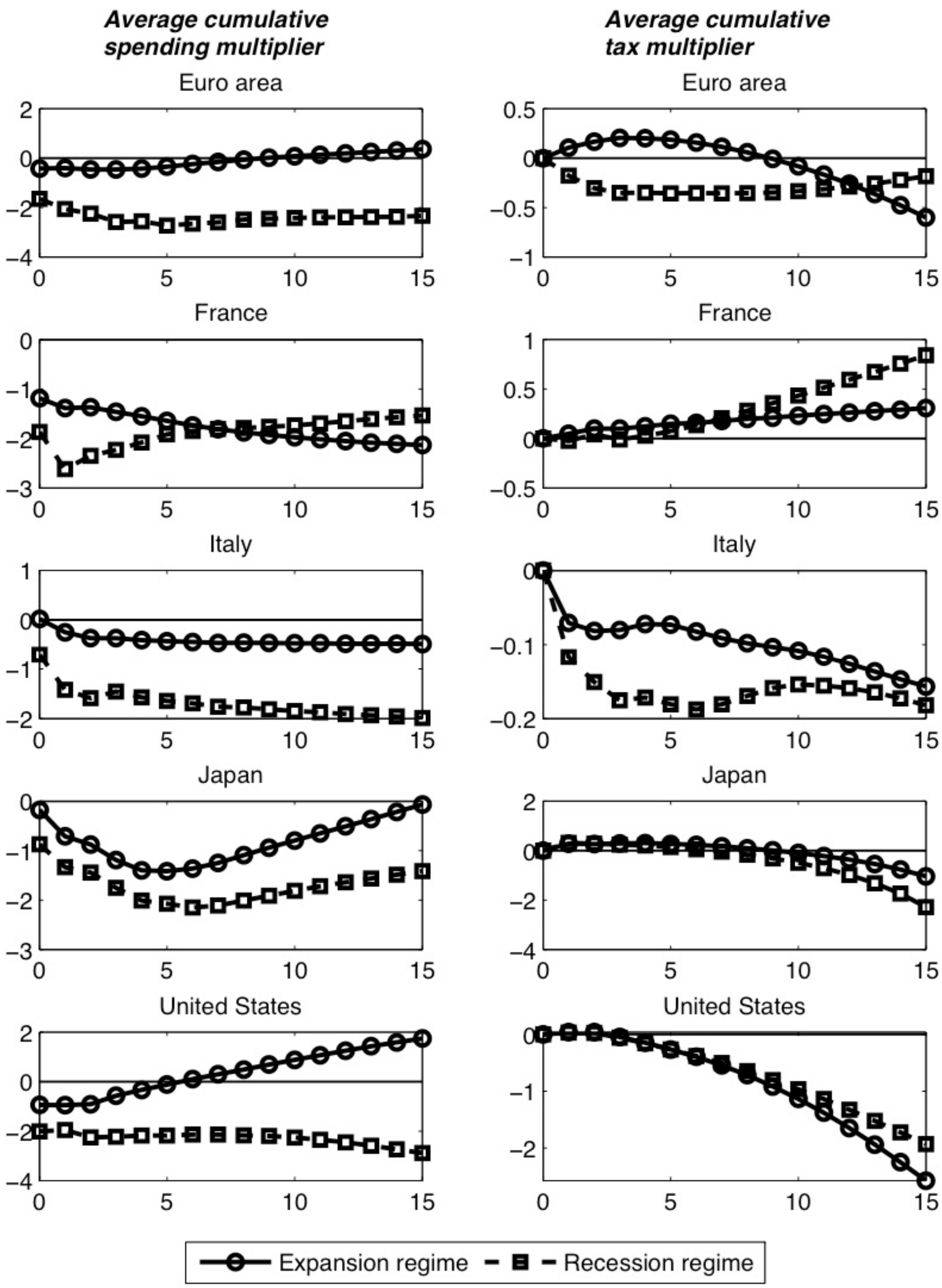

Figure 12 : Baseline Scenario (Adverse Growth Shock, No Fiscal Consolidation)

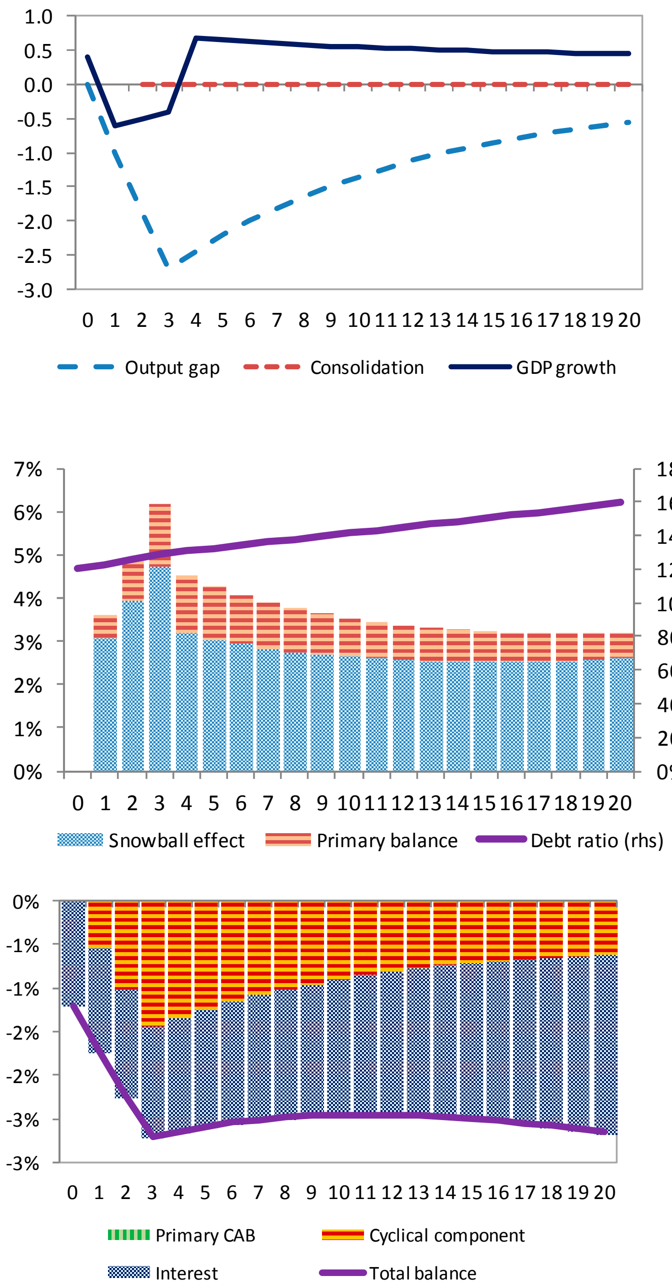

Figure 13: Debt-to-GDP Ratio Following a Smooth Fiscal Consolidation (Scenario I)

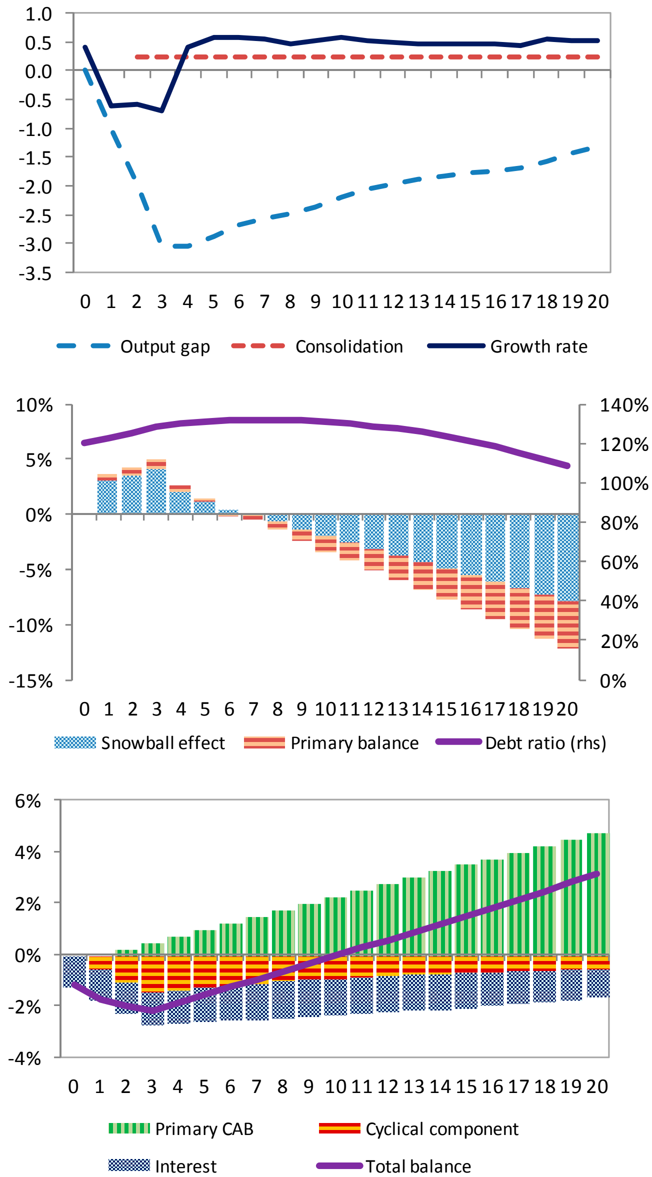

Figure 14: Debt-to-GDP Ratio Following a Frontloaded Fiscal Consolidation (Scenario II)

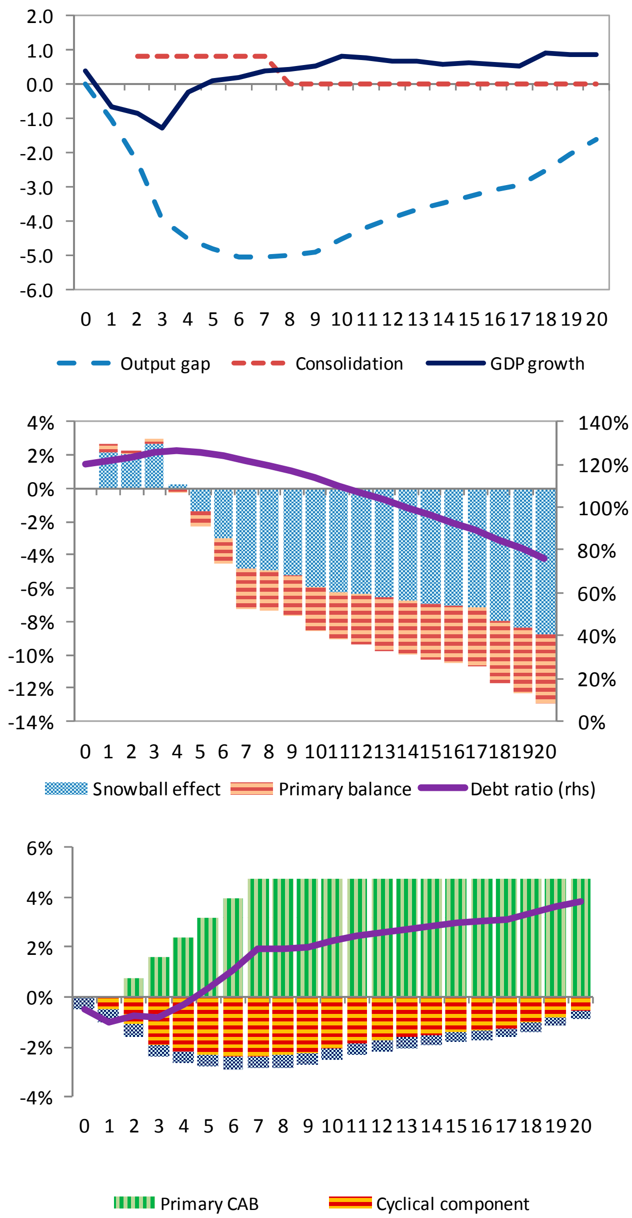

Figure 15 : Debt-to-GDP Ratio—Difference Between Frontloaded and Smooth Fiscal Consolidation

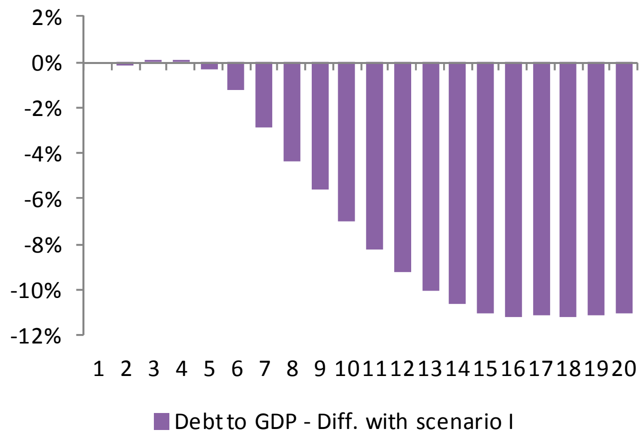

Figure 16: **Debt-to-GDP ratio—Difference Between Frontloaded (Spending-Cuts-Only Based) and Smooth Fiscal Consolidation**

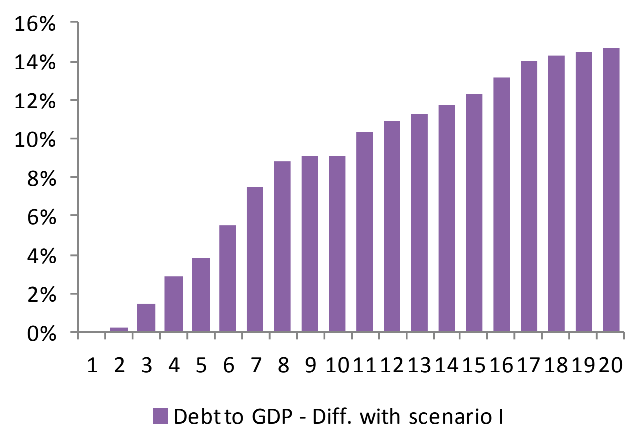

Figure 17 : Debt-to-GDP Ratio, Difference Between Frontloaded and Smooth Fiscal Consolidation With Exogenous Risk Premium of 0.5 Percent Per Quarter (Spending-Cuts-Based Only Consolidation)

Figure 18 : Debt-to-Gdp Ratio. Difference Between Frontloaded and Smooth Fiscal Consolidation with Endogenous Risk Premium (Spending-Cuts-Based Only Consolidation)

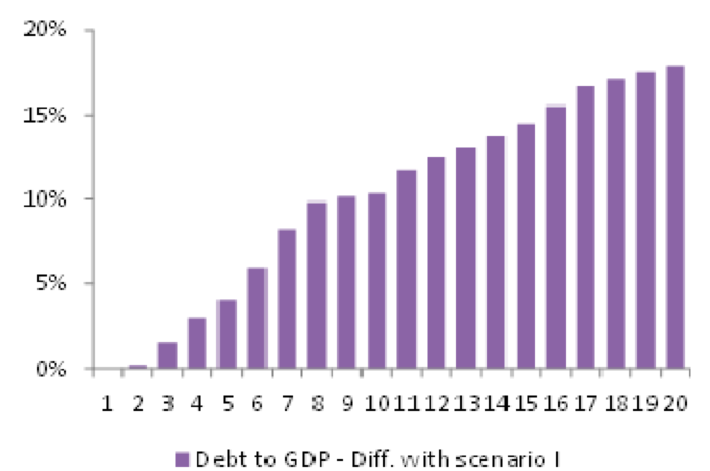

Table 1: Tests for Threshold VAR

Country	Likelihood ratio ?-square test statistics
Euro area	132.15 (0.000)
France	200.27 (0.000)
Italy	114.13 (0.000)
Japan	127.70 (0.000)
United States	213.16 (0.000)

Notes: Frequency is quarterly. Lag length is 4.
Test statistic constructed as in Doornik and Hendry (1997)
Null hypothesis of a VAR against alternative of a TVAR
P -values are reported in parenthesis.

Table 2. Cumulative Fiscal Multipliers

EURO AREA

	Simulations starting during recessions *Cumulative fiscal multiplier*		Simulations starting during expansions *Cumulative fiscal multiplier*		Linear benchmark *Cumulative fiscal multiplier*	
Horizon	Expenditure cut	Tax hike	Expenditure cut	Tax hike	Expenditure cut	Tax hike
1 quarter	-2.06	-0.18	-0.41	0.10	-0.30	0.15
1 year	-2.56	-0.35	-0.43	0.20	-0.42	0.49
2 years	-2.49	-0.35	-0.07	0.06	-0.25	0.55

FRANCE

	Simulations starting during recessions *Cumulative fiscal multiplier*		Simulations starting during expansions *Cumulative fiscal multiplier*		Linear benchmark *Cumulative fiscal multiplier*	
Horizon	Expenditure cut	Tax hike	Expenditure cut	Tax hike	Expenditure cut	Tax hike
1 quarter	-2.62	-0.02	-1.39	0.05	-1.54	-0.01
1 year	-2.08	0.03	-1.55	0.12	-1.75	0.04
2 years	-1.79	0.28	-1.88	0.20	-2.06	0.12

ITALY

	Simulations starting during recessions *Cumulative fiscal multiplier*		Simulations starting during expansions *Cumulative fiscal multiplier*		Linear benchmark *Cumulative fiscal multiplier*	
Horizon	Expenditure cut	Tax hike	Expenditure cut	Tax hike	Expenditure cut	Tax hike
1 quarter	-1.42	-0.12	-0.25	-0.07	-0.62	-0.07
1 year	-1.57	-0.17	-0.41	-0.07	-0.81	-0.07
2 years	-1.78	-0.17	-0.46	-0.10	-0.86	-0.01

JAPAN

	Simulations starting during recessions *Cumulative fiscal multiplier*		Simulations starting during expansions *Cumulative fiscal multiplier*		Linear benchmark *Cumulative fiscal multiplier*	
Horizon	Expenditure cut	Tax hike	Expenditure cut	Tax hike	Expenditure cut	Tax hike
1 quarter	-1.34	0.31	-0.71	0.27	-0.70	0.33
1 year	-2.01	0.21	-1.40	0.30	-1.15	0.31
2 years	-2.01	-0.17	-1.09	0.09	-1.50	0.22

UNITED STATES

	Simulations starting during recessions *Cumulative fiscal multiplier*		Simulations starting during expansions *Cumulative fiscal multiplier*		Linear benchmark *Cumulative fiscal multiplier*	
Horizon	Expenditure cut	Tax hike	Expenditure cut	Tax hike	Expenditure cut	Tax hike
1 quarter	-1.96	0.03	-0.95	0.04	-0.99	0.04
1 year	-2.18	-0.16	-0.33	-0.15	-0.50	-0.01
2 years	-2.17	-0.65	0.49	-0.72	0.00	-0.30

Table 3. Conditional Probabilities of a Recession (Expenditure Cut)

EURO AREA

Expenditure cut

	Simulations starting during recessions *Probability of a recession*			**Simulations starting during expansions** *Probability of a recession*		
Horizon	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)
1 quarter	0.44	0.52	0.61	0.18	0.27	0.38
1 year	0.31	0.32	0.32	0.27	0.27	0.27
2 years	0.33	0.33	0.33	0.27	0.26	0.25

FRANCE

Expenditure cut

	Simulations starting during recessions *Probability of a recession*			**Simulations starting during expansions** *Probability of a recession*		
Horizon	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)
1 quarter	0.53	0.61	0.67	0.14	0.23	0.36
1 year	0.32	0.33	0.31	0.20	0.21	0.21
2 years	0.28	0.28	0.26	0.22	0.22	0.22

JAPAN

Expenditure cut

	Simulations starting during recessions *Probability of a recession*			**Simulations starting during expansions** *Probability of a recession*		
Horizon	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)
1 quarter	0.37	0.38	0.40	0.30	0.38	0.45
1 year	0.39	0.42	0.47	0.35	0.38	0.40
2 years	0.42	0.40	0.38	0.38	0.37	0.35

UNITED STATES

Expenditure cut

	Simulations starting during recessions *Probability of a recession*			**Simulations starting during expansions** *Probability of a recession*		
Horizon	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)
1 quarter	0.51	0.60	0.68	0.20	0.27	0.36
1 year	0.35	0.34	0.31	0.26	0.19	0.14
2 years	0.30	0.30	0.30	0.32	0.30	0.29

ITALY

Expenditure cut

	Simulations starting during recessions *Probability of a recession*			**Simulations starting during expansions** *Probability of a recession*		
Horizon	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)
1 quarter	0.35	0.35	0.35	0.27	0.33	0.39
1 year	0.38	0.38	0.38	0.32	0.26	0.20
2 years	0.37	0.36	0.35	0.37	0.37	0.36

Table 4. Conditional Probabilities of a Recession (Tax Hike)

EURO AREA

Tax hike

	Simulations starting during recessions *Probability of a recession*			**Simulations starting during expansions** *Probability of a recession*		
Horizon	No consolidation	"Mild" Consolidation (+ 1 SD)	"Strong" Consolidation (+ 2 SD)	No consolidation	"Mild" Consolidation (+ 1 SD)	"Strong" Consolidation (+ 2 SD)
1 quarter	0.44	0.44	0.44	0.18	0.18	0.18
1 year	0.31	0.31	0.31	0.27	0.26	0.25
2 years	0.33	0.32	0.33	0.27	0.29	0.31

FRANCE

Tax hike

	Simulations starting during recessions *Probability of a recession*			**Simulations starting during expansions** *Probability of a recession*		
Horizon	No consolidation	"Mild" Consolidation (+1 SD)	"Strong" Consolidation (+ 2 SD)	No consolidation	"Mild" Consolidation (+1 SD)	"Strong" Consolidation (+ 2 SD)
1 quarter	0.53	0.53	0.53	0.14	0.14	0.14
1 year	0.32	0.34	0.36	0.20	0.22	0.25
2 years	0.28	0.27	0.26	0.22	0.21	0.20

JAPAN

Tax hike

	Simulations starting during recessions *Probability of a recession*			**Simulations starting during expansions** *Probability of a recession*		
Horizon	No consolidation	"Mild" Consolidation (+1 SD)	"Strong" Consolidation (+ 2 SD)	No consolidation	"Mild" Consolidation (+1 SD)	"Strong" Consolidation (+ 2 SD)
1 quarter	0.37	0.37	0.37	0.30	0.30	0.30
1 year	0.39	0.38	0.39	0.35	0.33	0.31
2 years	0.42	0.43	0.44	0.38	0.39	0.41

UNITED STATES

Tax hike

	Simulations starting during recessions *Probability of a recession*			**Simulations starting during expansions** *Probability of a recession*		
Horizon	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)
1 quarter	0.51	0.51	0.51	0.20	0.20	0.20
1 year	0.35	0.41	0.49	0.26	0.31	0.36
2 years	0.30	0.33	0.37	0.32	0.34	0.37

ITALY

Tax hike

	Simulations starting during recessions *Probability of a recession*			**Simulations starting during expansions** *Probability of a recession*		
Horizon	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)	No consolidation	"Mild" Consolidation (-1 SD)	"Strong" Consolidation (- 2 SD)
1 quarter	0.35	0.35	0.35	0.27	0.27	0.27
1 year	0.38	0.38	0.38	0.32	0.31	0.30
2 years	0.37	0.36	0.35	0.37	0.37	0.37

VIII. DATA APPENDIX

The frequency of all data used in estimation is quarterly. Data are expressed on an accrual basis and cover the general government. Government expenditures, gross domestic product (GDP) and tax revenue are in real per-capita terms. When original sources provide nominal values, the real values are obtained by dividing nominal values by the GDP deflator. The real interest rate is computed as the difference between a nominal interest rate with a one-year maturity and the inflation rate. The inflation rate is 100 × (difference in logs between the GDP deflator of each quarter and its value in the same quarter of the previous year). Most data are seasonally adjusted by the source. Where this is not the case, the seasonality is removed by using the US Census Bureau X-12 method.

Data sources are reported below:

A. Euro Area (1985 Q1– 2009 Q4):

- Government expenditures: Paredes et al. (2009);*
- Gross domestic product: AWM database; **
- GDP deflator: AWM database;
- Government total receipts: Paredes et al. (2009);
- Transfer payments: Paredes et al. (2009);
- Government interest payments: Paredes et al. (2009);
- Labor force: AWM database;
- Short-term interest rate: AWM database.

B. France (1970 Q1 – 2010 Q4):

- Government expenditures: INSEE, France;
- Gross domestic product: IFS of the IMF;
- GDP deflator: ALFRED, IFS of the IMF;
- Government total receipts: INSEE, France;
- Transfer payments: INSEE, France;
- Government interest payments: INSEE, France;
- Population: IFS of the IMF;
- Treasury bill rate: IFS of the IMF.

Definition of government spending and revenues:

- **Spending:** ESA 95 definition of government consumption: compensation of employees + intermediate consumption + social transfers in kind via market producers +

consumption of fixed capital (=depreciation) - sales + taxes paid on production - subsidies received on production. To this we need to add government investment

- **Revenues:** From Baum and Koester (): general government revenues (including social security contributions) minus transfers. Transfers are defined as subsidies + social security benefits paid by the government.

Note: Some of the sub-components of revenue (sales) and expenditure (transfers in kind) are available only annually; we can interpolate using some other similar series.

- **Gross revenues:** we use available total direct taxes, total indirect taxes and other current revenues (which all matches with the ESA95 numbers included in the FR_LATEST file); we also use available social contributions but to be in line with the literature we should exclude it. Receipts from sales are interpolated using the annual series on sales from INSEE and quarterly on production.

- **Expenditure:** We use available data from the agents' account from INSEE.

- **Transfers:** We use available social contributions other than social transfers in kind (D.62); subsidies (D.3); the fact that we cannot distinguish the transfers to the NPISH should not be a problem, since we are working with aggregate transfers. Social transfers in kind produced are interpolated the annual INSEE value with the quarterly values of total social transfers in kind (D.631).

C. Italy (1981 Q1– 2007 Q4):

- Government expenditures: Basile et al. (2011);***
- Gross domestic product: IFS of the IMF;
- GDP deflator: IFS of the IMF;
- Government net tax revenue: Basile et al. (2011);***
- Population: IFS of the IMF;
- Treasury bill rate: IFS of the IMF.

D. Japan (1981Q1– 2009 Q4):

- Government expenditures: Statistics Bureau, Japan;
- Gross domestic product: Statistics Bureau, Japan;
- GDP deflator: Statistics Bureau, Japan;
- Government total receipts: Baum et al. (2012);
- Transfer payments: Baum et al. (2012);
- Government interest payments: Baum et al. (2012);
- Population: Statistics Bureau, Japan;
- Money market rate: IFS of the IMF.

E. United States (1975 Q1– 2010 Q2):

For the US, the main data sources are the NIPA tables. Government Spending corresponds to government consumption expenditures (NIPA Table 3.1, Line 16) and gross investment (NIPA Table 3.1. Line 35). For the series of net taxes, we use government current receipts (NIPA Table 3.1, Line 1) minus current transfers payments (NIPA Table 3.2, Line 22). GDP corresponds to the Gross Domestic Product (NIPA Table 1.1.5, Line 1). Other variables come from the following sources:

- GDP deflator: ALFRED, Federal Reserve Bank of St. Louis;
- Government interest payments: NIPA tables, Bureau of Economic Analysis;
- Population: ALFRED, Federal Reserve Bank of St. Louis;
- Treasury bill rate: ALFRED, Federal Reserve Bank of St. Louis.

---

[*] Updated version of Paredes, J., Pedregal, D. J. and J. J. Pérez (2009), A quarterly fiscal database for the euro area based on intra-annual fiscal information, *ECB Working Paper Series*, 1132, European Central Bank, courtesy of the authors.

Updated version of the database described in Fagan, G., Henry, G. and R. Mestre (2001), An Area-wide Model (AWM) for the euro area, *ECB Working Paper Series*, 42, European Central Bank, downloadable form the website of the Euro Area BusinessCycle Network.

[***] Basile R., Chiarini B. and Marzano, E. (2011), Can we Rely upon Fiscal Policy Estimates in Countries with Unreported Production of 15 Per Cent (or more) of GDP?, *CESifo Working Paper Series*, 3521, CESifo Group Munich, courtesy of the authors.

[****] Baum, A., M. Poplawski-Ribeiro, and A. Weber, 2012, "Fiscal Multipliers and the State of the Economy," IMF Working Paper (forthcoming; Washington: International Monetary Fund), courtesy of the authors.