The effects of austerity[*]

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Abstract

In this paper we review the debate surrounding the macroeconomic effects of deficit reduction policies (austerity) with special attention to the European post financial crisis austerity programs implemented in 2010-14. We show that different types of austerity policies have very different macroeconomic short run effects. Spending based austerity plans are remerakebly less costly than tax based plans. The former have on average a close to zero effect on output and lead to a reduction of the debt over GDP ratio. Tax based plans have the opposite effect and cause large and long lasting recessions. These results also apply to the recent episodes of European austerity which in this respect do not look especially different form previous cases. **Keywords:** austerity, fiscal adjustment plans, output growth.
JEL codes : E60, E62.

1 Introduction

The austerity policies embraced by several European countries starting in 2010 have generated an extraordinarily harsh policy debate. One side argued that austerity is (almost) always a bad idea and even the European countries which were experiencing serious difficulties in financial markets, either by being totally cut off from borrowing or by paying high risk premia, like Greece, Portugal, Spain, Ireland and Italy should have continued to stimulate the economy with more government spending and more

debt. Austerity, the argument continues, was self defeating because the recessions it induced increased debt over GDP ratios. The other side argued that postponing austerity would have caused debt defaults and bank runs, another round of financial collapses and, possibly, the crumbling of the European monetary union with unpredictable and potentially disastrous consequences. We will never know what would have happened without austerity, but the self assurance with which many commentators and some economists argued that everything would have worked out much better with even more debt, is baffling. The markets instead seemed to appreciate the combination of fiscal restraint and the eventual intervention of the ECB, unfortunately delayed til late 2011.

A related but separate discussion was whether the 2010-2014 austerity was especially costly in terms of output losses and significantly different from previous cases: because of the zero lower bound on interest rates (ZLB), because it started during a recession and because many countries did it all at the same time. Blanchard and Leigh (2014) indeed argued that this round of austerity was especially costly. In other words, fiscal multipliers were especially high. In order to compare this latest round of austerity with earlier episodes, one obviously needs a common methodology to measure the effects of different episodes. This prompted a lively academic discussion.

We contribute to this discussion on the effects of austerity documenting the sharp difference between austerity programs mostly based on tax hikes and programs mostly based on expenditure reductions, an angle largely overlooked in discussions of the recent round of austerity. We shall argue that there is no such a thing as austerity per se: it all depends on the composition of the fiscal retrenchment program: it is composition what made some of these plans very costly, other much less so, both in the more distant past and in the post 2010 round.

What are the effects of austerity is a difficult question to answer for at least three reasons. The first is "endogeneity", the two-way interaction between fiscal policy and output growth. Suppose you observe a reduction in the government deficit and an economic boom. It would be preposterous to conclude that the policies that reduced deficits also generated growth, as it could easily (even likely) be the other way around: different factors (not fiscal policy) may have increased growth and by doing so raised tax revenues for given tax rates and reduced spending, say for unemployment compensation or welfare, thus reducing deficits. This question has of course been at the very core of all empirical work about the effects of fiscal policy. Here we shall restrict our attention to one specific identification strategy, the "narrative" method originally proposed by Romer and Romer (1989) for monetary policy and later extended by the same authors Romer and Romer (2010) to fiscal

policy. Romer and Romer (2010) only consider tax changes in the US (both tax increases and tax cuts) motivated not by a desire to stimulate the economy, but, say, for redistributive reasons. When applied to the study of the effects of austerity, this method requires selecting changes in taxes and primary spending driven by the desire to reduce deficits or stop the growth of the debt GDP ratio, not by considerations related to the cycle. This selection is achieved by analyzing policymakers motivation for each of their fiscal actions.

The second point is that the literature has thus far evaluated the effects of fiscal policy year by year (or even quarter by quarter) studying the effects of individual shifts in taxes or spending, referring to them as "fiscal shocks". This approach, when applied to austerity, overlooks two important points. One is the multi-year nature of fiscal adjustments. Virtually all austerity programs are multi-year plans announced in advance and sometimes revised along the way: to the extent that expectations matter for consumers' and investors' planning we need to take these announcements and the multi year nature of these plans into account. The other critical point is that decisions about how much to cut spending and how much to raise taxes are interconnected and thus cannot be assumed independent of one another. Typically a legislature first decides by how much a deficit should be reduced (in the case of EU countries this target has to be agreed upon with the European Commission). Given this target, its allocation between spending cuts and tax hikes is then decided during debates in the legislature, with complicated political bargaining. The stance of monetary policy also obviously matters, including the effects of the latter on exchange rates. Moreover, austerity programs often involve not only tax hikes and spending cuts but also other policies like structural reforms Inn short, a very complicated set of interconnected forces at play.

Finally, the third point is that in order to analyze the effects of austerity you need to choose a model to measure them — that is you need to select an empirical model that maps fiscal plans into macroeconomic outcomes. This too has been the subject of a heated debate.

After having walked the reader through these three aspects of the austerity debate, we shall present our own findings, explained in more detail in Alesina et al. (2019) (AFG 2019 in what follows). There we documented close to 200 austerity plans carried out in 16 OECD economies (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Portugal, Spain, Sweden, the UK and the US) from the late 1970s until 2014. To reconstruct these plans we have consulted original documents (some produced by national authorities, some by organizations such as the OECD, the IMF or the European Commission) concerning about 3,500 individual fiscal measures. The main disaggregation is between plans

mostly based on expenditure cuts (*EB*) and plans mostly based on tax hikes (*TB*). The spending measures are further disaggregated between cuts in transfers and in other government consumption (and investment) The measures on the tax side are broken down into indirect and direct taxes. Our data are available in a form which is ready to use at http://www.igier.unibocconi.it/fiscalplans

Our results document a sharp difference between austerity plans based mostly on tax increases and plans based mostly on expenditure reductions. We find in particular:

1. a large and statistically significant difference between the effects on output of EB and TB plans. In our sample EB consolidations have been associated, on average, with a very small downturn in output growth: an EB plan worth 1 percent of GDP implies a loss of about 1/4 of a percentage point relative to the average GDP growth of the country, which lasts less than two years;

2. the range of the output responses to an EB plan includes (at the extremes, observed in 5 per cent of all episodes) moderately expansionary austerity on the one side, and austerity with a loss of one half of a percentage point in GDP growth at the other;

3. the component of private demand which mostly explains this large difference between EB and TB consolidations is private investment;

4. the effects of reductions in entitlement programs and other government transfers are different from those of tax increases. They are accompanied by mild and short lived downturns, probably because these spending cuts are perceived as more permanent and are thus more likely to lead to a lower expected tax burden. Thus the evidence suggests that transfers are more akin to government expenditure than to negative taxes ;

5. we find a large and statistically significant difference between the effects on the debt-to-GDP ratio of TB and EB plans. In a high debt and high cost of debt environment an EB plan has a stabilizing effect on the debt ratio. On the contrary, a TB plan has a de-stabilizing effect. In a low debt, low cost scenario EB plans remain stabilizing, while the effect of a TB plan becomes neutral*;*

6. whether or not fiscal consolidations, on both the tax side and the spending side, are more costly when started during an economic downturn is a difficult point to discern. The answer depends on a variety of issues regarding the measurement of the dynamic pattern of the economy before and during the

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adjustment (see Auerbach and Gorodnichenko (2012a), Auerbach and Gorodnichenko (2012b),Ramey and Zubairy (2015), Ramey and Zubairy (2017)). We find that the asymmetry between EB and TB austerity is robust to the adoption of a model that allows for different effects of fiscal adjustment in an expansion and a downturn Alesina et al. (2018).

7. finally, the recent episodes of austerity which occurred after the financial crisis, started during a recession and involved many countries at the same time, do not appear to have been significantly different from previous cases. These episodes confirm the major asymmetry in the effects of the two types of plans. Countries that after the financial crisis chose TB austerity suffered deeper recessions compared to those that decided to adopt EB plans. We do not find support, at least for the sample of countries and the period we analyze, for the result reported by Blanchard and Leigh (2014).

Much of the debate has focused on point 2., namely the possibility of expansionary austerity. There have been several cases of clearly expansionary austerity: for instance Ireland, Denmark Belgium and Sweden in the eighties, Canada in the nineties and many others (see AFG 2019 for more details). But this discussion with vitriolic criticisms on the part of those who believe without any possibility of doubts that austerity, any austerity, has to be deeply recessionary, has distracted commentators and policymakers from the most policy relevant result, namely the enormous difference, on average, between expenditure based and tax based austerity plans.

The paper is organized as follows. In the next section we review the discussion about austerity focusing on the three methodological issues highlighted above. In doing so we review how the policy debate and the academic debate have evolved over time. In section 3 we present our answers to the three methodological questions and our results. The last section concludes.

2 Measuring the effects of austerity: three issues

2.1 The endogeneity issue

The early literature on austerity "solved" the endogeneity issue by considering episodes of large reductions in the cyclically adjusted budget deficit, a measure which, supposedly, mutes the effects of the business cycle on the government balance.

Giavazzi and Pagano (1990) analyzed three cases of large fiscal consolidations that occurred in the 1980s. In two, Denmark (1983-7) and Ireland (1987-9), a large

reduction in the cyclically adjusted deficit was associated with a vigorous increase in private domestic demand. They attributed it to wealth effects on consumption: reductions in the budget deficit signal that taxes may be lower in the future, with positive effects on consumers' permanent income and thus on consumption. Later, Ardagna and Alesina (1998), studying the case of the Irish 1987-9 adjustment, emphasized the importance of investment, labor costs and net exports. They identified five more episodes of large fiscal consolidation (Belgium 1984-6, Canada 1986-8, Italy 1989-2, Portugal 1984-6 and Sweden 1983-9). These consolidations were "large" in the sense that the cyclically adjusted primary deficit two years after the consolidation was 4 percentage points of GDP smaller than before the adjustment. These episodes were accompanied by growth of private consumption, and especially of investment, in almost every year of the adjustment, sometimes with a year delay or so.

One common finding of this early literature was that deficit reductions implemented via spending cuts were much less costly than those based upon tax increases, and that the former type of adjustment sometimes was associated with an expansion of GDP, even on impact. Giavazzi et al. (2000) find that tax hikes during large contractions do not increase national savings – a result which is at odds with the basic Keynesian model which suggests that an increase in one dollar of taxes reduces private savings by less than one dollar (since some of the reduction translates into lower consumption) and results in a net increase in national savings. Lane and Perotti (2003) find that increases in government spending on goods and services raise the real wage and depress profitability in the traded sector: thus spending cuts would have the opposite effects. McDermott and Wescott (1996) show that fiscal consolidation that concentrates on the expenditure side,and especially on transfers and government wages, is more likely to succeed in reducing the public debt ratio than tax-based consolidation. [1].

Using a panel of 19 OECD countries, Perotti (1999) estimates a model that predicts expansionary adjustments in "bad times" – *i.e.* periods of high indebtedness – and contractionary adjustments in "good times". In "bad times", when debt is grwing rapidly, a tax hike that rules out an even larger tax hike in the future can induce a positive response of consumption. In this vein Alesina and Ardagna

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[1]Lambertini et al. (2005) also find that spending cuts increase the probability that an adjustment is successful. Many of the consolidation episodes they consider occurred in periods of either high debt-to-GDP ratio or after rapid debt accumulation. Giavazzi et al. (2005) find that the circumstance most likely to give rise to a non-monotonic response of national saving to a fiscal impulse is a "large and persistent impulse", defined as one in which the full employment surplus, as a percent of potential output, changes by at least 1.5 percentage points per year over a two-year period. Alesina and Perotti construct measures of cyclically adjusted budget deficts directly estimating the elasticity of taxes and expenditures to macroeconomic variables such as the unemployment rate.

(2010) study a panel of OECD countries with yearly observations from 1970 to 2007. They define a period of fiscal adjustment as a year in which the primary cyclically adjusted budget balance improves by at least 1.5% of GDP. An adjustment is defined as "expansionary" if the deviation in average GDP growth from the G-7 weighted average in the current and the two subsequent years is above the 75th percentile of the empirical distribution of the realizations of the same variable in all adjustment periods. In this way, they (roughly) control for the state of the world business cycle. Besides showing that expansionary fiscal adjustments are exclusively spending based, the authors find that the fiscal adjustments associated with higher GDP growth are those in which a larger share of the reduction in the primary deficit is accounted for by cuts in current government spending rather than in investment spending. They also show a positive reaction of private investment spending to government spending cuts.

The problem with this early literature is that the cyclically adjusted measure of the deficit likely suffers from measurement error Perotti (2012) and endogeneity. One reason is that even if the change in the Cyclically Adjusted Primary Balance (CAPB) excludes budget changes induced by automatic stabilizers, it includes discretionary changes in taxes and spending that are motivated by the state of the economy. On a different line, (Guajardo et al., 2014) note that a boom in the stock market improves the CAPB thanks to the revenue from capital gains taxation, which is also likely to raise domestic demand via wealth effects.

Recently the literature shifted to the Romer and Romer (2010) (R&R in what follows) narrative approach to identify exogenous fiscal adjustments. Economists in the research department of the IMF Devries et al. (2011) have used the R&R methodology to construct a panel of exogenous shifts in fiscal variables for 17 OECD countries over the sample 1978-2008. These data only cover episodes of fiscal consolidation, while R&R analyze both exogenous expansions, tax cuts, and contractions, tax hikes; they include however, austerity measures both on the tax and expenditure side. [2] The exogenous shift in fiscal variables whose effects are analyzed in the two

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[2]The tax measures identified by R&R.are either motivated by the aim of improving long run growth (and in this case are almost exclusively tax cuts), or "deficit driven", i.e. motivated by the aim of reducing an inherited deficit (and in this case are almost exclusively tax increase). Devries et al. (2011), instead, only consider deficit-driven measures. Note that if, consistently with the evidence reported in R&R, the macroeconomic impact of deficit-driven and long-rung growth driven measures is different, then no "truncation" problem arises in the Devries et al. (2011) data which only include "deficit driven" adjustments. The evidence of an asymmetric effect of positive and negative fiscal measures is confirmed by Barnichon and Matthes (2016b) using an innovative econometric technique Barnichon and Matthes (2016a) that allows for the effect of fiscal policy to depend on the sign of intervention.

papers is also different: Devries et al. (2011) do not consider announcements but rather add up, year by year, shifts in fiscal variables that were unanticipated – that is implemented immediately – and shifts that are implemented in the same year but that had been decided upon in previous years. R&R instead add up unanticipated and announced shifts in fiscal variables, thus assuming that economic agents react to a shift in taxes when they learn about it, whether its implementation is instantaneous or delayed. The R&R approach is appropriate in the absence of liquidity constraints, when agents respond to news affecting their life-time income. The second approach is appropriate when agents are liquidity constrained and they only responds to changes in current income. (Guajardo et al., 2014), using the Devries et al. (2011) data, find that a fiscal contraction worth 1 percent of GDP is contractionary, with a peak effect on the level of GDP of - 0.6 percent within two years. This is a more pessimistic prediction than Alesina and Ardagna (2010)'s results based on the CAPB. Like these authors, however, they find that tax-based adjustments are much more recessionary than spending-based ones.

Finally, Jordà and Taylor (2016) overlook the difference between tax-based and expenditure-based austerity and concentrate exclusively on the issue of the recessionary versus expansionary effect of fiscal consolidations to show that (using the narrative variable as an instrument for the CAPB) a fiscal contraction worth 1 percent of GDP produces a recessionary effect on GDP growth after five-years of -2.94. Allowing for different multipliers in slumps and booms they find an effect of -1.36 on GDP within five years in a boom and a much stronger effect (-3.35) in a slump. The paper, however, lumping together tax hikes and expenditure cuts, confuses the key issue of austerity plans[3]

2.2   The multi-year dimension of austerity

The literature typically evaluates the effects of fiscal policy measuringthem year by year, or quarter by quarter, and assuming that shifts in taxes and spending are uncorrelated. This approach overlooks the multi-year nature of austerity. Austerity policies rarely consist of isolated one-year shifts in this or that tax, or in this or that spending item. Instead, they typically consist of multi-year plans designed with the objective of reducing the budget deficit by a certain amount every year until a final goal is reached. The multi-year nature of a fiscal adjustment, and the announcements that come with it, are an important determinant of economic

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[3]Importantly, these authors question the validity of the narrative fiscal instrument used by (Guajardo et al., 2014) and propose an alternative econometric modelling strategy. We discuss their criticism and their proposed econometric modelling strategy in the Appendix..

behavior. In addition, the decisions about how much to cut spending and how much to raise taxes are interconnected and therefore cannot be assumed to be independent from one another and studied in isolation. For example, the latest round of austerity in Europe typically took the form of multi-year plans of deficit reduction, announced by various countries in agreement with the EU or the "Troika". In some cases these signposts were a precondition for receiving financing from the EU and IMF, as happened in Greece, Portugal and Ireland. In other cases they were the conditions needed to avoid the "excessive deficit procedure", a status that implies automatic deficit reduction targets. In these agreements the EU and the Troika did not care much about the composition of deficit reduction policies: they just cared about the bottom line in terms of multi-year deficit targets. This turned out to be a mistake. It would have been much better to ask less drastic austerity plans but to insist they would be based on spending cuts.

We used our data on exogenous shifts in fiscal variables to construct multi-year austerity plans, as follows. Consider the set of exogenous, narratively identified measures adopted in year t aimed at reducing a country's budget deficit. Let us call f the total adjustment in the primary budget deficit, that is the budget deficit net of the expenditure on interest payments on the debt. This total adjustment can be decomposed into the sum of three components

$$f_t = e_t^u + e_{t,t+1}^a + e_{t-1,t}^a.$$

The first term represents measures announced and implemented immediately, the second term represents announcements of measures to be implemented in period $t+1$ the third term represents measures which had been approved in the past, that is at $t-1$, and are implemented today. (Here the future and the past are restricted to one period but an analogous notation would apply if the horizon extended beyond one period). We call e_t^u unexpected policy changes where the suffix u stands for unexpected and e stands for the sum of spending cuts and tax increases, to be separated later. e_t^u is scaled by the GDP in year $t-1$. The plan voted by the legislature in year t (our data are yearly) may also contain measures to be adopted one year later, that is announcements of future shifts in taxes or spending – we call them $e_{t,t+1}^a$ – that is, policies announced in year t for implementation in year $t+1$. Finally we have measures that are implemented in year t after having been announced in the past: we refer to them as $e_{t-1,t}^a$, where $t-1$ is the year of the announcement and t is the year of the implementation. These measures are rescaled by the level of GDP at time $t-2$, the year before they were announced. Needless to say not all three terms have to be different from zero. We define as "unexpected" any policy which is approved by a legislature and immediately implemented. Clearly, even a measure

announced and implemented immediately could have been anticipated based upon the legislative discussions that preceded its adoption. However, until a measure is implemented, it is close to impossible to evaluate how the expectations of the public move because of these debates. We also assume that announcements of future policies are believed by economic agents. This is of course restrictive and exploring credibility of announcements empirically is a useful path for future research. Each term e, consists of increase in taxes, τ, and cuts in expenditures, g. So, for example, in the case of unexpected measures $e_t^u = \tau_t^u + g_t^u$. The same notation applies for future announcements or past announcements implemented today. Tax increases are measured by the expected revenue effect of each change in the tax code, either due to a change in tax rates or in the tax base, as a percent of GDP the year before the tax change is introduced. Ideally one would want to distinguish between the two since they may have different economic effects (see Riera-Crichton et al. (2016)) but this was unfeasible. Spending cuts are changes in expenditure relative to the level that was expected absent the change in policy, as it is standard.

We distinguish *tax-based* (*TB*) and *expenditure-based* (*EB*) plans. *EB* (TB) plans are fiscal corrections in which the dominant component is a cut in spending (raise in taxes). To compute the dominant component we add up all fiscal measures entering a plan. Importantly, these two types of plans, *tax-based* and *expenditure-based* – unlike shifts in either taxes or spending that, as we discussed, are correlated – are mutually exclusive, since a plan is either tax-based or expenditure-based. In the data very few plans are close to being half and half and our results are robust to dropping them.

Consider a specific example: the fiscal consolidation in Belgium in 1992-4. The first set of columns in Table 1 reports the total fiscal shifts, e; the remaining columns report their tax τ and spending g components; the last column describes whether the plan is *tax-based* or *expenditure-based*. In 1992 a new plan is introduced, consisting of an immediate overall reduction in the primary deficit equivalent to 1.85 percent of 1991 GDP. At the same time a further deficit reduction is announced, equivalent to 0.47 percent of GDP (announced in 1992, t, to be implemented in 1993, $t+1$). The plan is EB because the largest share of measures is on the expenditure side. One year later the announced 0.47 correction is implemented, but two additional measures are announced: a 0.52 percent one is immediately implemented, while another 0.83 percent shift is announced for implementation in 1994. When 1994 comes, the 0.83 percent measure becomes effective, and a further unexpected 0.38 percent correction is implemented. In the right-most column, each plan is labelled as either tax-based (TB) or expenditure-based (EB).

Multi year plans often change during their implementation. When a plan is

modified through the introduction of new, unexpected, measures we treat it as a new plan and its label, TB or EB, can therefore change. This explains why the label changes from EB to TB in 1993 and then back to EB in 1994. Because an original plan and the new plan that results from the introduction of new measures, are concatenated, in the new plan $e^a_{t-1,t}$ may be different from zero since it is "inherited" from the original plan, now modified. The convention of calling a "modified" plan a new plan is irrelevant for our results: we could have used the opposite convention of calling a series of modified concatenated plans a single plan.

Year	$e^u_{i,t}$	$e^a_{i,t-1,t}$	$e^a_{i,t,t+1}$	$\tau^u_{i,t}$	$\tau^a_{i,t-1,t}$	$\tau^a_{i,t,t+1}$	$g^u_{i,t}$	$g^a_{i,t-1,t}$	$g^a_{i,t,t+1}$	
1992	1.85	0	0.47	1.03	0	0.05	0.82	0	0.42	EB
1993	0.52	0.47	0.83	0.40	0.05	0.55	0.12	0.42	0.28	TB
1993	0.38	0.83	0	0	0.55	0	0.38	0.28	0	EB

TABLE 1: The multi-year plan introduced in Belgium in 1992 (% of GDP)

The next step involves estimating the effects of multiyear austerity plans on the economy.

2.3   The Empirical Model

To analyze the effects of austerity you need to choose a model to measure them — that is you need to select an empirical model that maps fiscal plans into macroeconomic outcomes.[4] Once a model is chosen, and its parameters estimated, it can be used to generate two alternative paths for the macroeconomic and policy variables: in the presence and in the absence of a shift in fiscal variables (our plans). The difference between these two paths is the "impulse response" that describes the dynamic reaction of the economy to the policy correction (the impulse).

The model used by R&R is a moving average representation of output growth in terms of the narratively identified tax changes to derive the impulse response functions that allow them to compute the tax multiplier. In practice, they estimate an OLS regression of output growth on (3-year lags) of exogenous changes in taxes. This requires the orthogonality of the included narrative adjustments to all other structural shocks in the economy. In particular: narratively identified changes in taxes should be independent of each other; narratively identified changes in taxes and in spending should be orthogonal to one another; the truncation at a 3-year horizon does not exclude variables that are correlated with the included narrative

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[4]We provide in the Appendix a technical description of alternative models that can be used to simulate the macroeconomic effects of a plan.

adjustments. Finally, lumping together unexpected shifts in fiscal variables and announcements, their regression also assumes that the response of economic agents to the two policy shifts is identical.

These assumptions have been relaxed in a number of subsequent contributions. Mertens and Ravn (2013) find that unexpected changes in taxes produce short-run effects on aggregate output that are larger than those associated with announcements. Favero and Giavazzi (2010) avoid the "truncation" problem which arises in the R&R regression by including narrative shocks in a "fiscal" VAR which also includes government expenditure, government receipts, output growth, inflation, and the average interest cost of the public debt. Dynamic models such as VARs have several advantages. First the estimated coefficients on the narratively-identified shifts in fiscal variables measure the effect on output growth of the component of such shifts that is orthogonal to lagged included variables: thus the estimated multipliers are not affected by the possible predictability of plans on the basis of lagged information included in the model. Second, including in the VAR changes in revenues and spending (as a fraction of GDP) one can track the impact of the narratively identified shifts in fiscal variables on total revenues and total spending thus checking the strength of narratively identified instruments – for instance verifying if, following a positive shift in taxes, revenues indeed increase. Finally, dynamic models allow naturally to reconstruct the response of the debt/GDP ratio to a fiscal adjustment. This can be done by appending to the fiscal VAR the dynamic identity that describes the evolution of the debt/GDP ratio.

In AFG 2019 we proceed in two steps. First, all three components of narratively identified changes in the primary deficit (e_t^u, $e_{t,t+1}^a$ and $e_{t-1,t}^a$ in the notation of the previous paragraph) are used in a fiscal VAR. Each element of the change in the primary deficit is interacted with an indicator variable, *EB* or *TB*, that defines the type of plan in which the change occured. We then use the parameters estimated in such a VAR to track the dynamic response of the economy to the introduction of a plan (generating two alternative paths for the macroeconomic and policy variables, in the presence or absence of the plan). The model can be linear or non-linear(adopting a Smooth-Transition VAR). This allows, for instance, for the dynamic response to a fiscal plan to differ depending on the regime the economy is in when the plan is introduced – for example, in expansion or recession, with high or low debt/GDP ratio, etc..

In a multiyear plan unexpected measures are typically accompanied by the announcement of future measures. This means that one cannot simulate the effect of an unexpected measure in isolation, that is assuming that it is not accompanied by any announcement. Doing so would assume that unexpected measures and announ-

cements are uncorrelated – whicha re not in our data. We solve this problem using the in-sample correlation between announcements and unexpected measures. More specifically, we estimate the parameter φ^j in the regression $e^a_{t+j} = \varphi^j \ e^u_t + v_j$ that relates (j periods ahead) announcements to unanticipated shifts in fiscal variables. Then, when simulating the effects of an unexpected measure e^u_t, we accompany this unexpected measure with an "artificial" announcement constructed using the value of φ^j estimated in the sample. Finally, how should fiscal multipliers be measured ? Ramey and Zubairy (2017) discuss several assumptions in the literature, the most common alternatives being the integral of the output response to a given fiscal adjustment (typically one per cent of GDP) as in R&R, or the integral of the output response divided by the integral of the change in fiscal variables (see Mountford and Uhlig (2009); Uhlig (2010); Fisher and Peters (2010)). The latter is based on the definition suggested by Woodford (2011) and used by Auerbach and Gorodnichenko (2012a) and has the advantage of taking into account the response of taxes and spending to the fiscal plan, as well as considering the persistence of fiscal shocks. In the Appendix we also discuss the Local Projection method proposed by Jordà (2005).which implies computing impulse responses through the estimation of a battery of single equations, each of them capturing the effect of an exogenous shift in fiscal variables at a given horizon.

3   The effects of austerity

In this section we present our results which can be found with more detail in AFG 2019. We begin by documenting the sharp difference on output growth between austerity plans mostly based on tax hikes and plans mostly based on expenditure reductions. Designing an austerity plan that does not induce a recession is a necessary condition if we want the plan to produce a reduction in the debt-to GDP ratio, or at least to stop the growth of that ratio. But this may not be sufficient, for instance if positive output growth is accompanied by a higher cost of the debt (see Corsetti et al. (2013); Auerbach and Gorodnichenko (2013); Ilzetzki et al. (2013); Born et al. (2015)). We have thus studied the effect of alternative austerity plans on the growth rate of the debt ratio directly. The next question is the effect of state of the economy: How more costly is it to embark upon austerity during a recession as opposed to a moment when the economy is growing ? (see Auerbach and Gorodnichenko (2012a,b)) And what about monetary policy: is austerity at zero lower bound more costly? (see Christiano et al. (2011); Miyamoto et al. (2016)) Was expenditure-based austerity much more costly than tax-based austerity even in Europe in 2010-14 (see Jordà and Taylor (2016))?

3.1 Tax-based vs expenditure-based austerity

Three figures summarize our key results. The first 1 shows the effect on *per capita* GDP of two types of austerity plans, one mostly based upon spending reductions (the blue line) and one mostly based on tax hikes (the red line).

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The blue and red paths describe the response of GDP to such a plan relative to the path GDP would have followed in the absence of the fiscal plan. The Figure is based on the simulation of a panel VAR for the 16 countries in our sample over the period 1978-2014.[5] The difference between the effects of expenditure based and tax based plans is striking. As the dotted lines shows, the two are statistically different from one another (confidence intervals are such that the simulated response lies within the interval with a 90 per cent probability). Tax based plans lead to deep and prolonged recessions, lasting several years. Expenditure based plans on average exhaust their very mild recessionary effect within two years after a plan is introduced. These are of course averages of many plans. In the case of EB plans the slight average recession is the results of some cases of larger recessions and some cases of expansionary austerity. In the case of TB plans some may be less recessionary than the reported average and others even more costly (see AFG 2019 for details on specific episodes) .

When we distinguish the effect of cuts in expenditure on goods, services and investment from cuts in transfers, we find that the results are broadly similar, although cuts in transfers imply even lower costs on terms of GDP growth than cuts in spending on goods and investment. This finding suggests that if one wishes to aggregate transfers with other items of the government budget, they ought to be aggregated with spending and not considered akin to negative taxes.

The component of aggregate demand which mostly drives the heterogeneity between tax based and expenditure based austerity is private investment. 2 reports the responses of private investment to fiscal plans, which illustrates an even stronger heterogeneity than that observed for output growth. Net exports, on the contrary, do not behave differently during EB and TB plans suggesting that the behavior of the exchange rate is unlikely to be a major explanation of the results.

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[5]The results reported in Figure 1-2 are obtained by estimating directly the MA representation for output growth and investment on fiscal plans, while Figure 3 is derived from a panel-VAR for taxes, government expenditure, the average cost of financing the debt, output growth and inflation, with narrative identified plans and debt determined exactly by the intertemporal government budget constraint. The reported results are robust to the specification choice. In fact, the responses of output growth to fiscal plans derived from an MA representation are virtually identical to those derived from the VAR.

PLEASE INSERT FIGURE 2 HERE

In constructing EB plans we have aggregated cuts in current and in investment spending. We would have liked to separate current government consumption from public investment but while there are a significant number of fiscal stabilization plans whose main component is a cut in government transfers, there are almost none where the main component is a cut in investment. So our empirical strategy prevents us from estimating the effects of plans mostly based on cuts in government investment. However, when aggregating cuts in government consumption and investment, the former component represents around 80 percent of the total correction. The "spending-based" plans we study thus describe austerity programs mostly based on cuts in current government spending. The effects of cuts in investment spending is obviously a very important question to ask, but remains the subject of future research.

3 shows the effects of TB and EB plans on the debt over GDP ratio in two situations: the case of a high level of debt (around 120 per cent of GDP) and relatively high cost of debt service (the 1992-1993 period), and in the case of a low level of debt (around 60 per cent of GDP) and relatively low cost of debt servicing (for example during 1992-1993 or 2010-2014). The figure reports the difference between the path of the debt ratio in the presence of austerity and the path absent austerity. In the high debt high - cost of debt scenario a (blue) expenditure based plan has a stabilizing effect on the debt dynamics while a (red) tax based plan has a destabilizing effect. In the low debt - low cost scenario the expenditure based adjustment remains stabilizing, while the effect of a tax based plan becomes neutral.

PLEASE INSERT FIGURE 3 HERE

The bottom line is that the anti-austerity argument — stating that the latter creates large recessions and is counterproductive because it does not reduce the debt over GDP ratio — applies to tax based austerity. It does not apply at all to expenditure based austerity. This distinction has been vastly overlooked in the debate proceeding and following the 2010-2014 period by both commentators, international organizations and national governments.[6]

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[6]Only the government of Ireland in presenting its austerity plan in 2010 made an explicit reference to the academic literature emphasizing the different effects of tax hikes versus spending cuts.

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3.2 Austerity during expansions and recessions

Do fiscal multipliers depend on the state of the economy? Government spending is likely to have larger expansionary effects in recessions than in expansions since, when the economy has slack, an increase in government spending is less likely to crowd out private demand, and the other way around in case of spending cuts. The slack in the labour market, larger frictions in financial markets and an increase in the number of liquidity constrained agents might also contribute to generate higher multipliers during recessions. Auerbach and Gorodnichenko (2012a,b) (AG in what follows) allow for the effects of shifts in fiscal policy to differ depending on whether they are introduced during an expansion or a recession. [7] They find very different tax and expenditure multipliers in recession and in expansion. These results hinge on the assumption that the state of the economy is constant for at least the 20 quarters over which multipliers are computed. Ramey and Zubairy (2017) note that this is a reasonable approximation for expansions, but it is not for recessions, which, in their sample, have a mean duration of only 3.3 quarters. To address this problem Ramey and Zubairy (2017) compute multipliers allowing the state of the economy to evolve throughout the simulation. [8]. Using historical quarterly U.S. data, covering large wars and deep recessions (1889-2015) they find no evidence that government spending multipliers are particularly high during high unemployment periods. Most estimates of the multiplier are between 0.3 and 0.8.[9] Alesina et al. (2018) allow for the two sources of non-linearity, the composition of fiscal plans (TB or EB) and the state of the economy when a plan is introduced, to operate simultaneously, thus avoiding the risk of attributing to one source of non-linearity — for instance to the composition of a fiscal adjustment — effects that are in fact generated by the other. Differently from AG they study only austerity programs and derive impulse responses within a Smooth Transition VAR in which the state of the economy is allowed to respond to the fiscal impulse. They find that on average expenditure-based adjustments have consistently much lower costs than tax-based ones; the costs of the former are close to zero. The dynamic response of the economy to a consolidation plan does depend

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[7]The model they use to analyze the effects of fiscal policy is the model of taxes, government spending and output by Blanchard and Perotti (2002)

[8]Batini et al. (2012) illustrate the importance of allowing the regime to evolve as a function of the fiscal impulse.

[9]Two related papers which use Canadian data Ramey and Zubairy (2015); Owyang et al. (2013) had found higher multipliers in high unemployment states. Rivisitng those findings the authors find that the difference between the US and Canadian results were probably due to the special circumstances of Canada's entry into WWII, when output responded to the news long before government spending actually rose.

on whether this is adopted in a period of economic expansion or contraction, but the quantitative significance of this source of non-linearity is very small relative to the one which depends on the type of consolidation.

3.3 Austerity at the ZLB

Ideally one would want to study how multipliers are affected not only by the cycle and the composition of a fiscal plan but also whether they occur at or close to the zero lower bound. Unfortunately, we do not have enough observations to consider all three factors together. We can ask, however, whether the asymmetries we identified can be explained by a different (more or less constrained) response of monetary policy. In order to assess the potential relevance of the monetary policy response (or lack thereof at the ZLB) in determining the asymmetries Alesina et al. (2018) perform two exercises. First, they split the data in two sub-samples: euro area countries (Austria, Belgium, France, Finland, Germany, Ireland, Italy, Portugal and Spain) from 1999 onwards and non euro-area countries (Australia, Denmark, UK, Japan, Sweden, U.S. and Canada) together with euro area countries before 1999. The common currency prevents monetary policy from responding to fiscal developments in individual member countries. However, the ECB could still respond if fiscal consolidation happened in a large enough number of euro area countries at the same time. To capture this possible common response of monetary policy in the euro area, the specification also includes year fixed effects estimated on euro countries from 1999 onwards. The results appear to be similar regardless of the response of monetary policy. The only difference is that TB consolidations started during a recession appear to be more harmful when monetary policy is constrained. The finding that the response of monetary policy appears to dampen the recessionary effects of tax-based consolidations implemented during a recession could help understand the recessionary effects of European "austerity", which was mostly tax based in the countries mostly hardly hit by recession (Italy and Portugal) and implemented within a currency union.

3.4 Austerity after the financial crisis

Were recent episodes of austerity which occurred after the financial crisis (mostly in Europe in the aftermath of the euro crisis), started during a recession and involving many countries at the same time, different from previous cases ? Blanchard and Leigh (2014) run a bivariate OLS regression on a cross section of 27 advanced economies. The dependent variable is the difference between the actual cumulated real GDP growth (year-over-year) during 2010–11 (based on the latest available data)

and the forecast prepared for the April 2010 IMF World Economic Outlook. The explanatory variable is the forecasted change, over the same period, in the general government structural fiscal balance in percent of potential GDP. They interpret the significant coefficient (- 1.09) on the regressor as evidence that fiscal multipliers generated by the fiscal adjustment in 2011 were higher than those predicted by forecasters. These results, in our opinion, should be interpreted cautiously. First, one third of the fiscal "adjustments" considered were in fact fiscal expansions rather than contractions. More importantly, since the only variable included in the regression acts as an instrument for any omitted information. AFG 2019 show that the expected fiscal adjustments are in fact correlated with the contemporaneous change in long-term interest rates: the estimated coefficient in the specification adopted by Blanchard and Leigh (2014) could thus simply measure the recessionary effect of the contemporaneous rise in the long-term interest. See Ramey (2018) for a more extensive criticism of the results in Blanchard and Leigh (2014).

AFG 2019 show that the recent episodes of austerity which occurred after the financial crisis do not appear to have been significantly different from previous cases. These episodes confirm the major asymmetry in the effects of the two types of fiscal plans. Countries that after the financial crisis chose TB austerity suffered deeper recessions compared to those that decided to adopt EB plans. Yes, recession in some countries (Greece Spain Portugal, Italy) were large but so were the size of tax hikes adopted by these countries in their plans. The effects on the economy of these plans do not look different, according to our model and given their size, from previous cases of austerity. The two countries which adopted almost exclusively expenditure cuts (Ireland and the UK) had much smaller and brief recessions, despite, in the case of Ireland, a massive banking problem. The IMF underestimated the differences between TB and EB plans and vastly overpredicted the size of the UK recession. It severely criticized its austerity plan and later apologized with the UK authorities.

3.5 What could explain these findings ?

3.5.1 Accompanying policies.

One "theory" is that the difference between TB and EB plans is simply due to a systematic difference in accompanying policies. The most obvious candidate is monetary policy. Guajardo et al. (2014) argue that the difference in tax based and expenditure based austerity is mostly due to the response of monetary policy. AFG 2019 instead show that only a very small, close to insignificant fraction of the heterogeneous effects of EB and TB adjustments is related to monetary policy.

A second and related possibility could be that the difference is explained by the

behavior of the exchange rate. Note that exchange rate movements *during* a fiscal plan are clearly endogenous to it; but a devaluation prior to the introduction of a plan may not be and thus might explain the lower output cost of EB plans. AFG 2019 show that this is not the case. On average there is no systematic difference in the behavior of the exchange rate before fiscal adjustments based upon tax increases and those based on spending cuts. The authors also excluded from their sample all episodes of fiscal consolidation that are preceded by a devaluation of at least 3% to at least 10% over the previous three years (which is approximately the 10th percentile of the distribution of the three-year cumulative change in the exchange rate in our sample): the results were unchanged. In addition if the exchange rate had been an important explanation of the difference between TB and EB plans, the difference between the two cases in terms of GDP growth, should be associated to a different behavior of net exports. This is not the case: as we have seen, the driving force is domestic private investment.

Finally, large fiscal adjustments are often periods of structural reforms which may include products and/or labor market liberalizations. The latter may stimulate growth and if they were systematically occurring at the time of spending cuts, they may explain the findings. The answer is no: these reforms do not occur systematically during periods of spending cuts. Note that this result is not inconsistent with the evidence and the case studies reported in Perotti (2012); Alesina et al. (1998); Alesina and Ardagna (2013). What these papers show is that amongst all fiscal adjustments, the least costly were those accompanied by supply side reforms and by wage moderation. Our robustness check is different: we check whether the adoption of EB and TB adjustments can be explained by supply side reforms, and we find that it cannot.

3.5.2   Confidence

With this (admittedly vague) term we identify situations in which a fiscal consolidation removes uncertainty and stimulates demand by making consumers and especially investors more optimistic about the future. Imagine a situation, for instance as described in Blanchard (1990) and Alesina and Drazen (1991), in which an economy is on an unsustainable path with an exploding public debt. Sooner or later a fiscal stabilization has to occur. The longer one waits, the higher the taxes that will need to be raised (or spending to be cut) in the future. When the stabilization occurs it removes the uncertainty about further delays which would have increased even more the costs of the stabilization. A stabilization which eliminates the uncertainty about higher fiscal costs in the future stimulates demand today — especially, we may

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add, demand from investors, who are more sensitive to uncertainty about the future given the long run nature of their plans. The beneficial effects associated with the removal of uncertainty are more likely to occur in the presence of EB rather than TB plans: if the automatic increase of spending is not addressed, taxes will have to be continually increased to cover the increase in outlays.

Alesina and Ardagna (2010) and several papers reviewed therein, present evidence on the dynamics of government budgets consistent with this interpretation: spending based adjustments lead to more long lasting debt stabilization. Alesina et al. (2019) present results on business confidence which support this view. They show that, at least in their sample of OECD countries, business confidence increases immediately at the start of an EB consolidation plan, much more so that at the beginning of a TB plan. [10]

3.5.3 Persistence and the supply of labor

The degree of persitence of changes in taxes and expenditures is very important in determing their effecst on output. Alesina et al. (2017), analyzing a general equilibrium model, show that EB plans are the least recessionary the longer lived is the reduction in government spending. Symmetrically, TB plans are more recessionary the longer lasting is the increase in the tax burden and thus in distortions. The intuition is that, when persistence increases, the demand shift due to a cut in government expenditure starts to be dominated by the supply shift due to lower labor supply. The demand effect falls faster than the supply effect, so that the government spending multiplier decreases with persistence. Symmetrically, in the case of an increase in labor taxes, the multiplier increases with persistence. To put it simply, a persistent increase in labor taxes makes the static substitution effect between labor and leisure more permanent and this increases the wage tax multiplier. To the extent that fiscal adjustments are perceived to be permanent, and are on the supply side, a standard neokeynesian model thus implies that spending cuts are less recessionary than tax hikes.

3.5.4 Network effects

Acemoglu et al. (2016) study the role of networks linking different sectors in the economy and the propagation of shocks across such networks. Supply-side shocks

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[10]Croce et al. (2012) examines the effects of corporate taxation on firms' decisions, and hence on asset prices. Shocks to government expenditure generate tax risk for firms, and the extent of this uncertainty depends on the government's financing policy and on its ability to pin down long-run tax dynamics.

propagate downstream more powerfully than upstream: downstream customers in sectors that are hit by a supply shock are affected more strongly than upstream suppliers. The converse is true for demand shocks: they propagate more powerfully upstream. The reason for this asymmetry lies in the fact that supply-side shocks change the prices faced by customer industries, while demand-side shocks have much smaller effects on prices and propagate upstream.

How are these results related to the evidence illustrated in the previous paragraph? TB plans have a strong supply-side component, while EB adjustments are one of the benchmark cases of demand-side adjustments. Because their propagation is different, the size of their final effect on output depends on different elements of the input-output matrix. EB adjustments, being mainly demand shocks, have a network effect that goes through the connection of industry i with its customers. Symmetrically, TB adjustments, being mainly supply shocks, have a network effect that goes through the connection of industry i with its suppliers. Effects of TB and EB adjustments that reproduce the asymmetry documented above are found in Briganti et al. (2018). They analyze a spatial/global VAR model in which the effect of EB and TB adjustments are the sum of a direct effect and an indirect effect driven by a sector and an adjustment specific global variable, i.e. a weighted average of added value growth in all the other sectors with weights that are specific to each sector and to the nature of the adjustment.

4   Concluding: what did we leave out?

We use this concluding section to highlight a few additional points which we did not cover. The first are the redistributive effects of austerity achieved through tax hikes or spending cuts. There is a common perception, although so far never tested, that spending cuts, differently from tax increases, have negative effects on inequality. Thus, left wing parties typically favor tax hikes and right wing parties spending cuts, although the left-right distinction is getting incraesingly murky. Being as it may, it all depends on which taxes are raised and which spending items are cut. For taxes the argument is obvious, possibly slightly less so for spending. There are really two separate questions: one is whether budget cuts of these magnitudes can be achieved without affecting the welfare of the poor; another one is whether budget cuts have been introduced with these goals in mind. Clearly the two questions are not the same. As regards the first question, the question is the following one. In OECD countries, where government spending is between 40 and close to 60 per cent of GDP, can budget cuts of say 3 to 6 percent of GDP (the order of magnitude we observe in largest austerity plans) be achieved without affecting the welfare of the

really poor? Our sense is that the answer is yes. Much of the modern welfare state supports the middle class, in some cases even the upper middle class which enjoy free health care regardless of income levels, close to free university education, subsidized services, like transportation etc. (and this overlooking the large waste observed in many countries, especially but not only in Southern Europe). In addition one needs to distinguish which kind of redistribution we are considering: within the same generation, or across generations. In the latter case reform of pension systems, which lead to savings today, lead to a more equitable distribution of resources across generations. Cuts in current versus public investment also have important redistributive consequences across generations. In addition, not pursuing any form of austerity has consequences for the debt burden of future generations. Second: what are the electoral consequences of austerity, a question addressed in Alesina et al. (2019)? The standard view amongst commentators is that deficit reduction polices are the kiss of death for the governments which implement them. In reality this is not quite the case. The electoral effects of austerity are not clear cut, they are hard to predict, and strong conclusions, one way or the other are impossible. Several governments (and not only in Germany) have been reappointed during austerity periods

Third: we did not mention Greece, since so much has been written about it (see Gourinchas et al. (2017) for one of the best analyses of the Greek tragedy.) One word however about fiscal multipliers: in Alesina et al. (2019) we show that considering the size of the austerity plans imposed on Greece, it is baffling that the Troika seemed surprised by the size of the Greek recession. In fact using the (admittedly rough) data available for Greece, when the model presented in Alesina et al. (2019) is used to simulate the effects of the Greek austerity plans it predicts the Greek recession quite well. The "surprise" of the Troika seems an attempt at deflecting responsibility.

Fourth: was austerity in Europe started too soon in 2010? Obviously it is impossible to know what would have happened otherwise, although we strongly suspect that the rosy scenario painted by the anti austerity side is way too optimistic. Our analysis however suggests a few tentative conclusions. The effects of austerity would have been much smaller if the latter had occurred only on the spending side: Ireland and the UK, which did exactly that, had much smaller and shorter recessions than Italy, Portugal and Spain where a large portion of austerity was on the tax side. Less front-loaded, but credible, spending based austerity plans would have worked better: much smaller recessions and debt stabilization. An earlier intervention by the ECB would have been a welcome help.

5   Figures

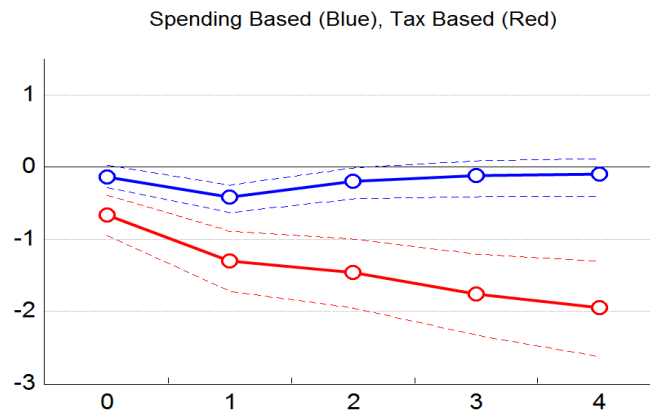Figure 1: Response of GDP to two different plans

Spending Based (Blue), Tax Based (Red)

Figure 2: Response of investment to two different plans

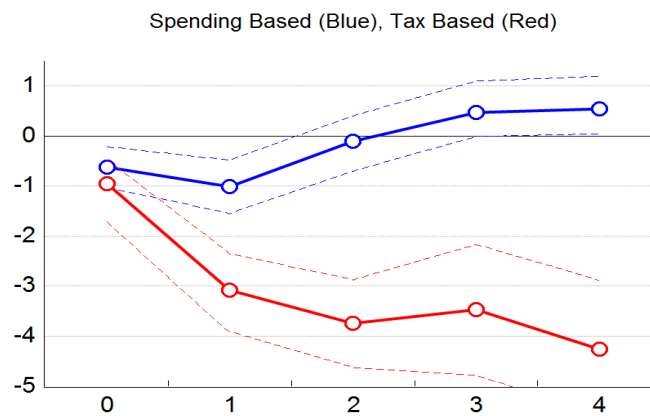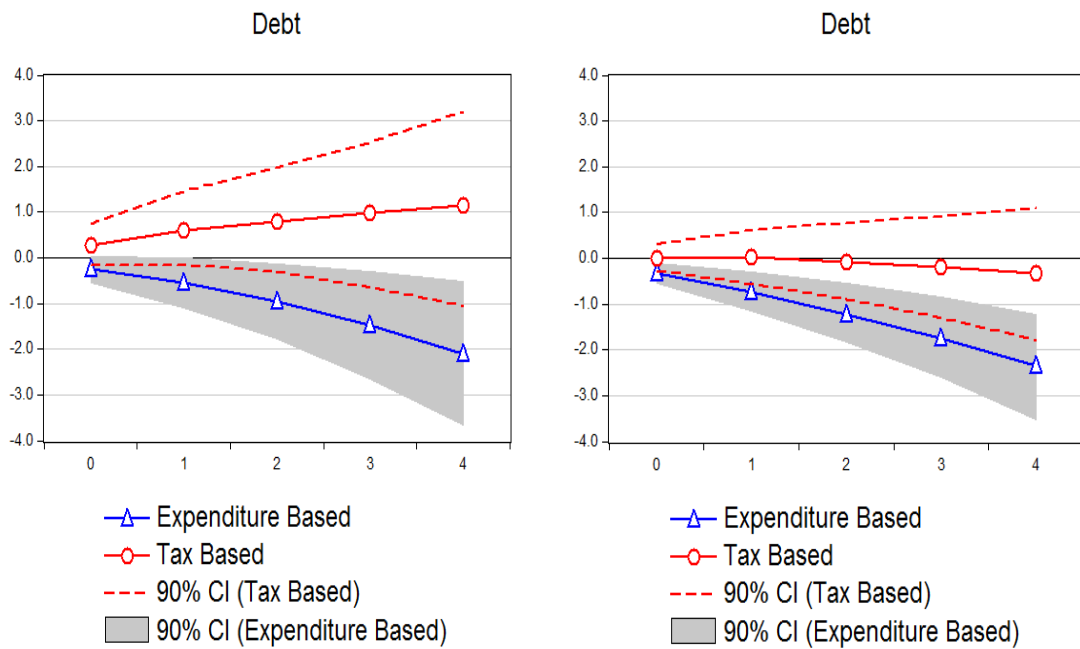**Spending Based (Blue), Tax Based (Red)**

Figure 3: Debt dynamics

High Debt (to GDP) - High Cost of Debt   Low Debt (to GDP) - Low Cost of Debt

6 Appendix: Empirical Models for Fiscal Policy Simulation

A model describes the behavior of a set of macro variables, $\mathbf{Y}_t$, as a function of their past values, $\mathbf{Y}_{t-1}$, the past values of a few policy variables $\mathbf{P}_{t-1}$ (in our case the primary surplus) and macroeconomic shocks. Similarly, the dynamics of the policy variables can be decomposed into a "rule" – which describes the response of current policy to past policy and past macroeconomic conditions – and deviations from the rule, that include our fiscal plans. Plans are constructed by considering a sequence of announced and implemented fiscal adjustments that replicate the in-sample correlation between announcements and unexpected measures. The equations that model plans allow to simulate the average adjustments observed in the data in the sense that when the effects of an unanticipated shift in some fiscal variable is simulated, announcements move consistently with what has been observed in the sample. Similarly, when we simulate an EB or a TB plan, we do not move taxes (spending) keeping spending (taxes) constant because this almost never happens in the plans. Instead we move taxes and spending according to what we have observed, on average, in the EB or TB consolidations present in our sample. Finally, the approach based on narratively identified fiscal plans deals with the "fiscal foresight" problem Leeper (2010) by simulating plans that explicitly include announcements.

$$\mathbf{Y}_t = f_1(\mathbf{Y}_{t-1}, \mathbf{P}_{t-1}, \Theta_1) + f_2(\mathbf{plan}_t, \Theta_2) + \mathbf{u}_{1t} \tag{1}$$

$$\mathbf{P}_t = f_3(\mathbf{Y}_{t-1}, \mathbf{P}_{t-1}, \Theta_3) + f_4(\mathbf{plan}_t, \Theta_4) + \mathbf{u}_{2t} \tag{2}$$

$$\mathbf{plan}_t = g\left(e_{i,t}^u, e_{i,t-1,t}^a, e_{i,t,t+1}^a, \Phi\right) + \mathbf{u}_{3t} \tag{3}$$

Once the variables to be included in $\mathbf{Y}_t$ and $\mathbf{P}_t$ are chosen (a choice that is limited by the scarcity of data), in order to use the model to run a simulation we need to decide on a functional form for the functions f_1, f_2, f_3, f_4 and to estimate the parameters $\Theta_1, \Theta_2, \Theta_3, \Theta_4$. Once the model is specified and estimated, the impact of fiscal plans on macroeconomic variables can be computed by constructing an impulse response (IR) computing the difference between two forecasts:

$$IR\left(t, s, d_i\right) = E\left(\mathbf{Y}_{i,t+s} \mid plans_t; \ I_t\right) - E\left(\mathbf{Y}_{i,t+s} \mid no\ plans_t; \ I_t\right) \quad s = 0, 1, 2, ...$$

The impact of fiscal plan is usually reported in the form of multipliers.

There are several approaches to experimenting with empirical models. Independently from the preferred choice of model, a number of conditions needs to be satisfied to have a valid simulation. First, empirical reduced form models need to

be simulated keeping all parameters constant. This is way the literature typically chooses deviation from a policy rule as the relevant policy experiment. In addition, if deviations from the policy rule occurs via plans, i.e. correlated unexpected and annouced fiscal adjustment measures, simulation with constant parameters only occurs if the relation between different measures is kept constant at its estimated pattern. Altough it is tempting to try and answer the question what is the response of the economy to some fiscal policy conducted differently from its estimated pattern within sample (for example exclusively via announced measures or via unanticipated measures while in the sample a mix of them has been always adopted), these simulations imply imposing different value than those estimated for some parameters of a reduced form model and robustness to the Lucas (1976) critique is not warranted. Deviations must satisfy three further conditions (see Ramey (2016)): *(1)* they must be exogenous for the estimation of the model parameters; *(2)* they must be uncorrelated with other structural macroeconomic shocks; *(3)* they should not mix anticipated with unanticipated shifts in policy variables. Condition *(1)* allows to identify the relevant information from the observed correlation in the data: if we can identify fiscal actions that are exogenous with respect to current fluctuations in output, then we can measure the output effect of fiscal policy analyzing the response of output to such policy actions. Condition *(2)* allows simulation of the effect of a shift in fiscal policy muting other potential sources of macroeconomic fluctuations (*i.e.* shifts in technology, or in monetary policy, or in consumers' preferences), so that their effect can be assessed by keeping all the other shocks constant. Condition *(3)* allows discrimination between the response of economic agents to changes in the information set, from their response to the implementation of fiscal measures.

The most generical specification of a model is a multivariate dynamic model for the macro and fiscal variables that could be linear (a VAR) or non-linear (a Smooth-Transition VAR), allowing for different dynamics of the economy as a function of the probability of occurring of different regimes (say expansion or recession or high debt/GDP and low debt/GDP). The general specification compensates the need of more data to pin down more parameters with several advantages. First, using a dynamic model which includes changes in revenues and spending (as a fraction of GDP) and tracks the impact of the narratively identified shifts in fiscal variables on total revenues and total spending allows to check the strength of narratively identified instruments – for instance it allows to verify if, following a positive shift in taxes, revenues indeed increase. Second, in a dynamic model the estimated coefficients on the narratively-identified shifts in fiscal variables measure the effect on output growth of the component of such adjustments that is orthogonal to lagged included variables: thus the estimated multipliers are not affected by the possible predictability of plans

on the basis of the lagged information included in the model. Third, a model allows to compute multipliers in two different ways: with respect to an initial fiscal impulse and with respect to the cumulated change in fiscal variables. The high parameterization of a general model usually requires a parsimonious parametrization in terms of variables. This does not affect the identification of the exogenous fiscal measures because these are not derived from VAR innovations but are directly observed. Our estimates of the output response to a fiscal plan, however, might also depend on the effect that plans have on variables not included in the VAR: this omission will not affect the measurement of the final effect but it prevents the identification of different transmission channels. Finally, dynamic models allow naturally to reconstruct the response of the debt/GDP ratio to fiscal adjustment. This is achieved by appending the dynamic identity that describes the evolution of the debt/GDP given the average cost of financing the debt, real growth and the ratio of primary surplus to GDP to a dynamic model that tracks overtime all determinants ot the debt/GDP ratio.

The empirical literature based on narratively identified adjustments has traditionally adopted simplified version of the full dynamic models by using a single equation approach to the computation of impulse responses. Romer and Romer (2010) have inaugurated this tradition by using the moving average representation of output in terms of the narratively identified fiscal adjustment to derive the impulse response function that describes the tax multiplier. The validity of such an approach requires the orthogonality of the included adjustments to structural shocks in the economy and the appropriate choice of the truncation of the length of the lag of policy instruments. Jordà (2005) has refined this approach to propose a Local Projection method to compute impulse responses via estimation of a series of single equations that captures the effect of exogenous adjustments on a given variable at each period after implementation of the policy. If the underlying model is linear and the structural shocks are correctly identified, then LP recovers exactly the impulse response computed from the VAR. If instead the underlying model is non linear, Local Projections can be interpreted as a linear approximation of the true model (see e.g. the applications in Auerbach and Gorodnichenko (2016); Ramey and Zubairy (2015, 2017)). The the validity of the Local Projections method requires that the exogenous adjustment variable is non persistent, which makes the application of this method practically impossible when plans are the relevant adjustment. Moreover, in the presence of non linearities — arising, for instance, because the dynamic response to a fiscal plan depends on the regime the economy is in when the plan is introduced — Local Projections do not offer a good approximation of the non-linearity described by a Smooth Transition VAR (STVAR). This is because in a STVAR impulses responses depend on the state of the economy in each period between when the im-

pulse occurs and when the response of the relevant variable is observed. Such a-non linearity cannot be replicated when the Local Projection Method is adopted. [11]

Further refinements to the econometric approach are proposed by Jordà and Taylor (2016), who question the validity of the narrative fiscal instrument used by (Guajardo et al., 2014). Building on evidence initially provided by De Cos and Moral-Benito (2016) they transform the narrative fiscal instrument into a binary "treatment" variable to show that it is predictable. Consolidation is more likely when public debt to GDP is high, when the economy is growing below potential, when growth slows down (in contrast with the common-sense timing of countercyclical policies) and when some consolidation has been introduced in the past. Predictability, however, does not per se imply the failure of exogeneity: it would do so if the (excluded) controls, that are good predictors, were correlated with output growth. Jordà and Taylor (2016) propose a statistical design based on taking "triple insurance" against the potential endogeneity. First, they take all episodes of consolidation from the IMF narrative instruments as a subset of all consolidation episodes that are a candidate for random allocation, second they add all the statistically significant predictors as covariates in the regression that measures the effect of the instruments on the macroeconomic outcome of interest, third they use inverse probability score weighting to re-randomise allocation of the IMF consolidation events (the more predictable is an event the less is the weight attributed to it in order to measure the macroeconomic outcome of fiscal consolidation). Finally they propose to measure the macroeconomic consequences of consolidations by using an IPWRA (Inverse Probability Weigthed Regression Adjusted) estimator.

The methodology adopted by Jordà and Taylor (2016) suffers, in our view, from a potentially serious problem of loss of information that occurs when the narrative adjustments are transformed into a binary treatment variable. There are two sources of identification of narrative adjustments: the timing of a fiscal correction and its size. Transforming fiscal adjustments into a 0/1 dummy completely neglects the importance of size as a source of identification. This ia a crucial shortcoming for an analysis of the effects of fiscal policy. Alesina et al. (2018) show that an the indicator variable that takes the value of 1 when an adjustment is implemented and 0 otherwise, explains a very low share of the variance of the narrative instrument, supporting the conjecture that the main source of identification is the size of the adjustment, not its timing. In addition, the evidence that the timing of narrative adjustments can be predicted does not imply that the fiscal correction itself is predictable because, as we have seen, its size cannot be predicted. In other words, fiscal policy is different

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[11]Batini et al. (2012) clearly illustrate the importance of allowing the regime to evolve as function of the fiscal impulse.

from a medical treatment in which a group of patients are given the same dose of a medicine and a control group no medicine. How much medicine is given matters a lot.The evidence that the timing of narrative adjustments can be predicted does not imply that the fiscal correction itself is predictable if its size cannot be predicted.

6.1 Empirical Models for Fiscal Policy Simulation: an example

To illustrate the practical implementation of model specification we give a detailed representation of the model used to derive the dynamic response of the debt/GDP ratio to fiscal adjustment plans. The dynamics of the debt ratio, d, for country i is

$$
\begin{aligned}
d_{it} &= \frac{1 + i_{it}}{(1 + x_{it})} d_{it-1} + g_{i,t} - \tau_{i,t} + u_{6,i,t} \\
x_{it} &\equiv \Delta p_{it} + \Delta y_{it} + \Delta p_{it} \Delta y_{it}
\end{aligned}
$$

where i_{it} is the nominal average net cost of financing the debt , x_{it} nominal output growth, Δp_{it} is GDP inflation, $\tau_{i,t}$ is tax revenue as a fraction of GDP, and $g_{i,t}$ is primary government spending, also as a fraction of GDP. $u_{6,i,t}$ is a stock-flow adjustment, namely a term that tracks the difference between the actual change in the debt ratio and the change associated with the three variables in the foregoing equation. The need for stock-flow adjustment arises, for example, in the presence of revenue from sales or purchases of financial and nonfinancial assets; revaluations, in the case the debt is valued at market prices; debt write-offs, and so forth, all items that do not enter the definition of the primary surplus $(g_{i,t} - \tau_{i,t})$. To track the effect on the debt ratio of austerity plans the model must be specified so that $\mathbf{Y}_t = (\Delta y_{i,t}, \Delta p_{i,t}, i_{it}, d_{it})$, $\mathbf{P}_t = (\Delta g_{i,t}, \Delta \tau_{i,t})$. We therefore adopt the following specification

$$
\mathbf{z}_{i,t} = \begin{bmatrix} \Delta y_{i,t} \\ \Delta p_{i,t} \\ i_{i,t} \\ \Delta g_{i,t} \\ \Delta \tau_{i,t} \end{bmatrix}, \mathbf{e}_{i,t} = \begin{bmatrix} e_{i,t}^{u} \\ e_{i,t-j,t}^{a} \\ e_{i,t,t+j}^{a} \end{bmatrix}, \mathbf{a}_i = \begin{bmatrix} a_{1,i} \\ a_{2,i} \\ a_{3,i} \end{bmatrix} \quad similarly \quad for \quad \mathbf{b}_i
$$

$$\Delta y_{i,t} = A_1\left(L\right)\mathbf{z}_{i,t-1} + \begin{bmatrix} \mathbf{a}_1'\mathbf{e}_{i,t} & \mathbf{b}_1'\mathbf{e}_{i,t} \end{bmatrix} \begin{bmatrix} TB_{i,t} \\ EB_{i,t} \end{bmatrix} + \lambda_{1,i} + \chi_{1,t} + u_{1,i,t}$$

$$\Delta p_{i,t} = A_2\left(L\right)\mathbf{z}_{i,t-1} + \begin{bmatrix} \mathbf{a}_2'\mathbf{e}_{i,t} & \mathbf{b}_2'\mathbf{e}_{i,t} \end{bmatrix} \begin{bmatrix} TB_{i,t} \\ EB_{i,t} \end{bmatrix} + \lambda_{2,i} + \chi_{2,t} + u_{2,i,t}$$

$$i_{it} = A_1\left(L\right)\mathbf{z}_{i,t-1} + \begin{bmatrix} \mathbf{a}_3'\mathbf{e}_{i,t} & \mathbf{b}_3'\mathbf{e}_{i,t} \end{bmatrix} \begin{bmatrix} TB_{i,t} \\ EB_{i,t} \end{bmatrix} + \lambda_{3,i} + \chi_{3,t} + u_{3,i,t}$$

$$\Delta g_{i,t} = A_2\left(L\right)\mathbf{z}_{i,t-1} + \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} \end{bmatrix} \begin{bmatrix} g_{i,t}^u \\ g_{i,t-1,t}^a \\ \tau_{i,t}^u \\ \tau_{i,t-1,t}^a \end{bmatrix} + \lambda_{4,i} + \chi_{4,t} + u_{4,i,t}$$

$$\Delta \tau_{i,t} = A_3\left(L\right)\mathbf{z}_{i,t-1} + \begin{bmatrix} \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} \end{bmatrix} \begin{bmatrix} g_{i,t}^u \\ g_{i,t-1,t}^a \\ \tau_{i,t}^u \\ \tau_{i,t-1,t}^a \end{bmatrix} + \lambda_{5,i} + \chi_{5,t} + u_{5,i,t}$$

$$d_{it} = \frac{1+i_{it}}{(1+x_{it})}d_{it-1} + g_{i,t} - \tau_{i,t} + u_{6,i,t}$$

$$x_{it} \equiv \Delta p_{it} + \Delta y_{it} + \Delta p_{it}\Delta y_{it}$$

To be able to recover the effect of adjustment plans on the fiscal and macroeconomic variables, the empirical model for $\mathbf{Y}_t$ and $\mathbf{P}_t$ must be accompanied by a set of equations describing the response of announcements to contemporaneous corrections and the relative weights of tax and spending measures within a plan. We allow both correlations to be different according to the type of plan, *TB versus EB*. In other words, we allow for plans to have a different intertemporal and intratemporal structure according to their type. The following equations complete the model forthe simulation of fiscal adjustment plans:

$$\tau_{i,t}^u = \delta_0^{TB}e_{i,t}^u * TB_{i,t} + \delta_0^{EB}e_{i,t}^u * EB_{i,t} + \epsilon_{0,i,t} \tag{4}$$
$$g_{i,t}^u = \vartheta_0^{TB}e_{i,t}^u * TB_{i,t} + \vartheta_0^{EB}e_{i,t}^u * EB_{i,t} + \upsilon_{0,i,t}$$
$$\tau_{i,t,t+j}^a = \delta_j^{TB}e_{i,t}^u * TB_{i,t} + \delta_j^{EB}e_{i,t}^u * EB_{i,t} + \epsilon_{j,i,t} \quad j = 1,2$$
$$g_{i,t,t+j}^a = \vartheta_j^{TB}e_{i,t}^u * TB_{i,t} + \vartheta_j^{EB}e_{i,t}^u * EB_{i,t} + \upsilon_{j,i,t} \quad j = 1,2$$

where the first two equations describe the average tax (δ) and spending (ϑ) share of *EB* and *TB* plans. The next two equations describe the relation between unexpected shifts and those announced for years $t+1$ and $t+2$, differentiating between EB and TB plans. (These auxiliary regressions allow us to construct the

$e^a_{i,t,t+j} = \tau^a_{i,t,t+j} + g^a_{i,t,t+j}$ needed to compute impulse responses). The coefficients in the equations describing the dynamic evolution of the plans are allowed to vary across the type of plan. This is to capture the fact that, TB plans tend to be front-loaded relative to EB plans because cutting expenditures takes longer than raising taxes. The model is non linear and therefore impulse response will depend on initial conditions, this is the reason why in the text we report different impulse response according to different levels of the initial level of debt and of the initial cost of debt servicing.

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