DISCUSSION PAPER SERIES

DP14072

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INTERNATIONAL MACROECONOMICS AND FINANCE

ISSN 0265-8003

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Discussion Paper DP14072
Published 22 October 2019
Submitted 21 October 2019

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www.cepr.org

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Abstract

This paper studies the impact of multi-year fiscal consolidation plans on public debt dynamics. Studying the dynamic impact of narratively identified fiscal adjustment plans we find that tax based adjustments result in significant slowdowns of output and inflation but have almost no effect on the debt GDP ratio over a short to medium-term horizon. Spending cuts have instead milder recessionary effects, but contribute to a sustained reduction in the debt GDP ratio. Extending our model to study non-linearities in the dynamics related to the business-cycle and the public debt to GDP ratio, we find that the heterogeneous impact of tax-based and expenditure-based plans on debt mainly emerges mostly in recessions and when debt is increasing rapidly.

JEL Classification: E60, E62

Keywords: austerity, public debt, output growth, fiscal adjustment plans

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Austerity and Public Debt Dynamics

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This paper studies the impact of multi-year fiscal consolidation plans on public debt dynamics. Studying the dynamic impact of narratively identified fiscal adjustment plans we find that tax based adjustments result in significant slowdowns of output and inflation but have almost no effect on the debt GDP ratio over a short to medium-term horizon. Spending cuts have instead milder recessionary effects, but contribute to a sustained reduction in the debt GDP ratio. Extending our model to study non-linearities in the dynamics related to the business-cycle and the public debt to GDP ratio, we find that the heterogeneous impact of tax-based and expenditure-based plans on debt mainly emerges mostly in recessions and when debt is increasing rapidly.

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1 Introduction

This paper investigates the dynamic response of the debt to GDP ratio to tax-based and expenditure based fiscal adjustment plans. There is by now a robust body of evidence in the empirical literature showing that tax multipliers are significantly larger

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than expenditure multipliers (Ramey (2018)). Alesina et al. (2019) show that tax-based fiscal adjustment plans are more recessionary than expenditure-based fiscal adjustment plans. There is also evidence that output multipliers are less positive or even negative when debt is high (Corsetti et al. (2012), Auerbach and Gorodnichenko (2012a), Ilzetzki et al. (2013)). However, a crucial criterion to assess the success of a stabilization plan is the dynamics of the debt to GDP ratio, which is only partially determined by the GDP dynamics. While the stabilization of the dynamics of the debt to GDP is just one of the criteria that can be used to evaluate the success of a stabilization plan, it is becoming increasingly relevant from an institutional point of view. Since November 2011, with the implementation of the so-called "six-pack" reform, an Excessive Deficit Procedure by the European Commission can also be based on the breach of the Maastricht debt criterion, which requires countries with general government debt to GDP ratios above 60 percent to reduce the level to this threshold at a satisfactory pace. Of a total of 48 EDPs opened in the period 2009-2015 only one has been so far a debt-based EDP, Malta in June 2013 (Górnicka et al. (2018)), but in 2018 and 2019 an important interaction between the Commission and the Italian Government took place on the possibility of opening a debt-based EDP for Italy. Alternative criteria of success can be derived by looking at the financial market responses to austerity considering fluctuations of default premia as measured by difference in sovereign yields vis-à-vis a riskless reference country issuing in the same currency with virtually zero probability of sovereign default (Born et al. (2015)). The impact of austerity on the health of government finance is different from the financial markets response to austerity measures. Fluctuations in yields to maturity are important to measure the financial markets reactions to fiscal plans but the impact of adjustment plans on the debt to GDP ratio depends on the cost of financing the debt (which adjusts slowly to fluctuations in yields with the speed of adjustment being determined by the debt duration), and on the dynamics of the primary surplus and the GDP. The study of alternative measures of success should be seen as complementary.

Fiscal research in the ten years since the financial crisis has reached the consensus that average spending multipliers lie in the range of 0.6 to 0.8 while tax change multipliers are much larger, ranging form 2 to 3 (Ramey (2018)). Is this asymmetry also reflected in the debt to GDP dynamics generated by fiscal adjustment plans? Our answer to this question is based on the database on fiscal adjustment plans made available by Alesina et al. (2019) consisting of around 170 multi-year fiscal consolidation plans in 16 OECD economies between 1978 and 2014. Fiscal plans, first introduced by Alesina et al. (2015), consist of announcements of a sequence of fiscal corrections on government spending and revenues, some to be implemented at the time of the legislation (unanticipated), and some in the following years (announced). Plans allow to control for the evidence that fiscal shocks are generally not isolated, but consist of multi-year programs of spending and taxes corrections. Plans are classified in two types, depending on the main component of the adjustment. If the size of the spending cuts is larger than that of tax hikes, a plan is labelled as expenditure-based (EB). In the opposite case, the plan is tax-based (TB). Following the method introduced by Romer and Romer (2010) for the U.S. and then extended by Leigh et al. (2011) for 17 OECD economies, the fiscal corrections are narratively identified as exogenous with respect to the state of the cycle: their adoption was motivated by an inherited budget deficit. We interpret these fiscal adjustment plans as multi-year deviations from the systematic dynamic path of government expenditures and receipts. Yared (2018) has documented a steady rise in the past four decades in debt levels in many countries (and in particular in the US). Normative macroeconomics can explain countercyclical deficits but not a broad based long-run trend in debt accumulation. Political economy theories can explain the trend as due to irresponsible governments who are shortsighted and promote immediate goals at the expense of long-term ones pushed by aging populations, political polarization and electoral uncertainty.

What is the effect on the debt to GDP ratio of tax-based and expenditure-based adjustments? A first cursory look at the data shows that the possibility of a similar heterogeneity in the response of debt to the one observed in the response of growth to different fiscal adjustment plans is worth investigating. When we look at the dataset of narratively identified fiscal consolidation plans, a clear trend emerges: countries that adopted larger and more frequent expenditure-based adjustment plans were successful at keeping their public debt under control; in countries where instead tax-based adjustments were the main fiscal policy instrument, debt has increased steadily despite the adoption of adjustment plans.

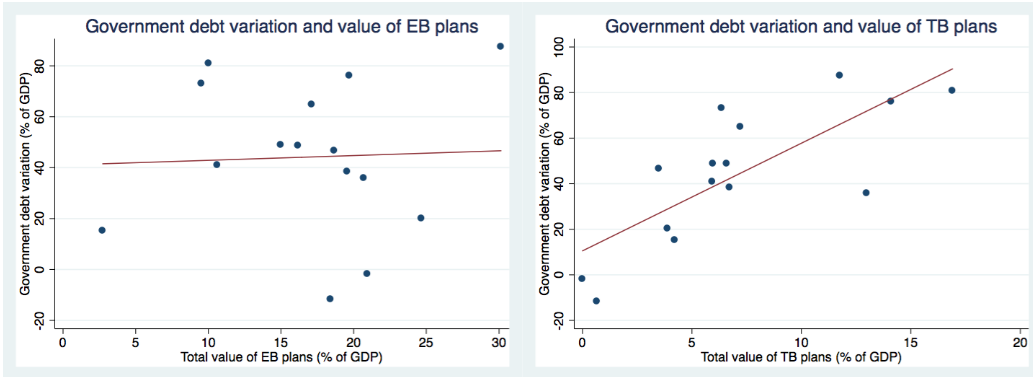


Figure 1: Public debt variation and total value of EB and TB corrections for 15 OECD countries in our sample between 1978 and 2014

Figure 1 shows the variation in the government debt ratio between the end and the start of our sample (1978-2014) for 15 of the 16 OECD economies in our sample (we omitted Japan as this case constitutes a clear outlier) plotted against the total value of EB and TB measures. Each dot represents a country. The two graphs illustrate that larger TB adjustments were associated with sharper debt increases, while this is not the case for EB plans. This paper provides further empirical insight into this issue by measuring the effect of fiscal adjustment plans on the debt dynamics by estimating and simulating a dynamic model. As our plans are narratively selected as being motivated by past debt dynamics and not by the state of the cycle, some care is needed in the implementation of our empirical analysis. To this end in the dynamic model adopted no parameters are estimated in an equation projecting the debt dynamics on fiscal adjustment plans. The model is built by augmenting the government inter temporal budget constraint, taken as an identity (up to an exogenous stock-flow adjustment term) with a dynamic system for real output growth, inflation, the net interest expenses on debt, government receipts and government expenditure (net of interest payments). This specification features a linear dynamics for the relevant macroeconomic variables and a non-linear dynamics for the the debt to GDP ratio, but no parameters are estimated in the equation describing the government inter temporal budget constraint. We compute the responses of debt to GDP to tax-based and expenditure-based fiscal adjustment plans using model simulation under a baseline specification with no adjustment scenario and an alternative simulation where either a tax-based adjustment or an expenditure-based adjustment is implemented. By the nature of the model, the impulse responses of the debt to GDP ratio are function of initial conditions (given the non-linearity in the debt to GDP dynamics) and therefore we also assess whether fiscal corrections have heterogeneous effects depending on the level of public debt and on the cost of financing it when the consolidation starts. We find that the public debt to GDP ratio declines after an EB correction compared to a baseline scenario without fiscal adjustment. In the case of TB corrections, the debt ratio is not reduced and can even increase depending on the starting conditions. This is explained by the fact that while the fiscal correction reduces the primary deficit (or increases the surplus), the large fall in output associated with TB plans more than counteracts it. This pattern is even more evident in a low interest rates environment. TB measures implemented to drive downwards the path of the debt to GDP ratio are therefore self-defeating: they are recessionary and do not lead to a reduction in the debt ratio compared to a scenario without correction. We assess the robustness of our results to the expansion of the dynamic model to take into account state-dependencies in the estimated parameters that determine the dynamics of the relevant macro variables. Considering a smooth-transition VAR à la Auerbach-Gorodnichenko, we show that the observed heterogeneity of TB and EB measures on debt emerges mainly during recessions and when debt was increasing fast before the consolidation. Finally we perform within-sample counterfactual simulations and present a case-study, namely the consolidations implemented by Ireland and Spain during the Eurozone crisis. We compare actual time series for the endogenous variables in the VAR and for debt with simulated ones that are obtained adopting a counterfactual fiscal adjustment policy. While such counterfactual exercises should be interpreted with caution, they give an idea of the size and importance of the heterogenous insights of EB and TB plans obtained from the computation of impulse responses.

Our work is related to a number of studies available in the literature. McDermott and Wescott (1996) - focusing on a sample of industrial economies in the 1970-1995 period - find that spending-based consolidations are more likely to succeed in reducing the public debt ratio than tax-based ones. Lambertini et al. (2005) find similar results. The self-defeating effect of consolidations based on revenues increases is also obtained more recently in Attinasi and Metelli (2016). Boussard et al. (2012) and Castro et al. (2015) theoretically discuss the conditions under which fiscal consolidations can raise debt ratios. The latter paper, using PESSOA - a medium-scale DSGE model for a small euro-area economy with non-Ricardian agents, nominal and real rigidities, and financial frictions -, shows that the decline in real GDP growth and inflation can outweigh the consolidation efforts and lead to an increase in the debt ratio. A high initial level of public debt exacerbates this effect. Compared to this literature, our paper features two main novelties. Firstly, it concentrates on the effects of multi-year fiscal adjustment plans. Secondly, the non-linear extensions of our model identify the macroeconomic conditions under which the observed heterogeneous effects of tax and spending measures on debt emerge.

The paper is structured as follows. Section 2 presents the macroeconomic data used, and focuses on the construction of the government debt series and of the measures of total government spending and revenues. In section 3 the baseline empirical model is presented and the identification, estimation and simulation strategies are discussed. In section 4 impulse responses of debt - and of the other variables in the dynamic model - are reported: we analyze TB and EB measures, allowing for different initial conditions. Section 5 deals with non-linearities in the model dynamics associated with the business cycle and the debt. In section 6 we present the counterfactual simulations that concentrate on a case-study during the Eurozone crisis. Section 7 concludes.

2 Data

The macroeconomic and public finance data used in this paper - with a few exceptions clarified in the dataset documentation [1] - are from the OECD Economic Outlook n.97 and 101. Macrodata are complemented by the narratively identified fiscal corrections derived and extensively discussed in Alesina et al. (2015), and Alesina et al. (2019). This dataset covers about 170 austerity plans legislated between the late 1970s and 2014 in 16 OECD economies - Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Japan, Ireland, Italy, Portugal, Spain, Sweden, the UK and the US. This dataset extends the work of Devries et al. (2011) and analyzes approximately 3,500 single fiscal measures. The single fiscal measures are then organized into plans so that in each year t and country i the total planned fiscal consolidation $f_{i,t}$ is equal to the sum of announced and immediately implemented measures $e^u_{i,t}$, announced measures to be implemented j years later $e^a_{i,t,t+j}$, and measures implemented but announced j years before $e^a_{i,t-j,t}$ (in other terms, $f_{i,t} = e^u_{i,t} + e^a_{i,t,t+j} + e^a_{i,t-j,t}$). Each component - for instance the unexpected one $e^u_{i,t}$ - is the sum of tax and spending measures, $\tau^u_{i,t}$ and $g^u_{i,t}$. Plan components are inter-temporally and intra-temporally correlated. The inter-temporal

[1] Data and documentation are available at www.igier.unibocconi.it/fiscalplans

correlation depends on the the multi-year nature of the adjustment. The intra-temporal correlation is a consequence of the fact that governments typically decide the total size of the adjustment first and then its composition in terms of increased revenues or reduced expenditure. Plans were constructed consulting original documents of national central banks, Ministries of Finance and Treasury departments, and international organization such as the OECD, the IMF and the European Commission. A plan is labelled TB if the largest component of the total fiscal correction, (obtained by adding up all components and measured as a fraction of GDP the year before the budget law is introduced) is an increase in taxes; similarly, EB plans are those where expenditure cuts are the largest component of the fiscal correction Table 1 shows the number of expenditure-based (EB) and tax-based (TB) plans in each of the 16 OECD countries over the sample period.

	TB	EB		TB	EB
AUS	3	4	FRA	3	7
AUT	1	3	GBR	4	6
BEL	4	11	IRL	6	8
CAN	3	16	ITA	6	12
DEU	3	6	JPN	3	5
DNK	3	5	PRT	4	7
ESP	8	7	SWE	0	5
FIN	2	7	USA	4	4
Total TB:	57		Total EB:	113	

Table 1: Fiscal consolidation plans between 1978 and 2014 in our sample

The EB plans in our sample - beyond being more numerous than TB ones - are slightly longer (2.88 years of average length instead of 2.51) and larger in size (1.94% of average total size instead of 1.60%). These differences are not relevant for the empirical results, provided that past macroeconomic conditions do not predict the adoption of one or the other type of plan. The hypothesis of plan type predictability is tested and rejected in Alesina et al. (2015).

Until very recently, data on government debt to GDP ratios were not available from a single source for our entire sample. The recently published IMF Global Debt Database fills this gap by providing the annual series for general government debt to GDP ratios. For a few observations (Australia between 1978 and 1988, Ireland in 1978, and Spain in 1978 and 1979) we integrated the missing data from the IMF Global Debt Database with data from the IMF Historical Public Debt Database and from national sources. We also verified the consistency with the OECD Economic Outlooks, which provide data on general government debt ratios starting in 1995. As discussed in Bloch and Fall (2015) and Dembiermont et al. (2015), due to differences in statistical approaches, government debt estimates for a given country can vary substantially, also for advanced economies. In the past, these factors have complicated the attempts to carry out cross-country comparisons of debt dynamics.

A remark about the aggregates for government spending and revenues used in this paper is needed. In order to track the evolution of public debt over time, the variable for spending should be the OECD measure of total general government disbursements, while for revenues that should be the OECD measure of total general government receipts. Total disbursements according to the OECD definition[2] include final government consumption expenditures, property income paid, social security benefits paid, other current outlays, fixed capital formation, capital transfers paid and government consumption of fixed capital. Our measure for government spending includes all such variables, with the exclusion of capital transfers paid and the government consumption of fixed capital. Differently from Alesina et al. (2018), in order to follow the OECD definition of total disbursements and properly track the debt, for final government consumption expenditure and for government fixed capital formation in this paper we use the appropriation account series instead of the volume series. Moving to the revenues side, total general government receipts according to the OECD include direct taxes on households and business, taxes on production and imports, social security contributions received, other current receipts, property income received and capital tax and transfers receipts. Our measure for revenues only excludes capital tax and transfers receipts. The reason for excluding these few (and small in size) components of total spending and revenues is motivated by the fact that the fiscal shocks identified via the narrative method do not affect such components.

The exclusion of the spending and revenues components mentioned above contributes to a small mismatch between the evolution of public debt as implied by the debt identity and its actual realizations in a given period. Beyond these three variables, the mismatch is also due to the stock-flow adjustments (henceforth, SFA). SFA, following Eurostat definitions, explain the difference between the change in government debt and

[2] OECD Economic Outlook n.102: Database Inventory

the government deficit or surplus in a given year. They can be distinguished into the following constituent elements: net acquisition of financial assets, debt adjustment effects and statistical discrepancies. Weber (2012) studies data on 163 countries between 1980 and 2010, and investigates the underlying determinants of SFA. An interesting finding of this paper is that in advanced economies with above average fiscal transparency (measured by the Report on Observance of Standards and Codes transparency index) SFA contribute to less than 30 percent of the total debt variation over the sample period. Changes in the primary deficit and in the interest-growth differential account for the remaining 70 percent. Most of the countries in our sample belongs indeed to this category. When simulating within sample the dynamics of debt using its identity, we generate for each country a series of augmented-SFA as the difference between actual debt and its computed value. The augmented-SFA contains SFA, capital transfers paid and government consumption of fixed capital, as well as capital tax and transfers receipts. For the economies in our sample, this can be assumed to follow an exogenous process that therefore does not affect the computation of impulse responses by simulation of our dynamic model.

3 Empirical model

To study the impact of a fiscal adjustment on the dynamics of the debt to GDP ratio, we specify a dynamic model that comes in three parts: a dynamic system for all the macroeconomic variables that enter the government inter temporal budget constraints, the government inter temporal budget constraint, that is specified as a (non-linear) identity determining the debt to GDP ratio, and a system of equations to model fiscal plans, i.e. the *intra-* and *inter-temporal* correlations between unanticipated, announced and implemented fiscal measures.

3.1 Macroeconomic dynamics

A 5-equation dynamic model is needed to capture the dynamics of the five variables that enter the debt identity: per-capita output growth, government revenues and spending, the GDP deflator and government net interest expenses. The following specification is adopted:

$$
z_{i,t} = \begin{bmatrix} \Delta y_{i,t} \\ \Delta g_{i,t} \\ \Delta \tau_{i,t} \\ \Delta p_{i,t} \\ r_{i,t} \end{bmatrix} \quad a_i = \begin{bmatrix} a_{1,i} \\ a_{2,i} \\ a_{3,i} \end{bmatrix} \; similarly\ for\ b_i
$$

$$
\Delta y_{i,t} = A_1(L) z_{i,t-1} + \begin{bmatrix} a_1^{'} & b_1^{'} \end{bmatrix} \begin{bmatrix} g^u_{i,t} \\ g^a_{i,t-1,t} \\ g^a_{t,t+1} \\ \tau^u_{i,t} \\ \tau^a_{i,t-1,t} \\ \tau^a_{t,t+1} \end{bmatrix} \lambda_{1,i} + \chi_{1,t} + u_{1,i,t}
$$

$$
\Delta p_{i,t} = A_2(L) z_{i,t-1} + \begin{bmatrix} a_2^{'} & b_2^{'} \end{bmatrix} \begin{bmatrix} g^u_{i,t} \\ g^a_{i,t-1,t} \\ g^a_{t,t+1} \\ \tau^u_{i,t} \\ \tau^a_{i,t-1,t} \\ \tau^a_{t,t+1} \end{bmatrix} + \lambda_{2,i} + \chi_{2,t} + u_{2,i,t}
$$

$$
\Delta g_{i,t} = A_3(L) z_{i,t-1} + \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} \end{bmatrix} \begin{bmatrix} g^u_{i,t} \\ g^a_{i,t-1,t} \\ \tau^u_{i,t} \\ \tau^a_{i,t-1,t} \end{bmatrix} + \lambda_{3,i} + \chi_{3,t} + u_{3,i,t} \qquad (1)
$$

$$
\Delta \tau_{i,t} = A_4(L) z_{i,t-1} + \begin{bmatrix} \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} \end{bmatrix} \begin{bmatrix} g^u_{i,t} \\ g^a_{i,t-1,t} \\ \tau^u_{i,t} \\ \tau^a_{i,t-1,t} \end{bmatrix} + \lambda_{4,i} + \chi_{4,t} + u_{4,i,t}
$$

$$
r_{i,t} = A_5(L) z_{i,t-1} + \lambda_{5,i} + \chi_{5,t} + u_{5,i,t}
$$

where Δy is real per-capita output growth, while Δg, $\Delta \tau$, Δp and r, are respectively the first differences of government spending and revenues, inflation as implied by the GDP deflator, and government net interest expenditures as a percentage of GDP. The narratively identified fiscal corrections for country i in year t are decomposed into their three components: unanticipated ($\tau^u_{i,t}$,$g^u_{i,t}$), implemented but previously announced ($\tau^a_{i,t-1,t}$, $g^a_{i,t-1,t}$), and announced for the future at various horizons ($\tau^a_{t,t+j}$,$g^a_{t,t+j}$). We also include country λ_i and time χ_t fixed-effects in each equation.

All components of fiscal adjustments enter in the specification for the macroeconomic variables. In the equations for $\Delta g_{i,t}$ and $\Delta\tau_{i,t}$ we include only fiscal shifts implemented in period t, either unexpected or previously announced: future announced corrections do not directly affect the dynamics of revenues and expenditures as their effect is not recorded in national accounts until they are implemented. Announced fiscal variables impact only on the dynamics of macro variables, output and inflation, while government expenditure and receipts respond directly only to implementation. Net interests do not respond directly to fiscal adjustments but only through the effect on the other four variables. This choice is consistent with the evidence that, while yields on government bonds at different maturities do respond immediately to announced and implemented adjustments, net interest expenses are slowly moving variable, as they are driven by the cost of financing the existing stock and the impact of the cost of financing the newly issued bonds is limited unless the average duration of the government debt is very short.

3.2 Debt to GDP dynamics

The dynamics of the debt ratio for country i is determined in each period t by the inter temporal government budget constraint:

$$d_{i,t} = \frac{1}{(1+x_{i,t})(1+\Delta p_{i,t})} d_{i,t-1} + (g_{i,t} - \tau_{i,t}) + r_{i,t} + ASFA_{i,t} \qquad (2)$$

where $x_{i,t}$ is the real output growth (obtained by adding to $y_{i,t}$ the exogenous population growth rate), while the other variables are the levels of the variables included in the VAR. $ASFA_{i,t}$ is the augmented stock-flow adjustment. As explained above, the need for stock-flow adjustment arises, for example, in the presence of revenue from sales or purchases of financial and non-financial assets, revaluations (in the case the debt is valued at market prices), and debt write-offs. These are all items which do not enter the definition of the primary surplus ($g_{i,t} - \tau_{i,t}$). The augmented version of SFA also contains the spending and revenues components unaffected by fiscal corrections that we did not include in neither $g_{i,t}$ nor $\tau_{i,t}$.

3.3 Fiscal plans

As in Alesina et al. (2015), and in Alesina et al. (2018), we simulate the response of the economy to multi-year plans rather than shocks. To the extent that expectations matter for the planning of consumers and investors, the multi-year nature of fiscal adjustments, and of the announcements that come with it, has to be modeled. To do so, we have to take into account the fact that fiscal plans have both an *intra-temporal* and an *inter-temporal* dimension: the first refers to the correlation between shifts in taxes, $\tau^u_{i,t}$, and government spending, $g^u_{i,t}$, in a given year, and the second is related to the correlation between current unexpected shifts, $e^u_{i,t}$, and announcements of future shifts in taxes and spending, $\tau^a_{i,t,t+j}$ and $g^a_{i,t,t+j}$. The subscripts j indicate to how many years ahead the announcements refers. Thus, we complete the model above with a set of equations describing the correlation between contemporaneous fiscal shifts and announcements, and modeling the share of tax and spending measures within EB and TB plans. We allow inter-temporal and intra-temporal correlations to be different according to the type of plan, TB or EB. Plans are specified as follows:

$$\tau^u_{i,t} = \delta_0^{TB} e^u_{i,t} * TB_{i,t} + \delta_0^{EB} e^u_{i,t} * EB_{i,t} + \epsilon_{0,i,t} \tag{3}$$

$$g^u_{i,t} = (1 - \delta_0^{TB}) e^u_{i,t} * TB_{i,t} + (1 - \delta_0^{EB}) e^u_{i,t} * EB_{i,t} - \epsilon_{0,i,t} \tag{4}$$

$$\tau^a_{i,t,j} = \delta_j^{TB} e^u_{i,t} * TB_{i,t} + \delta_j^{EB} e^u_{i,t} * EB_{i,t} + \epsilon_{j,i,t} \; j = 1, 2 \tag{5}$$

$$g^a_{i,t,j} = \vartheta_j^{TB} e^u_{i,t} * TB_{i,t} + \vartheta_j^{EB} e^u_{i,t} * EB_{i,t} + \upsilon_{j,i,t} \; j = 1, 2 \tag{6}$$

The estimated parameters in this system allow to track the relative contribution of tax and spending measures to EB and TB plans and to reconstruct in simulation the response of announced and implemented components of taxation and expenditure to TB and EB adjustment plans.

Separating plans in expenditure-based and tax-based is our proposed solution to an identification problem that needs to be solved to simulate the dynamic response of macroeconomic variables to adjustments in taxation and expenditure.

3.4 Our specification and identification strategy: a discussion

Our identification strategy hinges on separating fiscal adjustment plans into EB and TB ones. Adjustments in taxation and expenditure are contemporaneously and intertemporally correlated. Simulating a correction in each of the two components by keeping the other unaltered would contradict the correlation in the data, which led to the estimation of the relevant parameters in the dynamic model. A possible solution to this problem would be to try and extract two orthogonal tax and expenditure adjustments from the data. Organizing the data in TB and EB adjustments is an alternative solution as EB and TB plans are mutually exclusive and simulating the effect of an EB plan by keeping the TB plan at zero (and vice versa) not only matches exactly the correlation in the data but it also allows to have full control on the nature of the simulated adjustment plan. Table 2 shows the composition of TB and EB plans in our sample, specifying the share of the main component - respectively tax hikes $\tau_{i,t}$ and spending cuts $g_{i,t}$. Less than 10% of the cases feature a marginal classification of the main component, for instance cases when a plan is TB but the tax share of the correction is between 51 and 55 percent.

	Share of Main Component			
Type of Plan	≥ 0.75	< 0.75	< 0.65	< 0.55
TB (57 plans)	30	27	19	9
EB (113 plans)	55	58	33	7
Total Plans: 170				

Table 2: The composition of TB and EB plans

The narrative identification of the exogenous (with respect to output) fiscal adjustment plans an their components allows to include unexpected, currently implemented after being announced in the past, and future announced fiscal shifts, allowing them to have heterogenous effects on our variables. Whether agents respond only to the implementation of policies or also to their announcement has been a key issue in the fiscal policy literature. Mertens and Ravn (2012) study the different effects of anticipated and unanticipated U.S. tax policy shocks. Our specification also allows the data to speak on the relative size and significance of the different component.

Identifying these structural adjustments from innovations in the VAR describing the macro dynamics would not be possible for the "fiscal foresight" problem. As pointed out by Lippi and Reichlin (1994), Leeper et al. (2008) and Leeper (2010), the misalignment between the information set available to economic agents (who anticipate the fiscal adjustment) and the one recoverable from the VAR would result in distorted inferences about the effects of fiscal policy changes. A non fundamentalness problem arises and structural shocks in fiscal variables cannot be constructed through the inversion of the MA representation of the VAR (see also, Beaudry and Portier (2014) and Caggiano et al. (2015)). Including fiscal plans in a dynamic model for the drivers of the government inter temporal budget constraints has several advantages. First, the estimated multipliers are not affected by the possible predictability of plans on the basis of lagged information included in the model. Second, by including in the VAR changes in revenues and spending, one can track the impact of the narratively identified shifts in fiscal variables on total revenues and spending, thus checking the strength of the fiscal instruments.

Finally, we include in the simulated model the inter temporal budget constraint as in Favero and Giavazzi (2012). This allows to recover the debt response to plans without estimating any parameter in the equation that determines the debt dynamics. Importantly the government inter temporal budget constraint is non-linear and therefore the debt responses to fiscal adjustments becomes function of the initial conditions and different debt responses can be tracked for different initial conditions in all determinants to the debt dynamics. In our empirical work we shall concentrate on initial conditions on the level of the debt to GDP ratio and the net interest expenses. Deriving the non-linear responses of the debt to fiscal adjustment plans would be very difficult using alternative approaches, such as the local projection (LP) method by Jordà (2005). In principle LP allows to compute impulse response via the estimation of a series of single equations that captures the effect of exogenous adjustments on a given variable in each period after the implementation of the policy. However, in our specification the dynamics of one of the variables (the debt to GDP ratio) is a (non-linear) function of the dynamics of the other variables in the system. As a consequence exact impulse responses do depend on initial conditions and this feature is lost when the LP method is adopted (and indeed this is the very reason while the method is called an approximation method).

4 Empirical Results

4.1 Estimation

Our specification for fiscal plans allows us to assess the average intra-temporal and intertemporal composition of plans via the set of estimated coefficients reported in the Table 3. Consistently with the descriptive evidence reported in Table 2, the average composition of a TB plan is such that 78 per cent of the adjustment is made via increasing revenues and 22 per cent is made via reducing expenditure, while the average composition of an EB plan features a 60 per cent correction on the expenditure side and a 40 per cent correction on the revenue side. In both cases the 50/50 case lies outside the 95 per cent confidence interval on the composition of the identified plan.

Table 3: Estimated coefficients in the equations for plans

δ_0^{TB}	δ_1^{TB}	δ_2^{TB}	δ_0^{EB}	δ_1^{EB}	δ_2^{EB}
0.7823	0.1552	0.0170	0.3918	−0.0415	0.0072
(0.0175)	(0.0278)	(0.0099)	(0.0104)	(0.0165)	(0.0059)

$1-\delta_0^{TB}$	ϑ_1^{TB}	ϑ_2^{TB}	$1-\delta_0^{EB}$	ϑ_1^{EB}	ϑ_2^{EB}
0.2177	0.1290	0.0305	0.6082	0.1590	0.0364
(0.0175)	(0.0315)	(0.0152)	(0.0104)	(0.0187)	(0.0091)

4.2 Simulations and impulse responses

The five equation in the system, as well as the auxiliary regressions, are estimated simultaneously, and impulse responses are derived using the Koop et al. (1996) generalized method. The impulse responses for our macroeconomic variables in the vector z are therefore given by:

$$I(\mathbf{z}_t, \eta, \delta, I_{t-1}) = E(\mathbf{z}_{t+\eta} \mid e_t = \delta, I_{t-1}) - E(\mathbf{z}_{t+\eta} \mid e_t = 0, I_{t-1}) \tag{7}$$

Once initial conditions I_{t-1} are set, impulse responses for the five endogenous variables z_t in the dynamic model are computed at each time horizon η as the difference between the path of the variable in a scenario without fiscal correction (i.e. having set the vector $e_t = 0$) and a scenario in presence of an EB or TB plan (i.e. $e_t = \delta$). Confidence intervals are computed using bootstrap simulations with block-resampling of the residuals from the system, so that the correlation of residuals across equation is preserved. The structure of the fiscal correction - in terms of the burden between immediately implemented and announced measures - is modeled using the system of equations described in Section 3. The debt identity allows in each period to endogenously determine the debt ratio as function of the variables in the dynamic model. The impulse response for debt is also obtained as the difference between its evolution with and without fiscal correction. Two remarks concerning the debt identity are needed. First, while the debt identity requires real output growth $x_{i,t}$, the dynamic model determines only the evolution of per-capita real output growth $y_{i,t}$. Since our system does not endogenously determine the rate of population growth $n_{i,t}$, we assume n_i to remain constant for each country i through the simulation horizon. This seems a reasonable assumption given the countries and years included in our sample. Second, the augmented-SFA term $ASFA_{i,t}$, feature the same dynamics in the baseline and alternative simulation and it does not affect the impulse responses. We report in Figure 2 the impulse-responses with 90 percent confidence intervals for the five variables in the dynamic model.These responses are independent form initial conditions as the dynamics for all these variables is linear in coefficients.

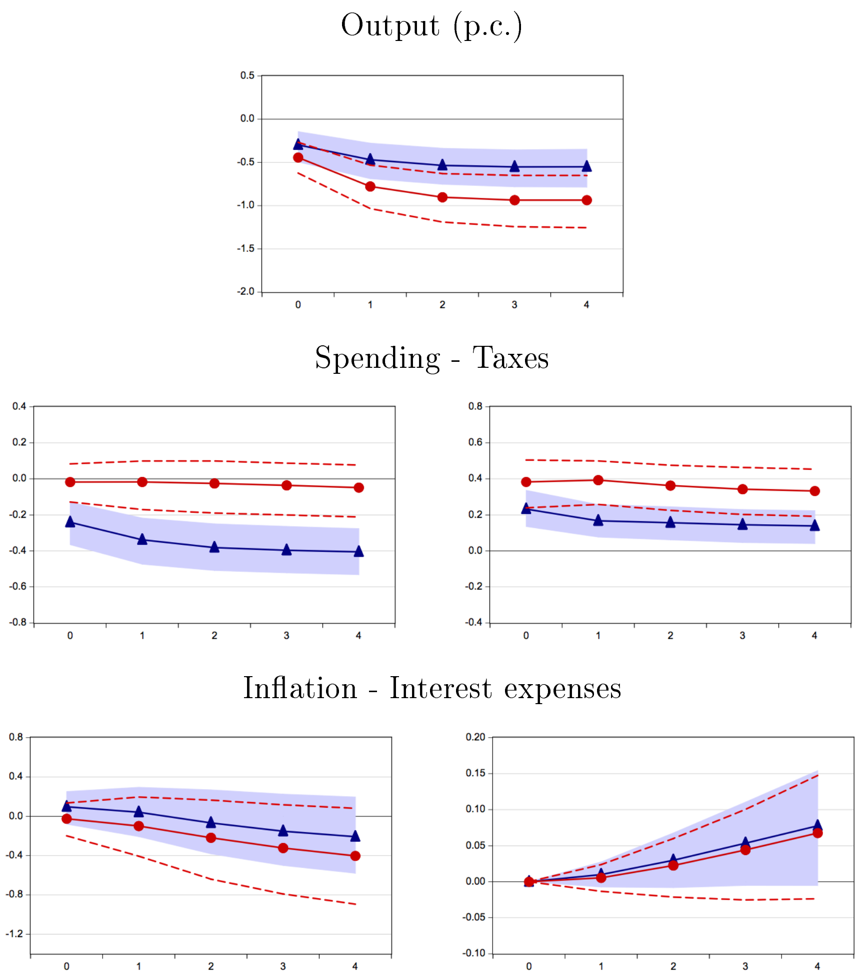


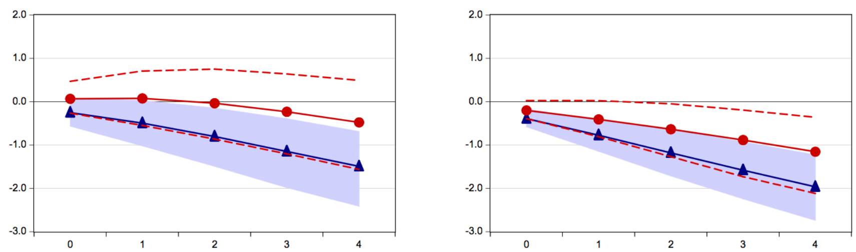
Figure 2: Baseline model: responses to an overall 1 percent fiscal correction

The available emprical evidence of an asymmetric response of growth to EB and TB adjustments, as in Alesina et al. (2018), is confirmed. Expenditure is virtually unaltered by TB plans, while EB plans feature an impact 0.4 percent reduction of goverment expenditure. Conversely, government receipts are more strongly affected by TB plans than by EB plans. The lagged response of the cost of debt to both type of plans is similar, small and positive (six basis points on average), although marginally significant. The responses of inflation are negative and small, not significantly different form zero.

Figure 3 reports the five-year impulse responses for the debt ratio which, differently from the responses of the other five variables, does depend on initial conditions. The figure reports the response of debt to four possible combinations of initial debt ratio and cost of debt, we consider the four scenarios determined by high (120 per cent) and low

(60 per cent) levels of government debt, and high (those prevailing in 1992-1993) and low (those prevailing in 2013-2014) costs of debt servicing. The figure shows that EB corrections tend to significantly reduce the debt-to-GDP ratio compared to a scenario without adjustment, whereas TB ones have generally no stabilizing effect on debt. In particular, five years after the introduction of an overall 1 percent EB adjustment, the debt ratio is approximately 2 percent lower than in a scenario without adjustment, regardless of the initial conditions. TB plans are mildly more effective at reducing debt only in low debt countries in a high interest rates environment.

High cost of debt
High debt country - Low debt country



Low cost of debt
High debt country - Low debt country

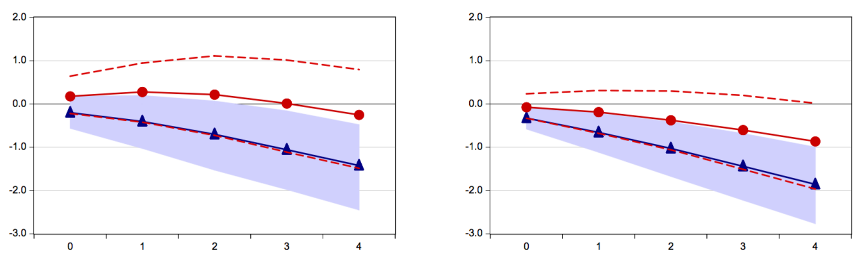


Figure 3: Government debt to GDP ratio responses to an overall 1 percent fiscal correction

The combination of a negative significant impact on growth and on inflation, a small adverse effect on the cost of servicing the debt and of a non-significant impact on the debt dynamics delivers the inability of TB plans to stabilize the debt to GDP ratio. The DSGE model of Castro et al. (2015) delivers similar results. In the EB adjustment case, instead, the milder slowdown in output and inflation, and the small increase in the cost of debt servicing, do not compensate the change in the deficit due to the cut in government spending. Therefore, EB corrections can be costly in terms of output losses but lead to a gradual fall in the debt ratio compared to a baseline without adjustment, while TB measures are self-defeating: they slowdown the economy and do not lead to sustained public debt reductions. This result is starker in a low interest rates environment.

As the response of debt seems significantly affected by GDP dynamics (and in turn by inflation), we take a closer look at the output multipliers. Table 4 below presents the fiscal multipliers of an EB and TB permanent fiscal plan of one percent of GDP computed from the 5-equation model we used so far. Multipliers are derived following two definitions: we show a cumulated multiplier and a multiplier defined as the sum of the output response over the simulation horizon, divided by the sum of the primary surplus response computed as $(\Delta\tau - \Delta g)$. The latter is based on the definition suggested by Woodford (2011) and used by Auerbach and Gorodnichenko (2012a). This 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. Note that since our simulated plans contain both spending and tax measures — and both expenditure and receipts react to EB an TB plans — what we compute here is a *primary surplus* multiplier.

Table 4: Output multipliers (under this specification, identical across countries and unaffected by the year when the simulation starts)

	$\sum_{t=0}^{4} \Delta y_t$	$\frac{\sum_{t=0}^{4} \Delta y_t}{\sum_{t=0}^{4} (\Delta\tau_t - \Delta g_t)}$
EB	-0.55	-1.02
	$(-0.78; -0.34)$	$(-1.43; -0.68)$
TB	-0.93	-2.47
	$(-1.25; -0.65)$	$(-3.69; -1.65)$

Note. The table reports the cumulated and cumulated as fraction of cumulated primary surplus multipliers obtained from the 5-equation VAR model. 90 percent bootstrapped (1000 repetitions) confidence intervals for the first column and one standard deviation for the second in parentheses.

Regardless of the definition, the multipliers of EB plans are significantly lower (in absolute value) than those of TB plans. Interestingly, the size of the multipliers in both cases is very similar to the one derived by Alesina et al. (2018) using a 3-equation system without inflation and net interest expenses on the outstanding debt.

5 Non-linearities: output and debt dynamics

The results obtained in the previous section are insightful but tell little about the macroeconomic circumstances under which the observed heterogeneity of debt responses to TB and EB consolidations emerge. To assess the state-dependence of our findings, we thus extend the baseline model to capture not only the different composition of plans, but also two sources of non-linearity: one related to the business cycle and one to the public debt dynamics before the consolidation is launched. This more flexible specification allows to study how debt responds to TB and EB corrections of the same size but legislated in different macroeconomic scenarios. This is one of the main novelties of this paper compared to previous works. The behavior of government bond spreads ahead of the consolidation could be another potentially interesting non-linearity to study. However, episodes of consolidations implemented in response to financial markets pressures and sudden stops are still few and concentrated during the Eurozone crisis. Similar considerations apply to consolidations implemented at the ZLB.

We leverage on the previous literature studying the state-dependence of fiscal multipliers to model our two non-linearities. Similarly to Auerbach and Gorodnichenko (2012a), we use a smooth-transition function to capture whether at each point in time a country is in a recessionary state or not, or if its public debt is increasing rapidly. However, following Ramey and Zubairy (2017), and Alesina et al. (2018), we allow the indicator for the state of the economy or for the debt dynamics to change during the multi-year consolidations. This is consistent with evidence that after consolidations are launched the position in the business cycle as well as the debt ratio can vary markedly. To this end, our state indicators depends only on the lagged values of GDP growth and of the debt change. This choice has obviously costs: assuming that the state indicator depends only on lagged - and not also on contemporaneous - GDP and debt changes implies that we rule out instances where the state is affected on impact by the fiscal correction. We refer to Alesina et al. (2018) for a more comprehensive cost-benefit analysis of this choice.

Each non-linearity is analyzed individually, but with a common technique. Using a logistic function $F(s_{i,t})$, we transform the distributions of the standardized two-year lagged moving averages of output and debt growth ($\Delta y_{i,t}$ and $\Delta d_{i,t}$ respectively) into a variable ranging from 0 to 1. This specification makes the transition between states of the economy smooth, with $F(s_{i,t})$ being the weight given to recessions or cases of increasing debt, and $(1 - F(s_{i,t}))$ the weight given to expansions or cases of decreasing debt. Formally, in the case of the output non-linearity, we define $F(s_{i,t})$ as follows:

$$F(s_{i,t}) = \frac{exp(-\gamma_i s_{i,t})}{1 + exp(-\gamma_i s_{i,t})}, \quad \gamma_i > 0 \tag{8}$$

$$s_{i,t} = \frac{\mu_{i,t} - \mathbb{E}(\mu_{i,t})}{\sigma(\mu_{i,t})} \tag{9}$$

$$\mu_{i,t} = \frac{\Delta y_{i,t-1} + \Delta y_{i,t-2}}{2} \tag{10}$$

where $\mu_{i,t}$ is the two-year lagged moving average — and $s_{i,t}$ its standardized version — of output growth during the previous two years and γ_i are the country-specific parameters of the logistic function. We define an economy to be in recession if $F(s_{i,t}) > 0.8$, and the parameters γ_i are then calibrated to match actual recession probabilities in the countries in our sample.

An analogous procedures is used when constructing the transition function for debt, with a few obvious differences. In this case, changes in growth $\Delta y_{i,t}$ are replaced with changes in the debt ratio $\Delta d_{i,t}$, and the parameters γ_i are calibrated to match instances in which the two-year lagged moving average of debt was larger than 5 percent. This threshold is approximately equal to an annual change in debt between one and two standard deviations larger than the average observed in our sample. This choice is also in line with previous works in the debt literature, such as Perotti (1999) and Giavazzi et al. (2000). In robustness analysis, we find that the results are not affected when calibrating γ_i at different thresholds around 5 percent.

The baseline model presented in section 4 is extended to have two states (recession and expansion for the output non-linearity, increasing and decreasing debt ratio for the debt non-linearity), and the usual non-linearity associated with the composition of a fiscal plan (TB or EB). The model thus becomes:

$$z_{i,t} = \begin{bmatrix} \Delta y_{i,t} \\ \Delta g_{i,t} \\ \Delta \tau_{i,t} \\ \Delta p_{i,t} \\ r_{i,t} \end{bmatrix} \quad \tau_{i,t} = \begin{bmatrix} \tau^u_{i,t} \\ \tau^a_{i,t-j,t} \\ \tau^a_{i,t,t+j} \end{bmatrix} \quad g_{i,t} = \begin{bmatrix} g^u_{i,t} \\ g^a_{i,t-j,t} \\ g^a_{i,t,t+j} \end{bmatrix} \quad a_i = \begin{bmatrix} a_{1,i} \\ a_{2,i} \\ a_{3,i} \end{bmatrix} \; similarly\ for\ b_i, c_i, d_i$$

$$\Delta y_{i,t} = \begin{bmatrix} 1 - F(s_{i,t}) \\ F(s_{i,t}) \end{bmatrix}' \begin{bmatrix} A^a_1 \\ A^b_1 \end{bmatrix} z_{i,t-1} + \begin{bmatrix} 1 - F(s_{i,t}) \\ F(s_{i,t}) \end{bmatrix}' \begin{bmatrix} a'_1 g_{i,t} & b'_1 \tau_{i,t} \\ c'_1 g_{i,t} & d'_1 \tau_{i,t} \end{bmatrix} + \lambda_{1,i} + \chi_{1,t} + u_{1,i,t}$$

$$\Delta g_{i,t} = \begin{bmatrix} 1 - F(s_{i,t}) \\ F(s_{i,t}) \end{bmatrix}' \begin{bmatrix} A^a_2 \\ A^b_2 \end{bmatrix} z_{i,t-1} + \begin{bmatrix} 1 - F(s_{i,t}) \\ F(s_{i,t}) \end{bmatrix}' \beta_1 \begin{bmatrix} g^u_{i,t} \\ g^a_{i,t-1,t} \\ \tau^u_{i,t} \\ \tau^a_{i,t-1,t} \end{bmatrix} + \lambda_{2,i} + \chi_{2,t} + u_{2,i,t}$$

$$\Delta \tau_{i,t} = \begin{bmatrix} 1 - F(s_{i,t}) \\ F(s_{i,t}) \end{bmatrix}' \begin{bmatrix} A^a_3 \\ A^b_3 \end{bmatrix} z_{i,t-1} + \begin{bmatrix} 1 - F(s_{i,t}) \\ F(s_{i,t}) \end{bmatrix}' \beta_2 \begin{bmatrix} g^u_{i,t} \\ g^a_{i,t-1,t} \\ \tau^u_{i,t} \\ \tau^a_{i,t-1,t} \end{bmatrix} + \lambda_{3,i} + \chi_{3,t} + u_{3,i,t} \quad (11)$$

$$\Delta p_{i,t} = \begin{bmatrix} 1 - F(s_{i,t}) \\ F(s_{i,t}) \end{bmatrix}' \begin{bmatrix} A^a_4 \\ A^b_4 \end{bmatrix} z_{i,t-1} + \begin{bmatrix} 1 - F(s_{i,t}) \\ F(s_{i,t}) \end{bmatrix}' \begin{bmatrix} a'_2 g_{i,t} & b'_2 \tau_{i,t} \\ c'_2 g_{i,t} & d'_2 \tau_{i,t} \end{bmatrix} + \lambda_{4,i} + \chi_{4,t} + u_{4,i,t}$$

$$r_{i,t} = \begin{bmatrix} 1 - F(s_{i,t}) \\ F(s_{i,t}) \end{bmatrix}' \begin{bmatrix} A^a_5 \\ A^b_5 \end{bmatrix} z_{i,t-1} + \lambda_{5,i} + \chi_{5,t} + u_{5,i,t}$$

Estimation and simulation procedures remain analogous to those presented in section 4, including the debt identity and the use of auxiliary regressions. However, this specification allows to investigate the responses depending on the different initial conditions when the plan is introduced. In section 4 the model can in fact be simulated from different initial conditions, but its specification constrains the estimated coefficients to be equal across different states.

5.1 Business cycle non-linearity

A lively literature has debated theoretically and empirically whether fiscal multipliers might differ along the business cycle. The DSGE models in Cogan et al. (2010), Christiano et al. (2011) and Coenen et al. (2012) show that multipliers might indeed be larger during a recession. Little agreement emerged thus far from empirical works. While Auerbach and Gorodnichenko (2012b,a) find different spending multipliers in recession and expansion, Ramey and Zubairy (2017), using quarterly U.S. data covering large wars and deep recessions between 1889 and 2015, find no evidence for this heterogeneity. Using the same dataset of narratively-identified fiscal corrections of this paper, Alesina et al. (2018) find no difference in the output effects of corrections legislated during recessions. These contrasting results are also a consequence of the different modeling choice of the state indicator, as discussed in the previous section.

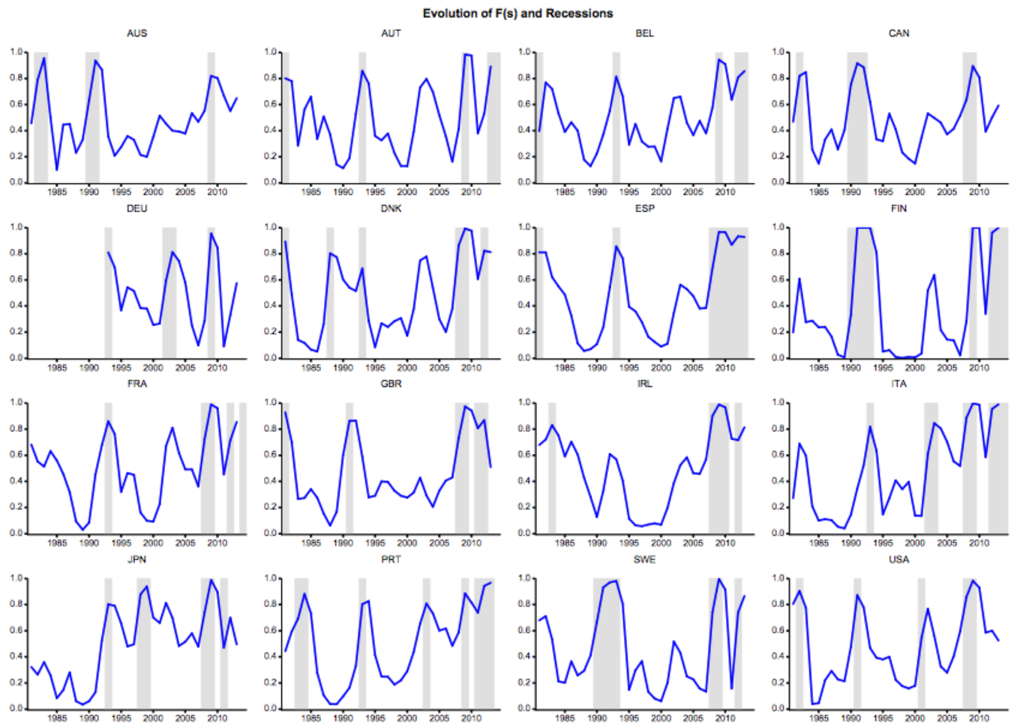


Figure 4: Evolution of $F(s)$ in the sample

In this paper, we take a different perspective. What we focus on is whether the impact of TB an EB plans on the debt ratio changes along the business cycle. This does not necessarily follows from the fact the output responds similarly in recessions and expansions. Inflation and the cost of debt might react differently in the two cases, due for instance to confidence effects or to the maturity structure of debt. This would in turn affect the response of the debt ratio.

Figure 4 shows the calibrated $F(s)$ functions within our sample, along with shaded areas corresponding to recessions in each country. When setting the initial conditions for the computation of impulse responses, a recessionary state is identified with the state indicator $F(s_{i,t}) \cong 0.8$. For expansions, we consider $F(s_{i,t}) \cong 0.2$. These starting values are in line with both Auerbach and Gorodnichenko (2012a) and Alesina et al. (2018). Our dataset of fiscal consolidation plans features more instances of corrections legislated when $F(s_{i,t}) \geq 0.8$ - i.e. in recessions - than when $F(s_{i,t}) \leq 0.2$ - i.e. during strong expansions. In particular, while only around 10% of EB measures and 5% of TB ones were adopted in the latter case, approximately 40% of EB and TB plans were legislated in the former. This is not an issue for the correct identification of the shocks in the model and the computation of impulse responses, but might result in an over-estimation of the negative output effects of the consolidations.

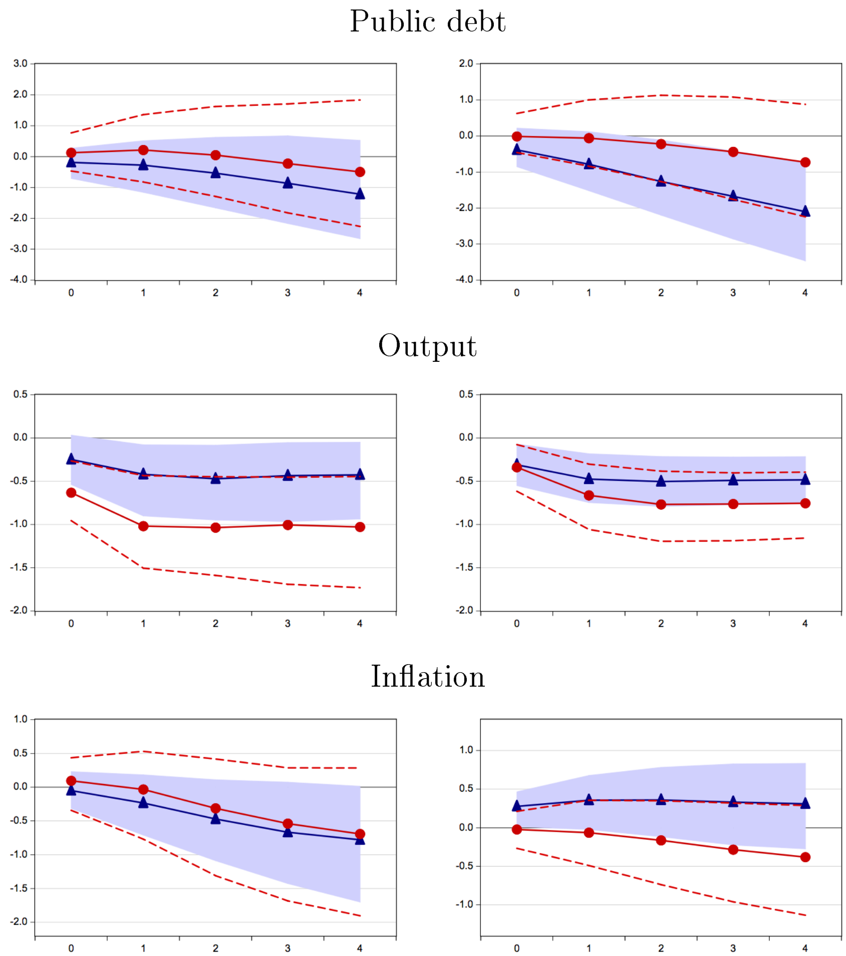


Figure 5: Impulse responses in expansion (left) and recession (right) in a highly indebted country

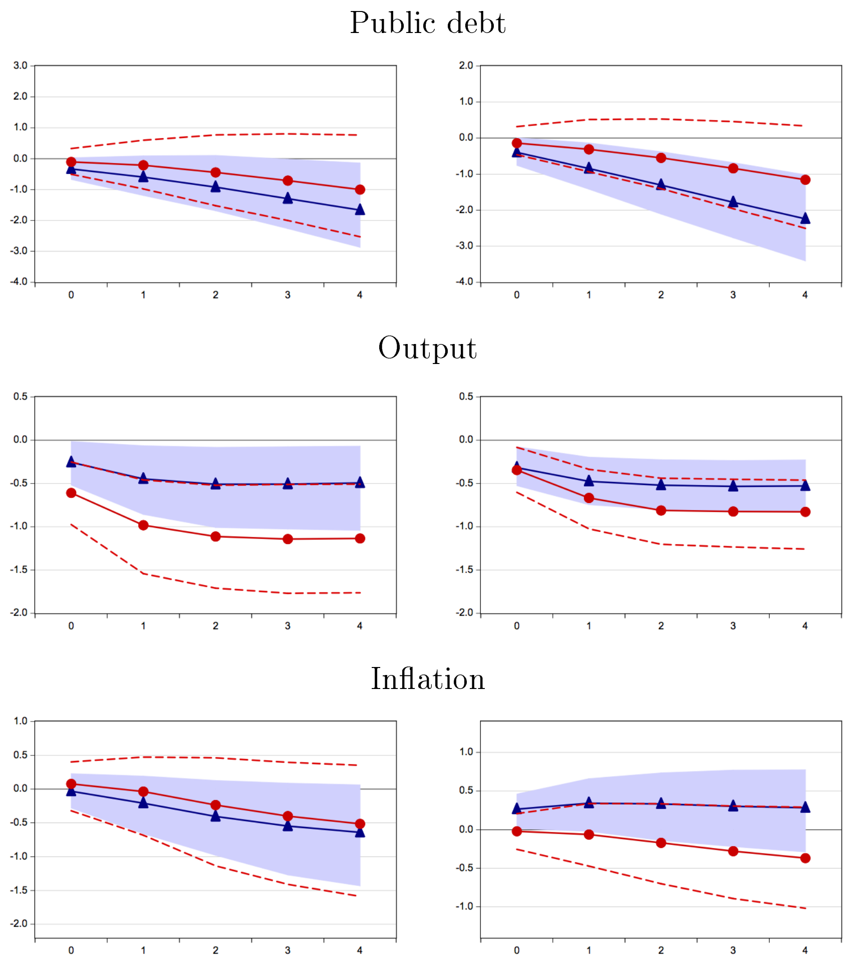


Figure 6: Impulse responses in expansion (left) and recession (right) in a moderately indebted country

Figures 5 reports the impulse response of the debt ratio, output and inflation when the consolidation is respectively launched in a recession and in an expansion for a highly indebted country. Figures 6 does the same, but for a country with a moderate initial debt ratio[3]. The results show interesting patterns. In recessions, for both highly and moderately indebted countries, EB corrections reduce significantly the debt ratio compared to a baseline scenario without adjustment, while the impact of TB ones is

[3]For figures 5 and 6, the initial conditions are set to match Italy's macroeconomics conditions in 1999-2000 and 2008-09 for the expansion and recession episodes in the high debt scenario, and Germany's in 1999-2000 and 2008-09 in the low debt one. We find analogous results when looking at different countries in different episodes of recessions and expansions. Moreover, when setting general initial conditions - i.e. not taking a specific country's historical macroeconomic data as we do in the next section for debt- we confirm these results.

not significant. Five years after its introduction, an EB plan worth 1 percent of GDP reduces the debt ratio by approximately 2 percentage points. This difference becomes less evident in strong expansions. Consistent with the discussion above, the result is only partially driven by the output responses, which are similar across states. Due to the fewer instances in the sample, the cumulative output responses to TB corrections in expansions - while remaining significantly negative - range in a wide interval between between -0.5 and -1.5. A major role seems to be played by inflation, which during recessions tends to rise in the first two years after the introduction of EB plans.

In sum, debt responds differently to TB and EB plans also when considering different positions along the business cycle. With minor differences, this applies to highly and moderately indebted country. One key result is that the TB-EB heterogeneity for debt is stronger during recessions: EB plans are even more successful at stabilizing debt during downturns, with the effect being mainly driven by the positive response of inflation.

5.2 Debt dynamics non-linearity

A consolidation launched when public debt is increasing rapidly might differ significantly - even in terms of output responses - from one started when public finances are not under strain. Blanchard (1990) provides a simple but insightful framework to explain why debt stabilizations might be more successful when the state of public finance is deteriorating. When a country's debt is rising fast and agents start to fear about its sustainability, a consolidation can remove uncertainty about the adoption of even more draconian measures in the future, and possibly of a default or a debt restructuring. Alesina and Drazen (1991) model also points to the beneficial effect of removing the uncertainty costs associated with delaying the debt stabilization. This might help explain, for instance, the positive response of private investments and business confidence to EB plans. Alesina et al. (2018) discusses in detail the confidence effects of fiscal adjustment plans.

Government debt dynamics have significantly featured in the previous literature regarding taxes and spending corrections. Seminal empirical studies including Perotti (1999) and Giavazzi et al. (2000) investigated whether the government debt dynamics – in terms of both debt levels and debt growth – may affect the output responses to a fiscal shock. However, fiscal shocks at the time were not identified as plans and were constructed from cyclically-adjusted changes in the primary budget. Caggiano et al.

(2015), while estimating U.S. fiscal policy multipliers in the context of a smooth transition VAR model, assess whether including the government debt level in the STVAR modifies the estimated GDP response to fiscal shocks. They find no significant effect on the derivation of fiscal multipliers. Their result echoes those derived by Favero and Giavazzi (2012) through a different econometric specification. Ilzetzki et al. (2013) find instead that fiscal policy multipliers change as the debt to GDP ratio exceeds the 60 percent threshold. Corsetti et al. (2012) study the impact on output of government spending shocks conditional on situations of 'weak public finances', defined as the debt ratio exceeding 100 percent or the lagged deficit beyond 6 percent. They find no significant differences in the estimation of fiscal multipliers.

In this analysis, we assess whether the change in government debt ahead of the adjustment matters for the effectiveness of the adjustment. We consider the government debt level – instead of its variation – to be less likely to represent a good indicator for the state of fiscal distress for two reasons. Firstly, our sample of 16 OECD countries only features four countries (Belgium, Ireland, Italy and Japan) with a sufficiently large number of years when government debt was high. This may result in drawing conclusions mainly based on the differential impact of fiscal policy in these four countries. Secondly, the macroeconomic literature exhibits substantial disagreement over the debt level beyond which the macroeconomic effects of fiscal measures are affected.

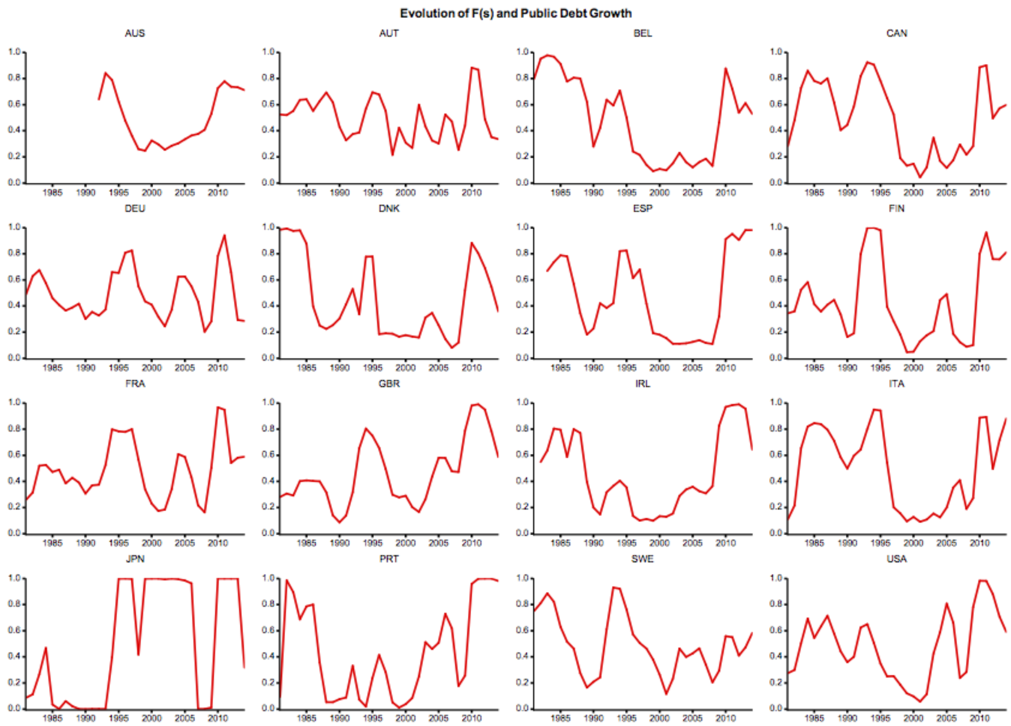


Figure 7: Evolution of $F(s)$ in the sample

Analogously to what we do to study the business-cycle non-linearity, when setting the initial conditions for the computation of impulse responses, a state of rapidly increasing debt is identified with the indicator $F(s_{i,t}) \geq 0.8$. In particular, we calibrate the γ_i in the transition function $F(s_{i,t})$ for each country i so that $Prob(F(s_{i,t}) > 0.8) = x_i$, where x_i indicates the number of years when public debt has increased by more than 5 percent in the sample. Figure 7 shows the evolution of $F(s)$ for each country. To model instances of stable debt we set $F(s_{i,t}) \cong 0.5$. Given the way in which fiscal corrections are identified, it is less relevant to simulate adjustments legislated when debt was rapidly decreasing (i.e. for values of $F(s_{i,t})$ closer to zero). Sensitivity analysis is carried out around these thresholds.

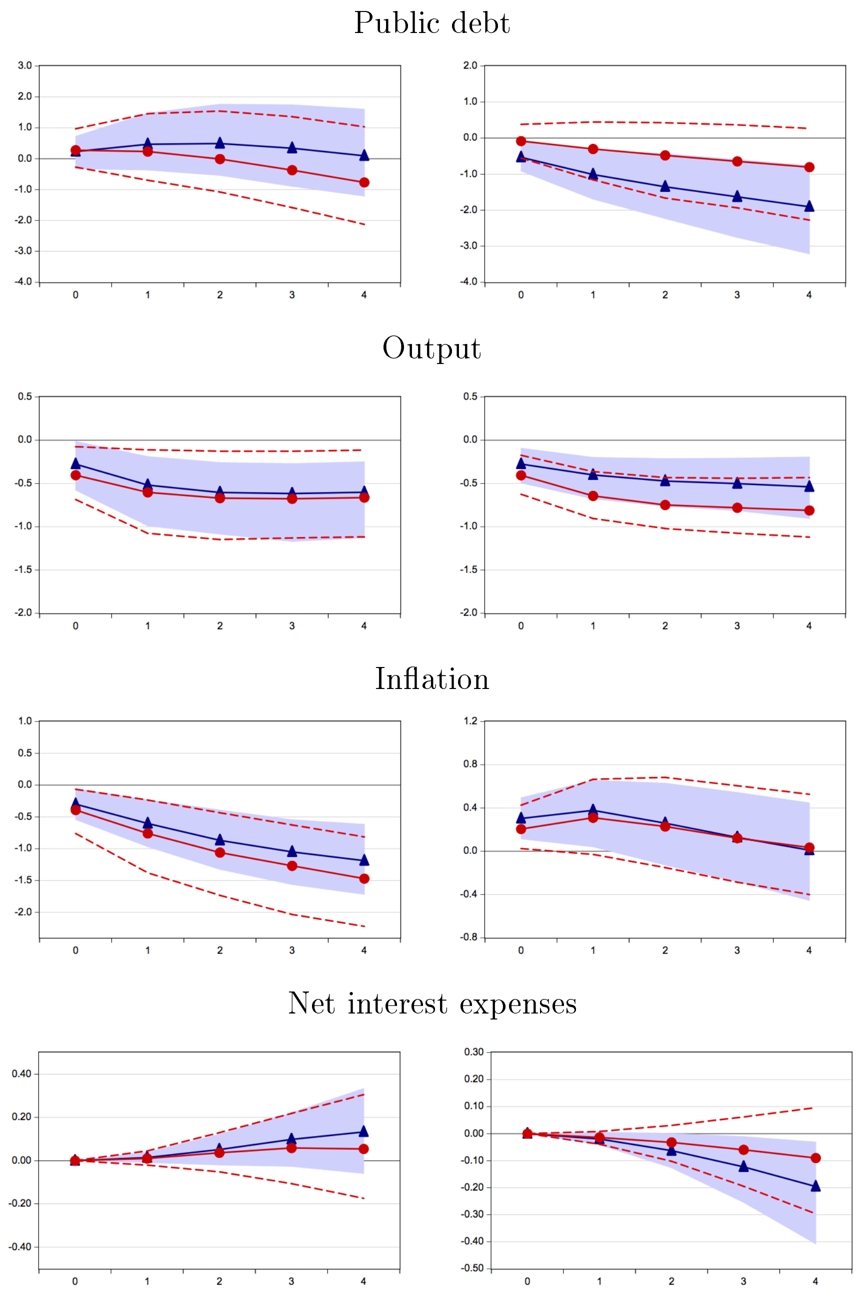


Figure 8: Impulse responses with stable (left) and increasing (right) debt in a highly indebted country

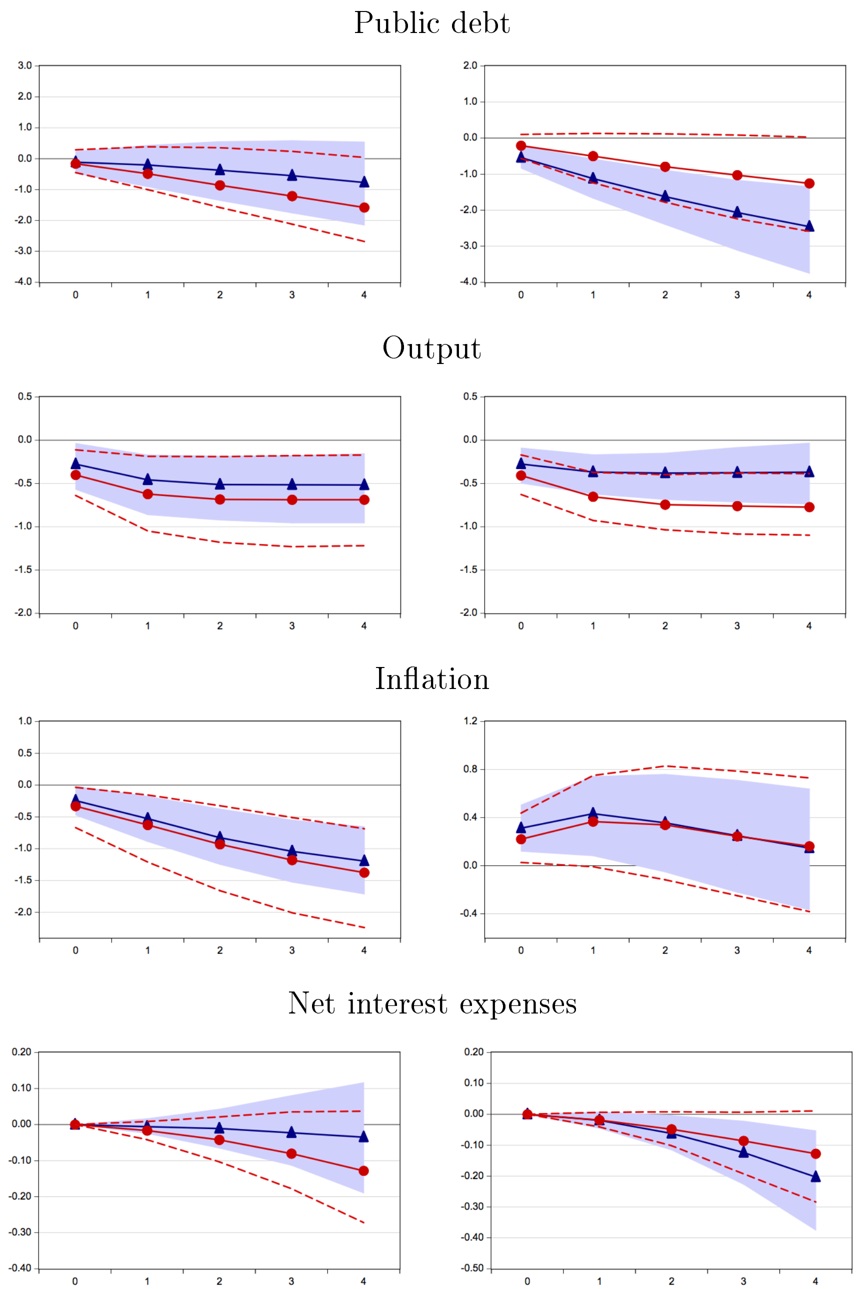


Figure 9: Impulse responses with stable (left) and increasing (right) debt in a moderately indebted country

Our results point to Blanchard (1990) and Alesina and Drazen (1991) intuitions, at least under certain conditions. When debt is increasing rapidly, EB consolidations are successful at stabilizing the debt ratio, as the right panels of figures 7 and 8 show. The positive impact of EB measures is driven by the mildly negative impact on output, and by the positive effect on inflation and on the cost of debt. This latter result is consistent with the idea that in a debt crisis a well-designed spending consolidation can ease concerns about debt sustainability and contribute to lower government bond spreads. The point estimates of the effects of TB measures on debt five years after the correction range between 0 and -1, with the effect being significant only for moderately indebted economies. When debt is stable, the effect of EB and TB measures on debt is almost indistinguishable. The debt ratio is slightly reduced by both type of plans when the country has a moderate debt, but remains unaffected when debt is higher. EB and TB plans seem not to have different effects on output when debt is stable. These results are robust to different calibrations of the country-specific γ. In other terms, they do not depend on the choice of calibrating γ_i so that $F(s_{i,t}) > 0.8$ when the standardized lagged MA of debt change was larger than 5 percent.

Differently from the business-cycle non linearity, the initial conditions for the simulations above are not set to match specific countries' macroeconomic conditions in a given year. Doing so would not allow to control for other key macroeconomic developments that affect impulse responses beyond the debt dynamics before the consolidation. For instance, a correction launched when debt is increasing rapidly might in theory have different effects if at the same time the economy is in a boom or in a recession. After performing several simulations, however, we concluded that - when using this model - the main differences emerge due to the debt dynamics, while the other macroeconomic conditions before the correction only impact marginally on the impulse responses. The simulations in figures 8 and 9 are computed using median levels of the macroeconomic variables in our sample, including the calibration of the γ, conditional on a country's type (i.e. highly or moderately indebted).

In sum, the TB-EB heterogeneity for debt still emerges for consolidations started when debt was increasing rapidly relative to country-specific trends. This no longer holds when debt is not increasing fast.

6 Counterfactual simulations

One interesting question to ask is how would the economies in our sample have performed if they over time adopted different fiscal policy measures. Running counterfactual simulations has to be done with caution. The economic, political and institutional context that led to a policy decision cannot be properly taken into account when performing such exercises. An important aspect for our analysis is that, for instance, tax measures might be quicker and easier to implement when a country needs to stabilize its public finances. Results on how the economy would have performed with spending instead of tax corrections - and viceversa - should be taken with a grain of salt.

6.1 A model for counterfactual simulations

We reconstruct within-sample counterfactual simulations through the following method. The 5-equation dynamic model of section 3 is first estimated across the whole sample. Then, after setting the initial conditions for all the macroeconomic variables in the model and in the debt identity for a given year of interest, we simulate ahead the model in four different ways. First, we simulate maintaining the time series of TB and EB adjustments as in our sample. Once we add the residuals obtained from the estimation to the five equations in the dynamic model and the augmented-SFA term - which is assumed to follow an exogenous process - to the debt identity, this first simulation replicates the time series for the variables in the system and for the debt ratio. After this, we run three additional scenarios where we respectively (*i*) consider all exogenous fiscal measures as EB plans, (*ii*) consider all exogenous fiscal measures as TB plans, (*iii*) set to zero all exogenous fiscal measures. More specifically, under scenario (*i*) we simulate a sequence of fiscal plans of the same size to those observed, but assuming they were all EB. Under scenario (*ii*), all TB. This requires taking the total amount of narratively identified fiscal measures and re-assigning them in proportion to tax τ and spending g measures depending on the type of plan we want to simulate. To do so, we run a series of fiscal plans regressions similar to those presented in section 3:

$$\tau^u_{i,t} = \beta^{TB}_0 e^u_{i,t} * TB_{i,t} + \beta^{EB}_0 e^u_{i,t} * EB_{i,t} + \epsilon_{0,i,t} \tag{12}$$

$$g^u_{i,t} = (1 - \beta^{TB}_0) e^u_{i,t} * TB_{i,t} + (1 - \beta^{EB}_0) e^u_{i,t} * EB_{i,t} - \epsilon_{0,i,t} \tag{13}$$

$$\tau^a_{i,t-1,t} = \beta^{TB}_1 e^a_{i,t-1,t} * TB_{i,t} + \beta^{EB}_1 e^a_{i,t-1,t} * EB_{i,t} + \epsilon_{-1,i,t} \tag{14}$$

$$g^a_{i,t-1,t} = (1 - \beta_1^{TB}) e^a_{i,t-1,t} * TB_{i,t} + (1 - \beta_1^{EB}) e^a_{i,t-1,t} * EB_{i,t} - \epsilon_{-1,i,t} \quad (15)$$

$$\tau^a_{i,t,j} = \beta_j^{TB} e^a_{i,t,j} * TB_{i,t} + \beta_j^{EB} e^a_{i,t,j} * EB_{i,t} + \epsilon_{j,i,t} \; j = 1,2 \quad (16)$$

$$g^a_{i,t,j} = (1 - \beta_j^{TB}) e^a_{i,t,j} * TB_{i,t} + (1 - \beta_j^{EB}) e^a_{i,t,j} * EB_{i,t} - \epsilon_{j,i,t} \; j = 1,2 \quad (17)$$

Equations (12) and (13) allow to estimate across all sample which percentage of an announced and implemented fiscal correction $e^u_{i,t}$ is constituted by spending and which by taxes in respectively TB and EB plans. Equations (14) and (15) do the same for inherited fiscal corrections $e_{i,t-1,t}$, while equations (16) and (17) for announced corrections $e_{i,t,j}$ at various horizons j.

6.2 Ireland and Spain during the Eurozone crisis

Between 2010 and 2014, Ireland and Spain adopted large-scale fiscal consolidation plans to respond to deteriorating conditions of their public finances as a result of the Great Recession and the Eurozone crisis. Although during the same years many of the countries included in our sample tightened fiscal policy with different mixes of tax and spending measures, these two countries stand at the extremes of the spectrum. The Irish government launched and maintained consistent EB plans, while the fiscal measures in Spain were concentrated on the tax-side, with 3 years of TB corrections and 2 of EB ones[4]. Both countries experienced significant increases in their debt to GDP ratio, thus making a comparison between the two of particular interest.

In Ireland, government spending cuts in 2010-14 amounted to around 11% of GNP, with additional tax hikes worth 4%. In the same period the country suffered from a massive banking crisis. Ireland embarked on a fiscal consolidation path as a condition for financial support from the IMF and the EU. In presenting its 2010 austerity plan, the Irish government made an explicit reference to the literature studying the heterogenous effects of tax and spending measures. The Ireland Stability Programme Update of December 2009 contains the following comment:

[4]Italy also adopted a strategy of mostly-tax measures in 2010-2014.

> In framing Budget 2010, the Government focused on curbing spending to adjust expenditure needs to the revenue base which has been reduced as a result of the overall contraction of the economy and the loss of certain income streams. In addition, in formulating policy the Government took on board evidence from international organizations, such as the EU Commission, the OECD, and the IMF, as well as the relevant economic literature which indicates that consolidation driven by cuts in expenditure is more successful in reducing deficits than consolidation based on tax increases. Past Irish experience also supports this view and suggests that confidence is more quickly restored when adjustment is achieved by cutting expenditure rather than by tax increases.

Spain introduced austerity measures in 2010-14 totalling 12 percent of GDP, with more than 7 percent on the revenues side concentrated after the start of the ESM assistance program in 2012. The main tax measures in the period consisted in VAT increases, complementary levies on personal income taxes, excise taxes, increases in social security contributions, and tax hikes for non-residents. On the spending side, corrective measures mainly affected public sector wages, government consumption and investments, health and education expenditures, and unemployment benefits.

Figure 10 shows the counterfactual simulations for public debt, GDP growth, government spending and revenues in Ireland starting in 2010. The results highly consistent with the results obtained in section 4. Output losses would have been much larger if measures had been concentrated on the tax side (a cumulative 5 percent loss over the simulation horizon). In general the economy would have performed better absent any fiscal correction. While it is hard to imagine a scenario where the economy would have performed better without corrections, this result shows that at a time of crisis the output costs associated with a fiscal contraction – imposed by financial market pressures or by fiscal rules – have to be carefully assessed. The response of public debt confirms that, while an EB plan can slowdown the economy, it is nonetheless able to stabilize public finances. A TB plan would have instead been self-defeating, triggering a deeper recession and not stabilizing debt. The debt/GDP ratio would have been more than 10 percent larger if the Irish measures were concentrated on the tax side. The responses of spending and revenues confirm that the counterfactual simulations are well identified: spending decreases more in all-EB scenarios, taxes increase more in all-TB scenarios.

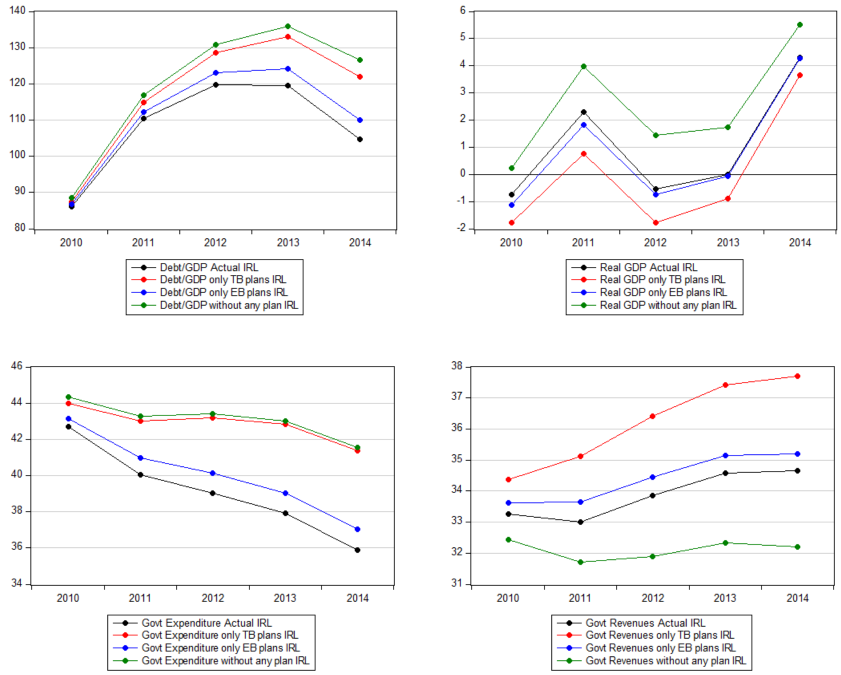


Figure 10: Counterfactual simulations for Ireland

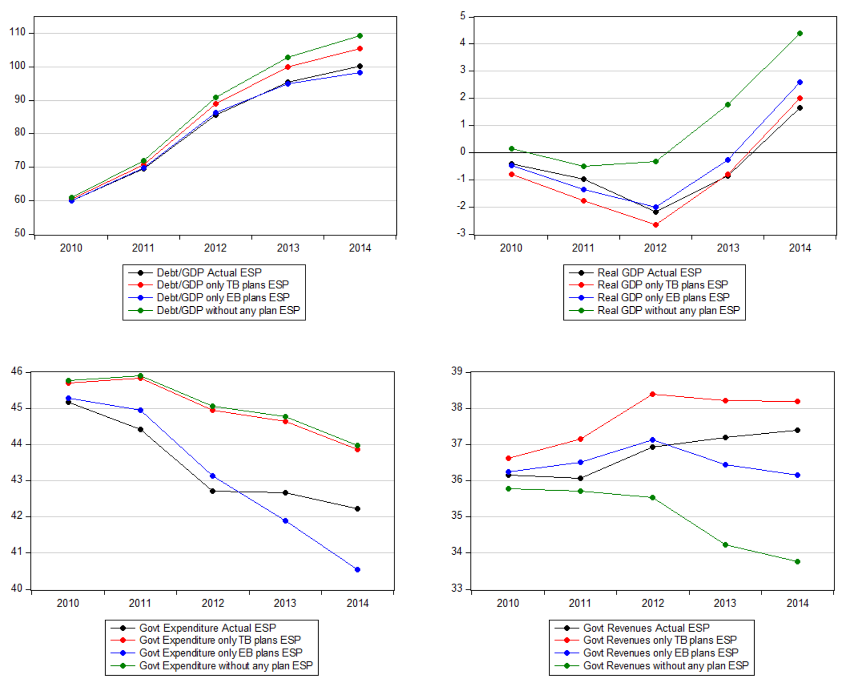


Figure 11: Counterfactual simulations for Spain

A similar pattern emerges for Spain, as shown in figure 11. Fiscal adjustments in any scenario would have produced a slowdown in the Spanish economy compared to a 'no fiscal intervention' scenario. However, the output losses would have been milder if Spain adopted a plan tilted towards spending cuts over the whole consolidation horizon, and not only in the first two years before 2012. Relative to the actual, this would have resulted in a cumulative 1.5 percent output growth gain. In a TB scenario over the whole period, the output losses would have been 2 percent larger than in the realized time series. This would have led to a debt ratio higher by approximately 7 percent in 2014.

7 Conclusions

This paper provides evidence on the impact of fiscal consolidation plans on government debt dynamics. Eventually, government debt is the key metric to observe when assessing the effectiveness of austerity measures. If the (potentially high) output costs associated with fiscal adjustments are not even compensated by a debt stabilization, then the consolidation efforts have been vain. Compared to previous works on this subject we introduce several empirical and methodological innovations. We consider multi-year plans instead of isolated shocks; we identify corrections that are exogenous to the macroeconomic conditions and motivated by long-term public finance concerns; we look at a large number of stabilization episodes occurred between 1981 and 2014 in 16 OECD economies; we investigate state-dependencies related to the business-cycle and to the public debt dynamics. Our results point to a large heterogeneity between spending-based and tax-based plans. While the former are mildly recessionary but are able to reduce the debt ratio compared to a baseline scenario without adjustments, the latter are self-defeating: they are not only associated with larger output losses, but are also ineffective at lowering the debt ratio. We find that this effect primarily emerges when the economy starts the stabilization during a recession or when debt was increasing rapidly.

When a country has accumulated a large public debt and needs to reduce it, various alternatives are available. The seminal contribution by Alesina (1988) reviews the methods historically adopted by advanced economies to deal with large public debts: defaults or debt restructuring, the introduction of a wealth tax or a capital levy, a significant and unexpected increase in inflation. These measures have often led to capital flights, the loss of reputation in financial markets and the erosion of private wealth. Reducing the debt via a steady growth and moderate inflation is a best-case scenario that many countries cannot afford, either as a consequence of their weak fundamentals, of financial markets' pressures or of fiscal rules to rapidly fix the state of their public finances. A fiscal consolidation is often the only solution left. This paper shows that trying to reduce debt via tax or spending measures can have very different effects, also depending on the macroeconomic conditions in which the adjustment is launched. These results should therefore be considered by countries that - similarly to Ireland in 2010 - assess how to design multi-year programs of fiscal consolidation to stabilize their debt.

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