Nonlinearities and expenditure multipliers in the Eurozone

Published Version:
Nonlinearities and expenditure multipliers in the Eurozone / Boitani, Andrea; Perdichizzi, Salvatore; Punzo, Chiara. - In: INDUSTRIAL AND CORPORATE CHANGE. - ISSN 0960-6491. - ELETTRONICO. - 31:2(2022), pp. 552-575. [10.1093/icc/dtab080]

Availability:
This version is available at: https://hdl.handle.net/11585/878568 since: 2022-03-15

Published:

DOI: http://doi.org/10.1093/icc/dtab080

Boitani, A., Perdichizzi, S., & Punzo, C. (2022). Nonlinearities and expenditure multipliers in the Eurozone. *Industrial and Corporate Change*, *31*(2), 552-575.

https://doi.org/10.1093/icc/dtab080

Nonlinearities and expenditure multipliers in the Eurozone

Andrea Boitani[*], Salvatore Perdichizzi[†], Chiara Punzo [‡§]

October 20, 2021

Abstract

We analyze the non-linear effects of government spending in the Euro area, by using the local projection method and by testing whether the impact of the shock depends crucially on the depth of the recession, on some structural characteristics of the EZ economies, and on the monetary policy stance. We provide four insights. First, expenditure multipliers in the Euro area are not significantly higher in recessions than in expansions. However they are always above unity. Second, state dependency emerges as soon as deep recession is distinguished from ordinary downturns. Third, structural characteristics, such as the presence of automatic stabilizers, the exchange rate regime, the degree of labour market flexibility, and initial conditions, such as the debt/GDP ratio, do influence the size of expenditure multipliers in the EZ. Fourth, multipliers are much higher when the policy interest rate is at the ZLB.

[*]Catholic University of the Sacred Heart. Email:andrea.boitani@unicatt.it

[†]University of Bologna. Email: salvator.perdichizzi@unibo.it

[‡]Direction Générale de la Stabilité Financière et des Opérations, Banque de France. Email: chiara.punzo@banque-france.fr

[§]We wish to thank Guido Ascari, Alan Auerbach, Fabrice Collard, Carlo Cottarelli, Domenico Delli Gatti, Elena Pesavento, Xavier Ragot, Eduardo Rossi, Francesco Saraceno, Morten Overgaard Ravn, two anonymous referees and the editors for helpful advise and insightful suggestions. We are also grateful to all the participants in EABCN Conference on *Advances in Business Cycle Analysis* at the Banca de España, May 30-31, 2018

1 Introduction

In a March 2020 *Financial Times* article, Mario Draghi wrote that Europe is well equipped to deal with the extraordinary shock of coronavirus. It has a strong public sector capable of co-ordinating a rapid policy response. However, there remains an enormous range of views over the strength of fiscal policy's macroeconomic effect, and the variations in these effects with respect to economic conditions [see Ramey (2019) for a survey]. This is not a comfortable position for an empirically based and reliable macroeconomic policy which is as badly needed as an empirically based macroeconomic theory [Colander et al., 2008]. Also key is knowing whether the effectiveness of a fiscal stimulus also depends on some key structural feature of the economy (such as labour market rigidities, the degree of openness, etc.) and/or initial conditions (such as the level of public debt or the existence of automatic stabilizers). In a nutshell: different non linearities need to be empirically assessed for the purpose of policy design. Uncertainties about the real effects of expansionary fiscal policies become even more embarrassing in the face of diminishing returns to monetary policy in confronting stagnation and very low inflation [Constâncio, 2020].

As Keynes (1936) early remarked "the employment of a given number of men on public works will (...) have a much larger effect on aggregate employment at a time when there is severe unemployment, than it will have later on when full employment is approached". Intuitively, when the economy has some slack, expansionary government spending shocks are less likely to crowd out private consumption or investment. However most estimates, devoted to US aggregate data, have found small multipliers, often lower than one. A deeper understanding of fiscal multipliers in the Eurozone is crucial and to such a purpose is devoted the present paper. Were expenditure multipliers small, an expenditure based fiscal stimulus may turn out to be non-expansionary, even when implemented in a slump, whilst still adding to government debt. According to the supporters of the non-Keynesian effects, Keynes could actually be turned on his head and fiscal consolidation (not fiscal expansion) may prove to be expansionary in downturns if confidence effects associated with public debt reductions overwhelm the direct contractionary effects which are anyway limited due to small multipliers [Giavazzi and Pagano, 1990; Alesina and Ardagna, 1998; Guajardo et al., 2014]. Hence the size of multipliers in downturns is pivotal in the cost - benefit analysis of fiscal policy notably in the Eurozone, where fiscal discipline is written in stone with the aim of preventing the build-up of government deficit and debt.

There are two distinct methods to derive fiscal multipliers: one is model-based[1], the other one is based on empirical estimation.[2] Different approaches may explain why estimates vary so widely.[3]

A large empirical literature analyses the size of fiscal multipliers when the economy is in a recession. Auerbach and Gorodnichenko (2012, 2013), and Ramey and Zubairy (2018) represent milestones in the literature. Auerbach and Gorodnichenko (2012) suggest that multipliers are higher than normal during recessions, i.e. that they are highly state dependent. On the other hand, Ramey and Zubairy (2018) show that state dependence is explained by subtle, yet crucial, assumptions underlying the construction of impulse response functions on which the multipliers are based. In contrast to linear models, where the calculation of impulse response functions is a straightforward undertaking, constructing impulse response functions in nonlinear models is fraught with complications. Ramey and Zubairy (2018) use Jorda's (2005) local projection method and estimates multipliers that are below unity irrespective of the amount of slack in the economy.

We focus on the EZ and not on the US (as Ramey and Zubairy, 2018) or on the whole set of OECD countries (as Auerbach and Gorodnichenko, 2013) and consider the period 1992-2015 within a unified econometric framework based on local projections, and using the same measure of unanticipated expenditure shocks in all estimations. Following Auerbach and Gorodnichenko (2013), we identify the shock with the forecast error of public expenditure[4], that is the difference between the actual growth rate of government spending and the forecast growth rate prepared by professional forecasters, after showing that the shock to military expenditures employed for the US by Ramey and Zubairy (2018) would not capture much if applied to Euro countries. We perform a

[1]The model based approach has been applied to many different countries, usually changing the models' assumptions (Coenen et al., 2012 for an early survey; Leeper et al., 2017 for an application to the US; in't Veld, 2017 on spillovers of stimulus packages in the EZ])

[2]Blanchard et al.(2017) use both methods.

[3]Gechert et al.(2016) dataset takes into account 98 studies published between 1992 to 2013, providing a sample of 1882 observations of multiplier values. The majority of the papers in the sample have been published after the Crises and subsequent policy action.

[4]As the present paper focuses on differences in aggregate government expenditure multipliers we shall deal neither with expenditure composition nor with the possibly different impacts of tax and expenditure multipliers.

robustness check with respect to the endogeneity of our shock measure and we find no relation in the EZ between our shock and, respectively, output and government spending. We also follow Auerbach and Gorodnichenko (2013) and Ramey and Zubairy (2018) in using local direct projections [Jordà(2005)] rather than the SVAR approach to estimate multipliers in order to economise on the degrees of freedom and to relax the assumptions on impulse response functions imposed by the SVAR method.

Our paper contributes to the general non-linear multiplier literature by highlighting some key methodological and policy-related issues. First, we show that some of the most widely cited findings of below unity multipliers during recessions do not apply in the EZ, when an (in our view) appropriate measure of the expenditure shock is chosen. Second, this paper contributes to the empirical literature by conducting an investigation about whether output multipliers in the Euro area differ when extreme events, such as deep recessions are isolated. Third, we enquire whether differences across Euro countries and over time as for structural macroeconomic features (trade openness, labour market rigidity, the size of automatic stabilizers, the exchange rate regime) and initial conditions (such as the debt/GDP ratio) affect the size of expenditure multipliers. Fourth, we investigate whether monetary policy plays a key role in multiplier estimation. We find significant non-linear effects of government spending, i.e. non-linear multipliers. Four main results arise. First, multipliers greater than one both in expansion and in recession. However, we find no evidence of larger multipliers in ordinary recession periods. Second, by separating deep recessions from mild downturns we show that non-linearities are likely to arise. In particular, larger fiscal multipliers emerge in deep recessions, peaking at at an early 1-year horizon. To the contrary, there is little difference between multipliers in expansions and multipliers in the linear model. In both cases they peak at the second horizon, staying above one thereafter. We run a robustness check with respect to our measure of state and we find results in line with our baseline findings. Third, we find that differences in macroeconomic structural features and initial conditions across Euro countries over time affect the size of multipliers in accordance to Keynesian predictions and (as far as the initial debt/GDP ratio is concerned) at odds with the standard "Ricardian" prediction. Fourth, we find that multipliers in the Euro Area are much higher when the policy interest rate is at the ZLB. We also attempted at testing the "double non-linearity" hypothesis, i. e. whether structural characteristics and state of the business cycle do have a compound effect on multipliers in the EZ. Although our estimation broadly confirm the hypothesis, the results lack statistical significance (they are reported in the Appendixes).

The structure of the paper is as follows. Section 2 is a literature review on state-dependent multipliers. Section 3 discusses the empirical methodology, describing the dataset used in this study. In Section 4 we compare GDP multipliers in the EZ across different regimes, expansions and recessions. In Section 5 we analyse non-linearities when recessions are are deep downturns. In Section 6 we report our results on how differences in initial conditions across EZ countries can affect the size of multipliers. In Section 7 we investigate on whether monetary policy plays a key role in multiplier estimation. Section 8 concludes.

2 Literature review

A recent large empirical literature has distinguished between multipliers in different underlying states of the economy. Auerbach and Gorodnichenko (2012) use a regime-switching SVAR and study asymmetries in the propagation of fiscal shocks in booms and downturns and report output fiscal multipliers of up to 2.5 during recessions. Their multipliers result significantly larger in downturns than in expansions. When the output gap is negative, the traditional crowding-out argument – that higher government spending displaces private spending – is generally less applicable since excess capacity is available in the economy. In addition, the proportion of credit-constrained households and firms, which adjust spending in response to a change in disposable income, is higher. According to Batini et al. (2012), quantitative estimates of the multiplier vary widely depending on the assumptions and techniques used. They include (i) the sample used in estimation; (ii) the estimation technique; (iii) whether the measuring accounts for automatic stabilizers or not; (iv) whether the economy is going through a particular phase of the business cycle (expansion or recession, high or low unemployment) or (v) whether spending is anticipated or not.

We focus on the interaction between the sample used in the estimation, the particular phase of the business cycle and the estimation technique in order to show that some of the most widely cited findings of below unity multipliers during recessions are due to the shock variable chosen. The shock variable employed by Ramey and Zubairy (2018) is news about future military spending, which admittedly leads to delayed rises in government spending, and consequently in output. The resulting low multipliers should come as no surprise. On the other hand, large estimates of output multipliers in recession can be found in Ramey (2011), Batini et al. (2012) and Baum et al. (2012), as well as Auerbach and Gorodnichenko (2012). As acknowledged by Ramey (2011), her results depend on the timing of the news. Riera-Crichton et al. (2015) - following the same single equation approach adopted in the present paper - show that in the OECD countries multipliers in bad times are much higher if the expenditure shock is actually counter-cyclical than what it is if the shock is pro-cyclical. In line with Baum et al. (2012), we investigate the link between the relationship between fiscal multipliers and the state of the economy. Baum et al. (2012) adopt a country-by-country approach for the G7 economies (excluding Italy) and show that fiscal multipliers differ across countries, calling for a tailored use of fiscal policy. Differently from them, we consider 10 Eurozone countries within a unified econometric framework. Also Gòrnicka et al. (2020) focus on European countries but using a unique new data set on the European Commission's recommendations under the excessive deficit procedure. They do not find evidence that the ex-post fiscal multipliers systematically exceeded 1 in the early crisis years.

Batini et al. (2012) aim at investigating on what is the pace of fiscal consolidation in the United States, the Euro Area and Japan that would achieve maximum adjustment given low growth, while preserving the recovery. This is the reason why they estimate fiscal multipliers for various stages of the business cycle and they need an empirical methodology that makes the stages of the business cycle endogenous to the computation of fiscal multipliers. Our focus is different. First, we isolate extreme events for the Euro area, i.e. deep downturns and recessions, with the aim of understanding if fiscal multipliers are larger in very severe economic conditions [Caggiano et al., 2015]. Second, we ask how structural characteristics of the EZ countries influence the economy's response to fiscal shocks.

Barrell et al. (2012) look at 18 OECD economies and show that multipliers tend to be smaller in more open economies, because the more open an economy is the more of a shock will spread into other countries through imports, and small open economies such as Belgium in fact have small multipliers. Ilzetzki et al. (2013) – putting together 44 countries, 20 high-income and 24 developing - confirm that relatively closed economies (whether due to trade barriers or larger internal markets) have long-run multipliers of around one, but relatively open economies have negative multipliers. We examine whether trade openness influences the economy's response to fiscal shock also in the Euro Area.

Countries with more rigid labour markets - stronger unions and/or stronger labour market regulation – have larger fiscal multipliers if such rigidity implies reduced wage flexibility, as rigid wages tend to amplify the response of output to demand shocks (see Gorodnichenko et al., 2012). Given that there are significant differences in labour market rigidity conditions across Euro countries and over time, we enquire whether these differences affect the size of multipliers.

It is important to assess the contribution of automatic stabilizers to overall fiscal expansion and to compare their magnitude across countries. Dolls et al. (2012) discuss how fiscal stimulus programs of individual countries are related to automatic stabilizers. In particular, they ask whether countries with low automatic stabilizers have tried to compensate this by larger fiscal stimuli. They find a weak (negative) correlation between the size of fiscal stimulus programs and automatic stabilizers. In the same vein, we check this conjecture for the EZ.

Does the exchange rate regime affects fiscal multipliers? Traditional analysis based on the Mundell-Fleming model suggests that the exchange rate regime has a first-order effect on the multiplier: it is predicted to be large in economies which maintain an exchange rate peg or which are part of a currency union, but to be zero in economies with a freely floating exchange rate. In the latter case, the increased activity due to higher government spending puts upward pressure on interest rates, triggering capital inflows and an appreciation of the currency. This, in turn, crowds out net exports and eventually offset the effect of increased public spending on the demand for domestic goods. Under fixed exchange rate, in contrast, monetary policy accommodates the increased demand for domestic currency to prevent the currency from appreciating. As a result, private demand rises along with public demand, while net exports remain unchanged. The multiplier exceeds unity (see Born and others, 2013; Ilzetzki et al., 2013). After the injection of the euro all of the transactions within the Eurozone are settled with a single currency, which is a proxy for a fixed exchange rate regime. As the transactions within the Eurozone make for a large share of all foreign transactions of EZ countries, we can say that exchange rates are prevalently fixed after 1999 whilst they were prevalently flexible before the euro. Hence, we investigate whether the spending multiplier is higher in the (post-euro) fixed exchange regime than in the (pre-euro) flexible exchange rate regime.

Kirchner et al. (2010) results indicate that rising government debt is the main reason for declining spending multipliers at longer horizons, and thus increasingly negative long-run consequences of fiscal expansions. In the same vein, Ilzetzki et al. (2013) show that the impact of government expenditure shocks depends crucially on key country characteristics, such as public indebtedness. Based on a novel quarterly dataset of government expenditure in 44 countries, they find that fiscal multipliers in high-debt countries are negative. During episodes where the outstanding debt of the central government was high (exceeding 60 percent of GDP), the fiscal multiplier was not statistically different from zero on impact and was negative (and statistically different from zero) in the long run. Experimentation with a range of sovereign debt ratios indicated that the 60 percent of GDP threshold used for example by the Eurozone as part of the Maastricht criteria, is indeed a critical value above which fiscal stimulus may have a negative impact on output in the long run. Also Auerbach, Gorodnichenko (2012) find that large government debt reduces the response of output to government spending shocks. Nickel and Tudyka (2014) analyse 17 European countries from 1970 and 2010, and find that multipliers of spending shocks turn negative as the debt/GDP ratio increases. Di Serio et al. (2021) find that multipliers in ten Euro Area countries (2002-2019) are systematically smaller when the interest rate - growth differential (r-g) is positive, which is often positively associated to the size of the debt/GDP ratio. We re-examine this issue as for the Euro Area and find results at variance with the cited papers but coherent with Guerini et al. (2018) and Batini et al. (2019). Indeed, Guerini et al. (2018) find that the public debt crowds in private consumption and investment and Batini et al. (2019), focusing on Euro Area countries, show empirically that high public debt does not lead deeper recessions unless the level of public debt is extremely high.

Finally, Keynes argued in favour of aggressive fiscal expansion during the Great Depression on the grounds that the fiscal multiplier was likely to be much larger in a liquidity trap than in normal times, and the financing burden correspondingly smaller. Interest in fiscal stimulus as a policy option has been greatly increased by the fact that in many countries, by the end of 2008, the short-term nominal interest rate used as the main operating target for monetary policy has reached zero so that further interest rate cuts were no longer available to stave off spiralling unemployment and fears of economic collapse. Woodford (2011) shows that a multiplier well in excess of one is possible when monetary policy is constrained by the zero-lower bound. However, Erceg, Lindé (2012) show that even if the multiplier is high for small increases in government spending, it may decrease substantially at higher spending levels; thus, it is crucial to distinguish between the marginal and the average responses of output and government debt. This is the reason why we investigate whether monetary policy plays a key role in multiplier estimation for countries in the sample which had monetary policy set at the zero lower bound between 2014-15. We do this also taking into account the most recent study by Blanchard et al. (2017) and Amendola et al. (2020). Blanchard et al. (2017) find that, outside of a liquidity trap, the effects of higher Euro Area's core economies government spending on periphery GDP tend to be small and even negative. But the spillovers to EZ periphery GDP are markedly different in a liquidity trap: EZ periphery GDP tends to rise. The size of the periphery GDP response to a core spending hike increases with the expected duration of the liquidity trap, with the import content of core government spending, and with the responsiveness of inflation. However, we do not focus on how the stimulative effects would be distributive between core and periphery in the EZ. As Amendola et al. (2020) we prefer to tackle the research question from a purely empirical viewpoint and we obtain similar results but with a different methodology, described in the following section.[5]

3 Data Description and Econometric Methodology

3.1 Data Description

We construct semi-annual data from 1992-2015 for Euro-10 area (Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain).[6] We use OECD's Statistics and Projections Database.[7] The historical series include real GDP, real government spending, import, export, 10-year government bond yield, and the Debt-GDP ratio. Real government spending is derived by the sum of real government consumption and real government investment. Government purchases include all national and local purchases but exclude transfer payments. We also include the EPL index on regular employment from the OECD Employment Protection Legislation

[5]Indeed, Amendola et al. (2020) condition the computation of the multiplier on an indicator that summarizes the overall monetary policy stance. To fully take the dynamics of the shadow rate into account, they use a factor-augmented interacted panel vector-autoregressive model purified of expectations.

[6]We removed Austria and Greece because there is no data available on real government spending .

[7]We are grateful to Alan Auerbach who shared with us his database from 1960 to 2010.

Database (2020), and the value of automatic stabilizers estimated by Dolls et al. (2019). Finally we use the ICE BofA Euro Corporate BAA Index from Bloomberg.

Accepting the Ramey and Zubairy (2018) critique, we use Gordon and Krenn's transformation (2010). Instead of taking logarithms of our key variables, we divide the real GDP and real government spending by estimating potential, or trend, GDP. This puts all macro variables in the same units so that we can calculate the "integral multipliers" directly (similar to Mountford and Uhlig, 2009; Fisher and Peters, 2010; Uhlig, 2010; and Ramey and Zubairy, 2018). Figure 1 shows the cumulative real GDP (Panel A) and government spending (Panel B).

It is well know the importance of ensuring that a shock is not only exogenous, i.e. independent of the state of the economy, but it should also be unanticipated. That is why we follow Auerbach and Gorodnichenko (2012) in providing a more precise measure of unanticipated shocks to fiscal policy, by relying on forecast errors as for our shock variable.[8] The forecast error is the difference between the actual and forecast series of the government spending prepared by professional forecasters at time *t-1* for time *t*.[9]

3.2 Econometric Methodology

Since the early 2000s, the literature has begun to explore whether estimates of government spending multipliers vary depending on circumstances, especially the state of the business cycle. Auerbach and Gorodnichenko (2012, 2013) consider the possibility that multipliers are higher than normal during recessions. Auerbach and Gorodnichenko (2012, 2013) starting point is the classic paper by Blanchard and Perotti (2002). We label this approach as *standard*, and we summarize it by the following equation:

$$logY_t = \beta * logG_t + error \rightarrow multiplierM = \beta * (\overline{\frac{Y_t}{G_t}})$$

[8]We do not follow Ramey and Zubairy (2018) in employing news on future military spending. Using defence data may be well suited for estimating US multipliers because US military spending is both high and volatile. The share on total public expenditure is 19.14 percent on average, with 15.4 as variance from 1985-2016. In the Euro area, military spending represents a meagre 4.6 percent of total public expenditure on average, with a variance of 1.04 - *https://data.worldbank.org/indicator/*.

[9]In the following section, we provide evidence of the exogeneity of our shock variable from both the state of the economy and government spending.

Figure 1: Cumulative Real GDP (Panel A) and Real Government spending (Panel B) (Gordon and Krenn's transformation (2010))

Ramey and Zubairy (2018) show that high multipliers during recessions are due to assumptions that may be at odds with the data-generating process. They show that the finding of high multipliers during low-growth periods disappears when data-consistent assumptions are used. Using Jordà's (2005) local projection method, they find no evidence that government spending multipliers are high during high-unemployment states. Their approach can be summarized by the following equation:

$$\frac{Y_t - Y_{t-1}}{Y_{t-1}} = \beta * \frac{G_t - G_{t-1}}{Y_{t-1}} + error \rightarrow multiplierM = \beta$$

Ramey and Zubairy (2018) criticise the "standard" approach on the ground that the $\frac{\bar{Y}_t}{\bar{G}_t}$ ratio may vary systematically with the business cycle. Moreover, in line with Mountford and Uhlig (2009), Fisher and Peters (2010), and Uhlig (2010), Ramey and Zubairy (2018) argue that - in order to address the relevant policy question - multipliers should be calculated as the integral of output response divided by the integral government spending response inasmuch this is a correct measure of the cumulative GDP gain relative to the cumulative government spending in a given period.

With a view to avoid the mentioned bias, first we use Gordon and Krenn's transformation (2010), and we then divide all macroeconomic variables by an estimate of potential, or trend, GDP as in Ramey and Zubairy (2018), using a polynomial to estimate trend real GDP and real government spending. Second, we follow the single-equation approach advocated by Jordà (2005) and Stock and Watson (2007), which does not impose the dynamic restriction that are present in the SVAR methodology and is able to accommodate non-linearities in the response function[10] and we estimate the cumulative multiplier *á la* Ramey and Zubairy (2018) using the following equation in the linear specification:

$$\sum_{j=0}^{h} y_{i,t+h} = \alpha_i + \mu_t + \Phi_{i,h}(L)x_{t-1} + m_h \sum_{j=0}^{h} g_{i,t+h} + \epsilon_{t+h} \qquad \text{for } h = 0,\ 1,\ 2,..., \qquad (1)$$

where i and t index respectively country and time, y is the variable of interest, x is the vector of the control variables, $\Phi_{i,h}(L)$ is a polynomial in the lag operator, α_i is the country fixed effect and μ_t is the time fixed effect. Our vector of the baseline control

[10]The Jordà method simply requires estimation of a series of regressions for each horizon h for each variable.

variable, x, contains government spending, each divided by trend GDP. In addition, x includes lags of the shock and dependent variables to control for any serial correlation in the shock variable. The term $\Phi_i(L)$ is a polynomial of order 4. As Instrumental Variable (IV) approach, we use $shock_t$ as an instrument for $\sum_{j=0}^{h} g_{i,t+j}$, while $\sum_{j=0}^{h} y_{i,t+j}$ is the sum of real GDP, from t to $t+h$.

As shown by Ramey and Zubairy (2018) the one-step estimate of the cumulative multiplier at horizon h, m_h give the same result as the one found by the three-step method: 1) estimate equation (1) for the variable of interest for each horizon j to h and sum the β_j, 2) the same as the step 1 but using as dependent variable the government spending; 3) compute the multiplier as the ratio of step 1 divided by step 2.[11]

Our measure of the $shock_t$ is $FE_{i,t}^{G}$, that can be read as the surprise government shock. It is the forecast error, i.e the difference between the actual and forecast series of the government spending (Government consumption + Government Investment) prepared by professional forecasters at time *t-1* as for time *t*. Moreover, using $FE_{i,t}^{G}$ as the surprise government shock we overcome two factors that are often criticized in the literature. First, by using forecast errors we eliminate the problem of "fiscal foresight" [Ramey, 2011; Corsetti et al., 2010; Forni and Gambetti, 2010, 2016; Leeper et al., 2012, 2013 and others].[12] Second, we minimize the likelihood that estimates capture the potentially endogenous response of fiscal policy to the business cycle due to automatic stabilizers.[13]

The one-step equation for the state-dependent case is given by:

[11]The results of the one step and of the three steps estimates are identical if and only if all the regressions are estimated on the same sample.

[12]Fiscal foresight is the phenomenon that legislative and implementation lags ensure that private agents receive clear signals about the tax rates they face in the future and it is intrinsic to the tax policy process. Fiscal foresight produces equilibrium time series with a non-invertible moving average component, which misaligns the agents' and the econometricians' information sets in estimated VARs [Leeper et al.(2008)].

[13]In the STVAR or standard VAR analysis of how government spending shocks affect the economy, the impulse response is constructed in two steps. First, the contemporaneous responses are derived from a Cholesky decomposition. Second, the propagation of the responses over time is obtained by using estimated coefficients in the lag polynomials. The direct projection method effectively combines these two steps into one.

$$\sum_{j=0}^{h} y_{i,t+j} = I_{t-1}\left[\alpha_{A,i} + \mu_{A,t} + \Phi_{A,i,h}(L)x_{i,A,t-1} + m_{A,h}\sum_{j=0}^{h} g_{i,t+h}\right] \\ + (1-I_{t-1})\left[\alpha_{B,i} + \mu_{B,t} + \Phi_{B,i,h}(L)x_{i,B,t-1} + m_{B,h}\sum_{j=0}^{h} g_{i,t+h}\right] + \epsilon_{t+h}, \tag{2}$$

using $I_{t-1} \times shock_t$ and $(1 - I_{t-1}) \times shock_t$ as the instruments for the respective interaction of cumulative government spending with the two states. For the definition of slack state, we allow for a smooth transition threshold based on a 7-semi-annual moving average of output growth, similar to Auerbach and Gorodnichenko (2012). In our case, $I_{t-1} = F(z_{i,t-1})$

$$with : F(z_{i,t-1}) = \frac{exp(-\gamma z_{i,t-1})}{(1 + exp(-\gamma z_{i,t-1}))}, \gamma > 0 \tag{3}$$

$F(\cdot)$ is the transition function for each country in the sample with the range between 0 (strong expansion) and 1 (deepest recession), $z_{i,t-1}$ is a variable measuring the state of the business cycle, which is based on the deviation of the 3.5 years moving average of the output growth rate from its trend, normalized by the standard deviation of the output growth rate; i.e.

$$z_i = \frac{\text{(output growth rate)-(trend output growth rate)}}{\text{standard deviation of output growth rate}}$$

γ is a smoothing parameter: the higher is γ the lower is the probability that the economy stays in a recession (expansion) for long. The $z_{i,t-1}$ is normalized such that $E(z_{i,t-1}) = 0$ and $Var(z_{i,t-1}) = 1$ for each i. Moreover, we allow the trend to be time-varying inasmuch some EZ countries show low frequency variations in the output growth rate. For this reason, we use the backward HP filter to extract the trend with a high smoothing parameter $\lambda = 10,000$.

Figure 2 shows the scatter-plots of our shock $FE^G_{i,t}$ and (Panel a) our measure of the state of the business cycle ($z_{i,t}$); (Panel b) the actual level of public expenditure ($G_{i,t-1}$); and (Panel c) the actual GDP ($Y_{i,t}$). As already mentioned, no correlation emerges between our shock and the cited variables.[14]

In the following section we also test the relevance of shock ($FE^G_{i,t}$) as a valid and robust instrument in our IV setting. We allow all of the coefficients of the model to vary according to the state variable. Thus, we are allowing the forecast of $y_{i,t+j}$ to differ according to the states when the shock hits. Using the Jordà method the error term is likely to be correlated across countries. Thus, we use the Newey-West correction for our standard errors [Newey and West, 1987].

The one-step IV method *á la* Ramey and Zubairy (2018) has several advantages: 1) the standard errors of multipliers are estimated in one step; 2) the shock and the government spending can have measurement error whereas they are uncorrelated; 3) as an IV set can show the relevance of the instrument. This is useful because the government spending shocks tend to be relevant at different horizons. In the following sections, we test the instrument relevance across the different states.

4 Expansion *versus* recession

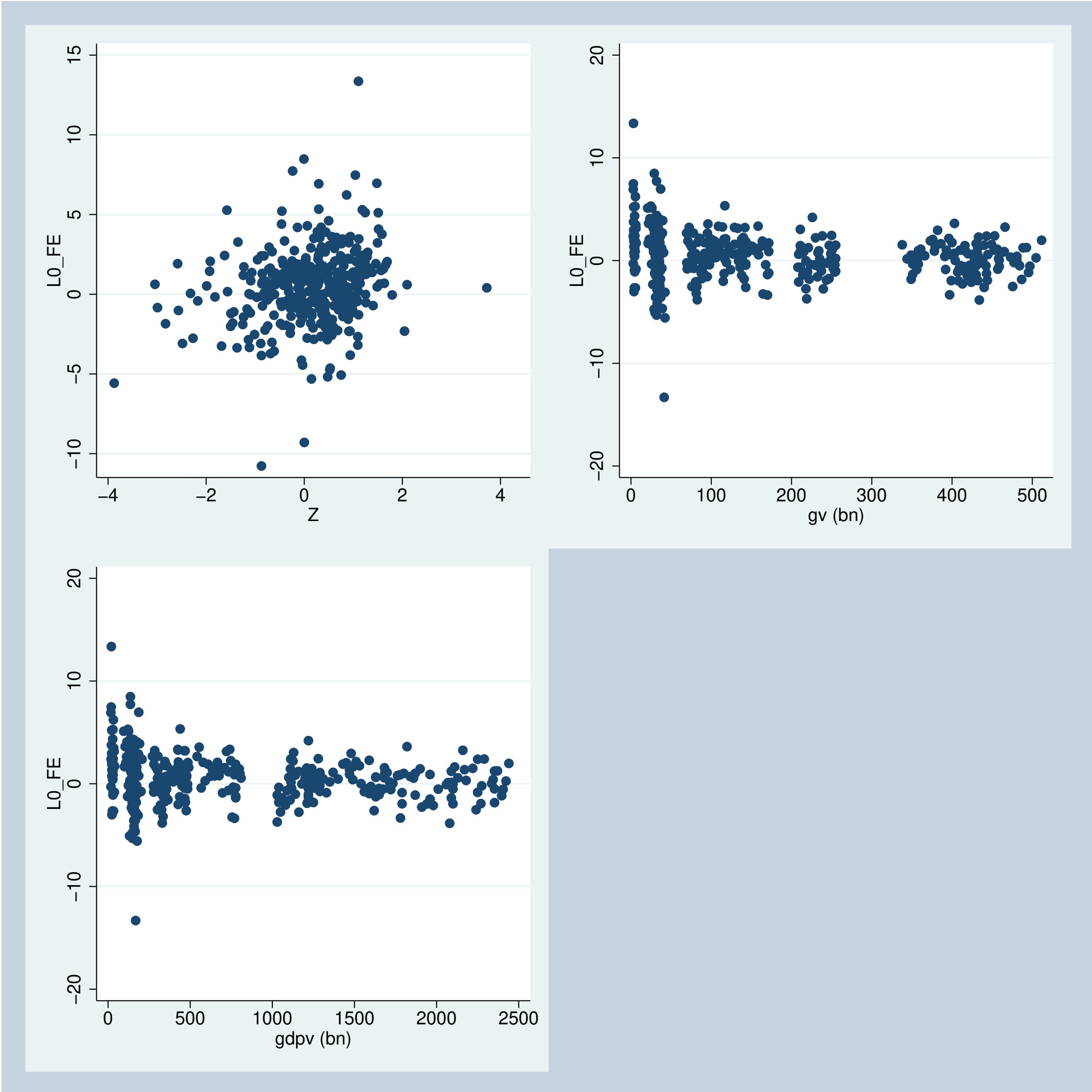
In this Section, we deal with our first non-linearity by comparing GDP multipliers in the Eurozone across different regimes, expansions and recessions.[15] However, the size of fiscal multipliers may change according to the state of financial markets. More precisely, following Ferraresi et al. (2015), we conjecture that fiscal policies should be more successful at stimulating output in regimes wherein the financial accelerator leads to "tight' credit conditions, hence to constrained production, employment and investment. Fiscal stimulus is especially effective in bypassing all such constraints and therefore may prove more effective when credit is actually tight. We proxy non linearities resulting from credit conditions using as threshold variable the spread between the BAA-rated corporate bond yield and the 10-year treasury constant maturity rate.

In line with Ferraresi et al. (2015), we prefer the BAA corporate bond spread to commercial paper because the former is more intertwined with long-term investment projects, and therefore it should allow one to better capture long-term changes in lenders'

[14] We also control for GDP ($Y_{i,t+h}$), government spending ($G_{i,t+h}$) and the state of the business cycle ($z_{i,t+h}$) at time *t+1*, *t+2*, *t+3*, *t+4* and the $FE^G_{i,t}$ fixed at time *t*, and no correlation emerges.

[15] We consider a smooth transition threshold based on a 7-quarter moving average of output growth, as in Auerbach, Gorodnichenko (2012).

Figure 2: Fiscal Policy shock vs Economic Cycle (Z), Government Spending (C+I, gv) and Gross Domestic Product (gdpv)



perceived risk (see Atanasova, 2003; Ernst et al., 2010). Moreover, as the low default rates on commercial paper make it a close substitute for treasury bills, in line with Ferraresi et al. (2015), we believe that the BAA spread is better suited to catch flight-to-quality episodes.

However, in Europe, it is impossible to find the corresponding BAA corporate bond yield for each country. Hence we move on to using the BAA corporate bond yield for the entire Eurozone proxied by the ICE BofA Euro Corporate Baa Index (the information is available from 1996). We proxy the credit conditions variable as the difference between the ICE BofA Euro Corporate BAA Index and the 10-year government bond yield at constant maturity for each of the countries in our sample (the 10-year government bond is not available for Luxembourg). A possible drawback of our measure is that at the beginning of the European sovereign debt crisis, in 2010, the BAA spread became negative for periphery eurozone countries and positive for core eurozone countries, as the Euro BAA corporate bond yield is equal for all euro countries and does not include the different corporate country-specific risk. As this could be misleading and in contrast with the meaning of the BAA spread measure, we only consider the period preceding the eurozone debt crisis (2010).

We define as "tight" credit conditions, the values of the 75 percentiles of the distribution of BAA spread. Furthermore, following Balke (2000) and Ferraresi et al. (2015), we apply a MA(2) to the series in first differences to avoid the presence of an implausible number of regime switches over time. The obtained series is shown in **Figure 3** for the sample period 1996-2008.

A possible problem could arise if the variations of the BAA spread variable closely track business cycles. In this case, our threshold variable would not be able to capture different credit market regimes as it would turn out to be only a proxy for output fluctuations. In line with Ferraresi et al. (2015), a straightforward way to test this hypothesis is to compute the correlation between our spread variable and GDP growth rates. We find that the correlation between GDP growth and the BAA spread is only -0.0327.[16] Moreover, we compare the sample of observations in the "tight" credit regime with those classified as "contractions" according to the OECD business cycle indicators. We find that only 23 observations out of 79 in the "tight" credit regime correspond to

[16] We also check for the correlation between the cumulative GDP and the BAA spread. It is -0.0959

OECD recessions. Finally, we also compare the sample of observations in the "tight" credit regime with those defined by the smooth transition threshold based on a 7-semi-annual moving average of output growth (see Auerbach and Gorodnichenko (2012)) and we find that only 28 observations overlap. We find that, when we take into account the double non-linearity, the state of the economy and the credit regime, as Ferraresi et al. (2015) do, differences in fact do exist. In recession, the multipliers are higher when considering a "tight" credit regime, but only in the long run. On the contrary, in expansion, the multiplier is higher when considering an ordinary regime. Moreover, most of the results are not statistically significant. Therefore, contrary to Ferraresi et al. (2015), we cannot claim that there is a clear dependence of multipliers on the interaction between the state of the economy and the credit regime. The results are shown in the Appendix B.

Now we can proceed to estimate multipliers using IV regressions. The question remains, however, whether the one we use is a relevant instrument. The standard rule of thumb is that an F-statistic below 10 indicates a potential problem with instrument relevance [Staiger and Stock, 1997)]. However, Olea and Pflueger (2013) show that the threshold can be different, and sometimes higher, when the errors are serially correlated. Since there is inherent serial correlation based on using the Jordà method, we use the Olea and Pflueger (2013) effective F-statistics and thresholds.

Panel A of Figure 4 shows the difference between the first-stage effective F-statistic and the Olea and Pflueger (2013) thresholds.[17] A value above zero means that the effective F-statistics exceeds the threshold. The F-statistics are from the regression of the sum of real government spending from t to $t+h$ on the shock(s) at t. The regression also includes all the other controls from the second stage. The results are shown for the linear case (black line), for an expansion scenario (red dashed line) and for a recession scenario (blue line).

Several features are evident from Figure 4. First, the linear case has potential relevance problems at very long horizons whereas the expansion scenario has always high relevance. Second, moving beyond the first year, the recession scenario effective F-statistic often falls below the threshold. Because of possible problems with instrument

[17] We use the threshold for the 10 percent critical value for testing the null hypothesis that the two-stage least squares bias exceeds 10 percent of the ordinary least squares bias. For one instrument, the threshold is 19.7.

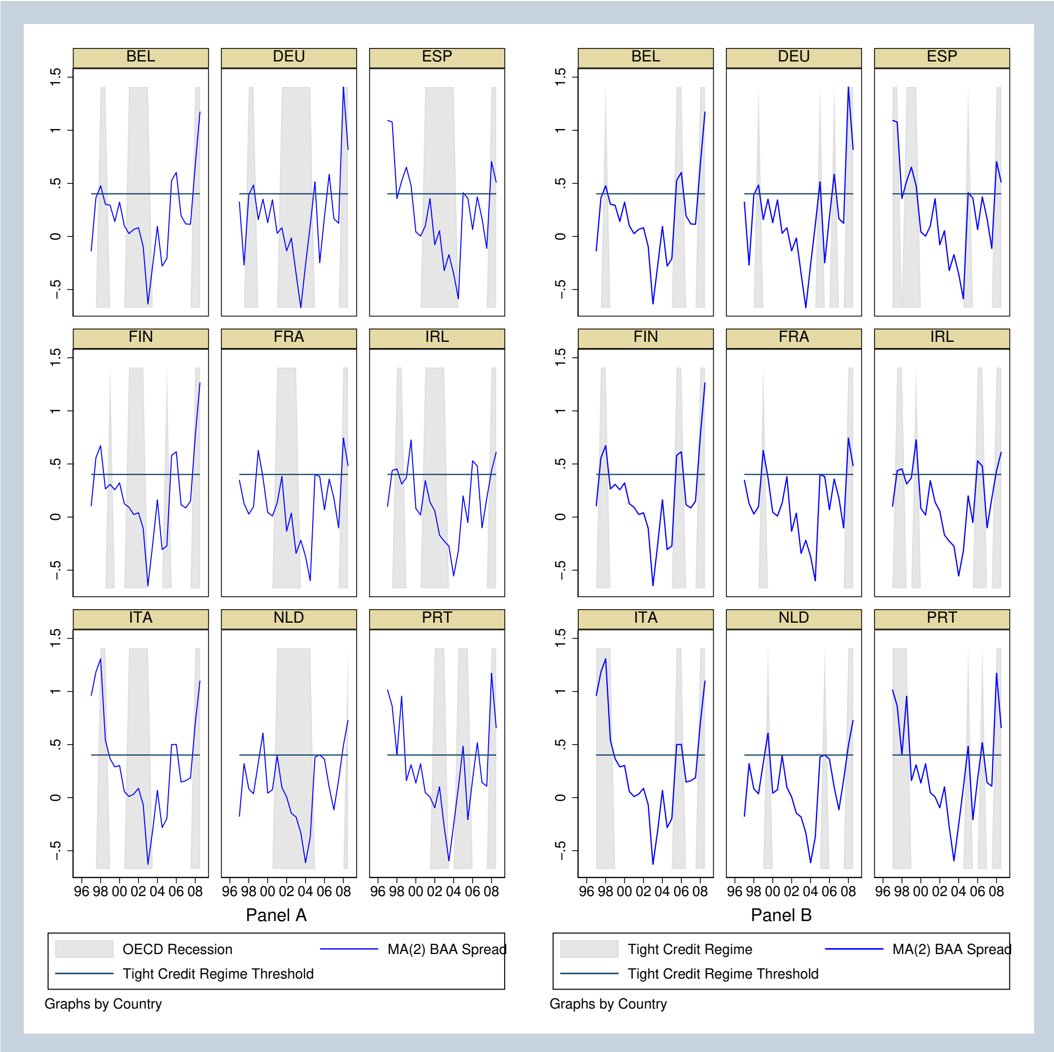


Figure 3: Threshold variable. Shaded areas in Panel A: recession periods according to OECD business cycle chronology. Shaded area in Panel B: estimated 'tight' credit periods. (Panel A) MA(2) of the first difference of the spread between BAA-rated corporate bond yield and 10-year government constant maturity rate. (Panel B) MA(2) of the first difference of the spread between BAA-rated corporate bond yield and 10-year government constant maturity rate.

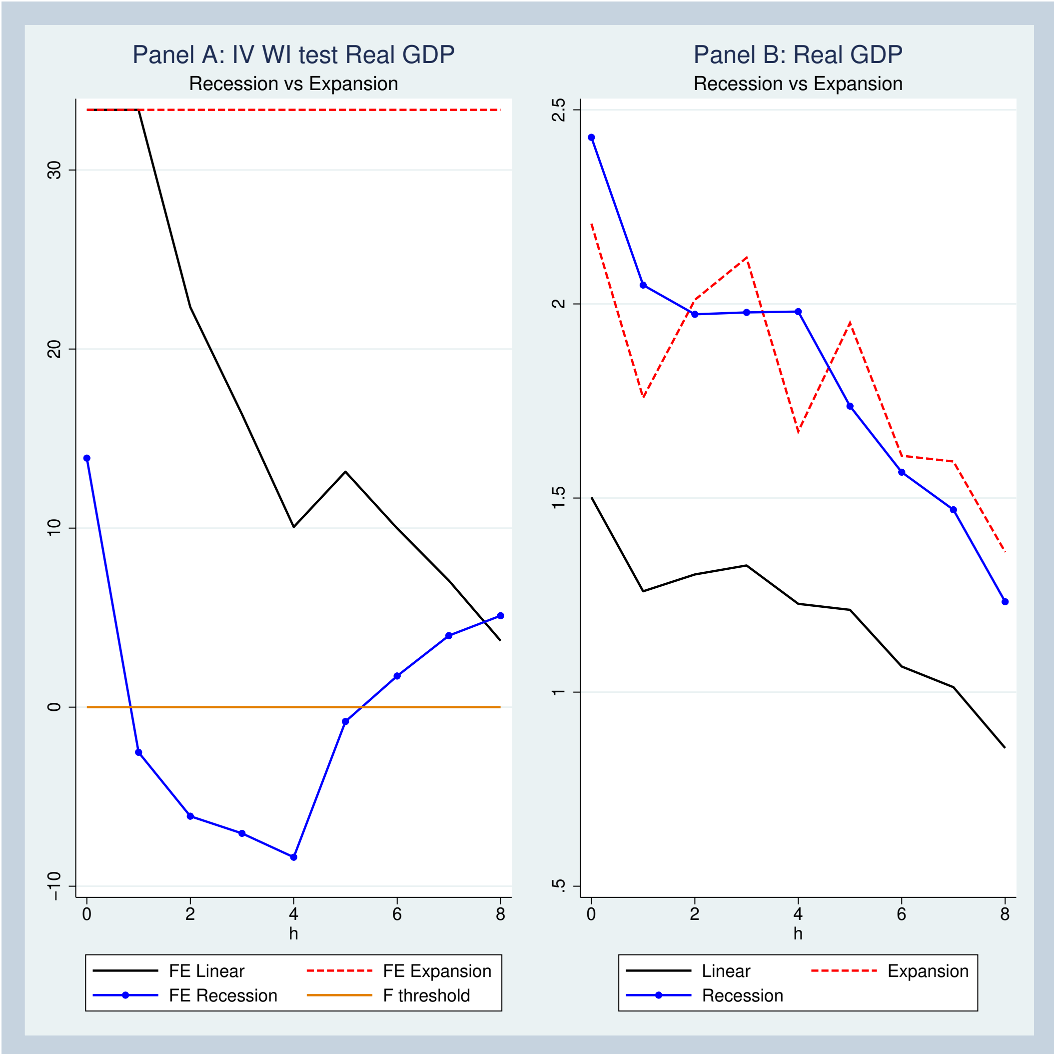


Figure 4: *Panel A*: Tests of instrument relevance. The lines show the difference between the effective F-statistic and the relevant threshold for the 10 percent level and are capped at 30. The effective F-statistics are from the regression of the sum of government spending through horizon h on the shock at t and all the other controls from the second stage, separately for the linear case (black line), the expansion scenario (red dashed line), and the recession scenario (blue line). The sample is 1992s1-2015s2. *Panel B*: GDP response to a FE shock equal to 1 percent of GDP. The black line is the response in a linear model; the red dashed line is the response in expansion and the blue line is the response in recession.

relevance for some horizons, we will also conduct some key hypothesis tests using Anderson and Rubin (1949) statistics, which are robust to weak instruments. However, these tests have lower power.

In Panel B of Figure 4, the main results of our analysis are presented using the local projections method. Panel B shows the impulse response functions. We first consider results from the linear model, which assumes that multipliers are invariant to the state of the economy (black line). After a FE shock equal to 1 percent of GDP, output immediately peaks at 1.5. We compute multipliers from a 1-year to a 4-year horizon, using m_h from equation 1. As indicated in the first column of Table 1, the implied multipliers are around 1.2.

The first question addressed in this paper is whether multipliers are state dependent and especially whether they are high in periods of slack. The impulse response functions in the state-dependent case are derived from the estimated $m_{A,h}$ and $m_{B,h}$ from equation (2). We show the responses when we estimate the state-dependent model, where we distinguish between periods with (blue dotted line) and without slack (red dashed line). The larger output response in recession does not imply a larger multiplier. In fact, as shown in the second and third column of Table 1, the implied multipliers from 1-year to 4-year are very similar across the two states, both around 1.8.

The final column shows the p-values for the test that the multiplier estimates differ across states. The first p-value reported is based on heteroscedastic-autocorrelation-consistent (HAC) standard errors and is valid only for strong instruments; the second is based on the Anderson, Rubin (1949) test and is robust to weak instruments. However, it has lower power, so we prefer the HAC-based test when the instruments are strong. There is no evidence of significant differences in multipliers.

Summing up we do not find state dependent multipliers in the Eurozone when looking to all expansion and recession phases between 1992 and 2015. However all multipliers estimated for the Eurozone both in expansion and recession are greater than one, contrary to Ramey and Zubairy (2018) findings as for the US.[18] The effectiveness of an expansion-

[18]We conduct robustness checks by changing the definition of the slack state. We consider standard OECD recession indicators (http://www.oecd.org/sdd/leading-indicators/CLI-components-and-turning-points.pdf), where I_{t-1} is a dummy variable which indicates the state of the economy when the shock hits. Using this definition, we find results in line with our baseline findings: multipliers are higher than one but not state-dependent in the Eurozone (see Appendix C).

Table 1: Estimates of Multipliers: Expansion *versus* Recession

GDP				
	Linear Model	Recession	Expansion	P-value for difference in multipliers across states
1-year integral	1.26	2.05	1.76	HAC = .42
	(0.55)	(0.82)	(0.89)	AR = .11
2-year integral	1.33	1.98	2.12	HAC = .55
	(0.44)	(0.57)	(0.83)	AR = .07
3-year integral	1.21	1.74	1.95	HAC = .52
	(0.36)	(0.34)	(0.60)	AR = .05
4-year integral	1.01	1.47	1.59	HAC = .25
	(0.29)	(0.23)	(0.60)	AR = .06

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

ary government spending policy appears in line with other estimates and much larger and more persistent than in the estimate of Ramey and Zubairy (2018). As the estimation method is the same, such a difference in the findings should be attributed to the shock variable chosen and the sample of countries under scrutiny, pointing to a possible larger impact of fiscal stimulus in the EZ with respect to the US.

5 Normal Times *versus* Deep Recession

The next question we address is whether evidence of non-linearities might arise when extraordinarily deep recessions are considered. Caggiano et al. (2015) finds that US multipliers are not state-dependent except for very deep recessions versus strong expansion. In a similar vein, we test whether Eurozone multipliers in deep recessions are definitely higher than in expansion. We consider a deep recession when the probability of recession $F_z > 75\%$, and we re-estimate equation 2, where I_{t-1} is a dummy variable equal to 1 when $F_z > 75\%$ and 0 otherwise.[19]

Panel A in Figure 5 shows the difference between the effective F-statistics and the thresholds for the periods split into deep recession periods and normal times. In the linear model and in normal times, the instrument loses relevance after 9 horizons, while

[19] $F_z > 75\%$ is the AG's indicator of the state of the economy, when $F_z = 1$ indicates the most severe recession possible and $F_z = 0$ indicates the most extreme boom possible.

the recession instrument has effective F-statistics for all horizons, except around the fourth period. In any case, the instrument appears to be strong.

To determine whether multipliers are different in deep recession, we estimate our state-dependent model. We consider our sample 1992s1-2015s2. Panel B of Figure 5 shows the impulse responses. The results suggest that output responds more strongly and more persistently in deep recessions that it does in "normal" times (both expansions and mild downturns).

Table 2 shows the cumulative multipliers in each state from 1-year horizon to 4-year horizon. We see little difference between multipliers in normal times and multipliers in the linear model. The multiplier both in the linear model and in expansions peaks at the second horizon, staying above one thereafter if we use the linear model. Differently, it is slightly higher than one only at 2-year horizon if we consider normal times. On the other hand, as for the deep recession case, the multiplier peaks at 1-year horizon (2.43) and gradually decreases (see the third column of Table 2) - but remaining always higher than multipliers in normal times and in the linear model. There is also statistical evidence of differences in multipliers, as evidenced by the p-values; we refer to the HAC-based tests since the instruments appear to be strong. This difference is due to large multipliers in deep recessions.

Our results corroborate, as for the Euro area, the findings by Caggiano et al. (2015) which suggest that deep recessions are associated with larger fiscal spending multipliers in Unites States. Auerbach and Gorodnichenko (2012, 2013) conclusion might be driven by the implicit assumption that all recessions are treated like extreme events when conducting their impulse response analysis. Caggiano et al. (2015) suggests that this may very well be the case. Overall, our analysis based on "disaggregated" recessions shows that non-linearities are likely to arise when we separate deep recessions from mild downturns. In particular, we find support in favour of larger fiscal multipliers when deep recessions are considered. This result has important implications in a policy perspective, suggesting that a fiscal stimulus may be highly effective when it is most advocated, i.e. when economies plunge into deep recessions both in United States, as Caggiano et al. (2015) find, and in the Euro Area, as found in the present paper.

We also conduct a robustness check by changing the definition of "deep recession". We consider the OECD recession indicators as for GDP drops of at least 1 percent, where I_{t-1} is a dummy variable which indicates the state of the economy when the shock hits.

Figure 5: *Panel A*: Tests of instrument relevance. We consider a deep recession when the probability of recession $F_z > 75\%$ ($F_z > 75\%$, is AG's indicator of the state of the economy, when $F_z = 1$ indicates the most severe recession possible and $F_z = 0$ indicates the most extreme boom possible). The lines show the difference between the effective F-statistic and the relevant threshold for the 10 percent level and are capped at 30. The effective F-statistics are from the regression of the sum of government spending through horizon h on the shock at$t$ and all the other controls from the second stage, separately for the linear case (black line), the expansion scenario (red dashed line), and the recession scenario (blue line). The sample is 1992s1-2015s2. *Panel B* : GDP response to a FE shock equal to 1 percent of GDP. The black line is the response in a linear model; the red dashed line is the response in expansion and the blue line is the response in recession.

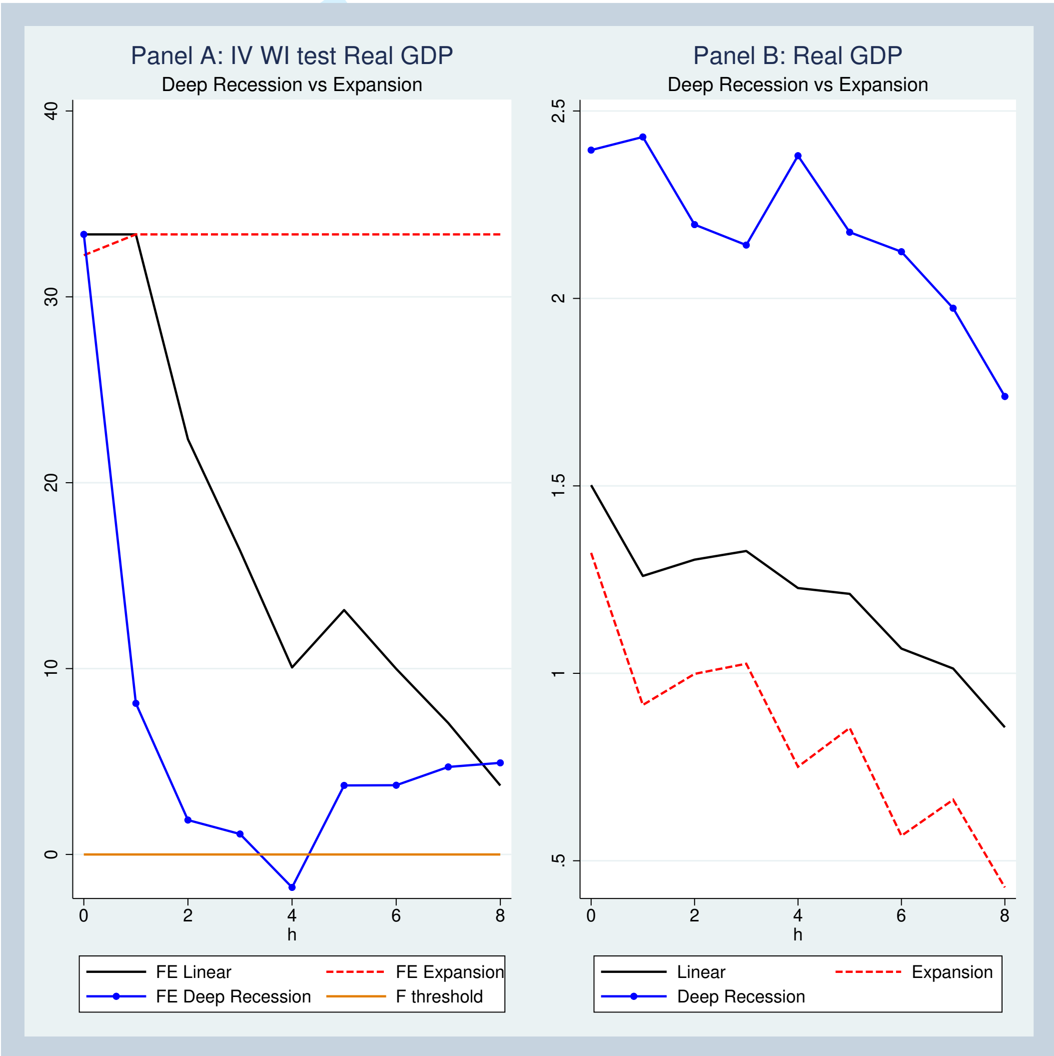


Table 2: Estimates of Multipliers: Normal Times *versus* Deep Recession

GDP				
	Linear Model	Deep Recession	Normal Times	P-value for difference in multipliers across states
1-year integral	1.26	2.43	0.92	HAC = .19
	(0.55)	(1.11)	(0.56)	AR = .23
2-year integral	1.33	2.14	1.03	HAC = .22
	(0.44)	(0.83)	(0.47)	AR = .11
3-year integral	1.21	2.18	0.85	HAC = .05
	(0.36)	(0.54)	(0.37)	AR = .08
4-year integral	1.01	1.97	0.66	HAC = .01
	(0.29)	(0.32)	(0.37)	AR = .09

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

Using this definition, we find results in line with our baseline findings: multipliers are significantly higher in deep recession in the Eurozone (see Appendix C).

6 Initial conditions heterogeneity

Since there were significant differences in macroeconomic initial conditions across Euro countries over time, in this section we enquire whether these differences affect the size of multipliers. The factors that might affect the results will be decomposed, for instance, by looking at temporary and long period shifts in fiscal policy. When undertaking experiments it is important to be able to dissect the contributing factors. This is the reason why, for each factor, we will show the cumulative multipliers from 1-year horizon to 4-year horizon, by keeping as a benchmark the multipliers obtained in a linear model that (by definition) does not account for the impact of non-linearities in initial conditions here analysed. In addition, in order to give a more coherent and comparable interpretation of the results, we estimate the multiplier conditioning on the phase of the business cycle and structural characteristics of the economy. This is expected to shed light on the mechanisms through which the spending efforts become more effective in the Eurozone. We however confine this analysis to Appendix D, because the limited data available make most of the results non statistically significant.

6.1 Trade openness

IMF (2008) found conflicting results on the topic. The conclusion is that the measure of openness used in the regressions was picking up other effects not accounted for in their simulations. Barrell et al.(2012) show that multipliers tend to be smaller in more open economies, because the more open an economy is the more of a shock will spillover onto other countries through imports. Indeed small open economies such as Belgium have small multipliers. In the same vein, Ilzetzki et al.(2013) show that the government spending multiplier is higher in closed economies than in open economies, which is consistent with the macroeconomic literature. We confirm these results for our 10 EZ countries in the period 1992-2015.

We divide our sample of 10 countries based on their ratio of trade (imports plus exports) to GDP, following Ilzetzki et al. (2013). As a shorthand, we label an economy as *open* if this ratio exceeded the median value of the sample. If foreign trade is less than the median value, we defined the country as *closed*. The cumulative responses, shown in Table 3, indicate that the volume of trade as a proportion of GDP is a critical determinant of the size of the fiscal multiplier. For economies with low trade-GDP ratios, the impact response is 2.07 and the long-run multiplier (4-year horizon) is 2.44. For economies with high trade volumes as a proportion of GDP, the impact response is 0.55 and 0.89 in the long run. Hence, multipliers are statistically different between open and closed economies at all forecast horizons and are far larger in closed economies than in open economies.[20]

6.2 Labour market rigidity

Gorodnichenko et al. (2012) argue that to fully understand the reaction of the Finnish economy to the shocks caused by the collapse of Soviet trade, it is important to examine the Finnish labour market, which is notable for its high degree of unionisation. In general terms, this entails that labour market rigidity may interact with the measure of openness - previously discussed - as for the impact on fiscal multipliers. Given that there are significant differences in labour market rigidity conditions across Euro countries and over time, we enquire whether these differences affect the size of multipliers.

[20] We refer to the AR-based tests since the instruments appear to be strong only in the short term.

Table 3: Estimates of Multipliers: Open *versus* Closed Economy

	GDP			
	Linear Model	Open Economy	Closed Economy	P-value for difference in multipliers across states
1 year integral	1.12	0.55	2.07	HAC = .25
	(0.54)	(0.67)	(1.09)	AR = 0.16
2 year integral	1.40	1.16	2.17	HAC = .40
	(0.45)	(0.57)	(0.96)	AR = 0.04
3 year integral	1.32	1.27	2.31	HAC = .38
	(0.37)	(0.49)	(0.84)	AR = 0.01
4 year integral	1.09	0.89	2.44	HAC = .10
	(0.34)	(0.45)	(0.73)	AR = 0.01

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

We divide our sample of 10 countries based on the EPL index on regular employment (see OECD Employment Protection Legislation Database, 2020). As a shorthand, we label the labour market rigidity as *high* if this index exceeded the median value of the sample. If the index is less than the median value, we defined the labour market rigidity as *low*.

As shown in Table 4, cumulative fiscal multipliers are persistently higher the more rigid are labour markets. This confirms the Keynesian intuition that under rigid labour markets, wages (and consequently prices) do react slowly to aggregate demand increases ignited by a fiscal stimulus, leaving room for larger "quantity" changes, i.e. higher fiscal multipliers.

6.3 The size of automatic stabilizers

Larger automatic stabilizers tend to reduce fiscal multipliers as the automatic endogenous response of transfers and tax revenues mechanically offsets part of the initial fiscal stimulus, lowering its effect on GDP (Dolls et al. 2012, 2019). In order to check this conjecture as for the EZ, we divide our sample of 10 countries based on the average value of automatic stabilizers of each country over time estimated by Dolls et al.(2019). As a shorthand, we label the automatic stabilizer as *high* if that value exceeded the median value of the sample. Otherwise, if that value is less than the median value, we define the automatic stabilizer as *low*.

Table 4: Estimates of Multipliers: High *versus* Low Labor Market Rigidity

	GDP			
	Linear Model	High Labor Market Rigidity	Low Labor Market Rigidity	P-value for difference in multipliers across states
1 year integral	1.11	1.82	0.91	HAC = .50
	(0.54)	(0.94)	(0.69)	AR = .09
2 year integral	1.41	1.75	1.56	HAC = .95
	(0.45)	(0.79)	(0.55)	AR = .01
3 year integral	1.35	1.61	1.61	HAC = .81
	(0.38)	(0.76)	(0.45)	AR = .01
4 year integral	1.10	1.67	1.27	HAC = .77
	(0.34)	(0.68)	(0.38)	AR = .01

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

Table 5: Estimates of Multipliers: High *versus* Low Automatic Stabilizer

	GDP			
	Linear Model	High Automatic Stabilizer	Low Automatic Stabilizer	P-value for difference in multipliers across states
1 year integral	1.34	1.23	2.02	HAC = .59
	(0.60)	(0.70)	(1.14)	AR = .07
2 year integral	1.66	1.66	2.64	HAC = .55
	(0.50)	(0.62)	(1.00)	AR = .01
3 year integral	1.54	1.35	2.93	HAC = .24
	(0.42)	(0.58)	(0.95)	AR = .01
4 year integral	1.29	1.20	2.34	HAC = .49
	(0.40)	(0.57)	(1.07)	AR = .03

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

Table 6: Estimates of Multipliers: Exchange Rate Regime

GDP				
	Linear Model	Eurozone	Before Eurozone	P-value for difference in multipliers across states
1 year integral	1.15	1.31	0.49	HAC = .28
	(0.58)	(0.62)	(0.46)	AR = .11
2 year integral	1.44	1.63	0.85	HAC = .31
	(0.44)	(0.48)	(0.59)	AR = .02
3 year integral	1.36	1.59	0.82	HAC = .30
	(0.36)	(0.38)	(0.58)	AR = .01
4 year integral	1.10	1.25	1.09	HAC = .78
	(0.32)	(0.33)	(0.61)	AR = .01

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

Table 5 summarizes the results. It shows that automatic stabilizers are indeed crucial factors which drive fiscal multipliers, and that automatic stabilizers are negatively correlated to the size of fiscal multipliers.

6.4 The exchange rate regime

In the traditional Mundell-Fleming model, government spending is ineffective at stimulating domestic demand under flexible exchange rates because a fiscal expansion *crowds out* net exports as a consequence of the exchange rate appreciation, following the home interest rate increase. In contrast, under fixed exchange rates, fiscal policy becomes effective because the exchange rate appreciation is immediately offset through monetary expansion.

After the injection of the euro all of the transactions within the Eurozone are settled with a single currency, which is a proxy for a fixed exchange regime. As the transactions within the Eurozone make for a large share of all foreign transactions of EZ countries we can say that exchange rates are prevalently fixed after 1999 whilst they were prevalently flexible before the euro. Hence we investigate whether the spending multiplier is higher in (post-euro) fixed exchange rate regime than in the (pre-euro) flexible exchange rate regime. We show evidence that supports the standard Mundell-Fleming prediction.

The cumulative multipliers, shown in Table 6, suggest that the exchange rate regime matters a great deal. The third column shows results for our sample of countries after the creation of EMU. The impact multiplier is 1.31, and rises to 1.63 in the second year. The fourth column shows results as for the pre-euro period. The impact multiplier is 0.49, and it rises to 1.09 in the fourth year. Multipliers show a gradual decline after the second year in the EMU period, whilst they do not show a monotonic pattern in the pre-euro period. In sum, we find sizeable and statistically significant differences at any forecast horizon in the fiscal policy transmission mechanism across exchange rate regimes.[21]

6.5 The debt level

It may be expected that countries affected by high interest rates will experience lower effectiveness of a public spending expansion. As soon as the boundaries of public debt sustainability are met, the cost of government borrowing will skyrocket and this will make the expansion short lived through the standard crowding out and possibly intertemporal substitution effects.

For the same reason, expanding public expenditure in countries with a low fiscal space is deemed to be not very productive. Indeed, a common tenet is that a fiscal stimulus is less effective - fiscal multipliers are lower - in high public debt countries, as an increase in public expenditure fuels the "Ricardian" expectation of future tax hikes which induce people to save more and spend less. Moreover, Ilzetzki et al. (2013) find that if an expansionary fiscal policy raises the deficit and public debt ratio, the risk premium on interest rates rises, ultimately boosting the cost of borrowing and negatively affecting aggregate demand. However, they consider 44 OECD countries and use not only a SVAR model as in Blanchard and Perotti (2002) but also a 60 percent debt-gdp ratio as a (rather low) threshold. In the same vein, in Kirchner et al. (2010), the effects of spending shocks on output and consumption are expected to be smaller the higher the initial debt-to-GDP ratio. They use the lagged aggregate Euro area debt-to-GDP ratio to measure the initial financing needs of all Euro area governments.[22] Their results suggest that an increase in the share of government debt over GDP has had a negative impact on contemporaneous spending multipliers. A one percentage point increase in the debt ratio leads to a decline in the spending multiplier by 0.01 points. In summary,

[21] We refer to the AR-based tests since the instruments appear to be strong only in the short term (1-year).

[22] It is a time series approach, differently from our panel approach.

they find that the level of government debt has an adverse impact on the size of spending multipliers especially in the long run whereas the short-term impact turns unimportant once they account for the uncertainty in estimated multipliers. Also Auerbach and Gorodnichenko (2012) find that large government debt reduces the response of output to government spending shocks. However, in order to define high debt countries, they multiply their debt-to-GDP ratio by the expenditure shock.

There is a second strictly interlinked question: does a fiscal stimulus always lead to an increase in the debt to GDP ratio? As argued by Auerbach and Gorodnichenko (2017) "a fiscal stimulus in recession can pay for itself: when economy is strong, additional government spending is unlikely to increase output considerably and thus a spending shock adds to debt without much improvement in the denominator of the ratio. In contrast, when the economy is weak, a spending shock has a stimulatory effect so strong that the ratio decreases, both as a result of a lower numerator (...) and a higher denominator (higher GDP)" (p.18). De Long and Summers (2012), under the assumption of hysteresis, show that a fiscal stimulus can lead to a reduction in the debt to GDP ratio, if multipliers are greater than 1 and interest rates are stuck to their lower bound. In the same vein Fatás and Summers (2015) show that fiscal consolidation may be self-defeating and even lead to an increase in the debt to GDP ratio (via hysteresis). There is a logical chain from the initial level of debt/GDP ratio which might affect the size of multipliers which in turns affects the dynamics of the debt to GDP ratio.

In this section we aim at investigating the first ring of the chain. We follow Auerbach and Gorodnichenko (2017) in directly estimating GDP multipliers in high public debt and low public debt countries.[23] Since there were significant differences in initial debt levels across Euro countries and over time, we can gauge the correlation between such initial conditions and the size of government spending multipliers by re-estimating equation 2, where I_{t-1} is a dummy variable equal to 1 for high debt countries and 0 for low debt countries. As for the definition of the threshold we follow the suggestion of the European Fiscal Board (EFB) and fix it at a debt/GDP ratio equal to 80%.[24]

[23] Auerbach and Gorodnichenko (2017) find that even in countries with high public debt, the penalty for activist discretionary fiscal policy appears to be small. The convincing critique advanced by Ramey and Zubairy (2018) to Auerbach and Gorodnichenko's econometric approach led us to Jorda's local projection method as in Ramey and Zubairy (2018).

[24] On September 11, 2019, the European Fiscal Board (EFB) published an assessment of the EU fiscal rules. In line with the Assessment of EU fiscal rules, we define the high-

Table 7 shows the cumulative multipliers in each state from 1-year horizon to 4-year horizon. We see little difference between multipliers in low debt countries and in the linear model. The multiplier both in the linear model and in low debt countries peaks at the second horizon, still being greater than one at each horizon in the linear model. Differently, it is equal or slightly higher than one respectively at 2-year and 3-year horizon if we consider low debt countries.

As for high-debt countries, the multiplier peaks at 1-year horizon at such a high value as 2.33, remaining thereafter greater than multipliers in the linear model and in low debt countries. There is also statistical evidence of differences in multipliers, as shown by the p-values; we refer to the AR-based tests since the instruments appear to be strong only in the short term (1-year). This difference is due to large multipliers in high debt countries.[25] Hence, we find that the fiscal multiplier is higher when debt burdens are high, particularly in the short run. Our findings are consistent with the strong and statistically significant (10%) negative correlation between the aggregate saving rate (out of disposable income) and the debt/GDP ratio in EZ countries. Moreover the negative correlation becomes even stronger in countries that have seen their debt/GDP ratios raising abruptly after the crisis.[26] This suggests that the strong feedback between multipliers and the level of debt could still operate via fluctuations, analysed previously (recessions *versus* expansions). Indeed, in the sample period under analysis, countries *entering* the high debt scenario, meaning those trespassing the 80 percent threshold that we consider (Germany, Spain, France, Ireland, Portugal) are also those that were experiencing periods of recession. We address this issue in Appendix D.

---

debt Member States in the Eurozone, Country that have a debt-GDP ratio higher than 80%. $https : //ec.europa.eu/info/publications/assessment - eu - fiscal - rules - focus - six - and - two - pack - legislation_en$

[25]We replicate the same exercise using the Deficit-GDP ratio as an indicator of different initial conditions, and we find very similar results. First the difference in multiplier is statistically significant for each period considered. Second, the 2- and 4-year multipliers are widely different across the two states: as for high-deficit countries they are respectively 2.4 and 1.9, whilst as for low-deficit countries they are 0.5 and 0.4. When using deficits the estimated multipliers are greater than one only in high-deficit countries. Regressions will be available upon request.

[26]We run simple panel regressions with fixed effects of the saving rate over the debt/GDP ratio since 2000 for the EZ countries from the Eurostat database. We also estimated a VAR model for the same variables and the results point to the direction presented in the main text. Regressions will be available upon request.

Table 7: Estimates of Multipliers: High *versus* Low Debt

GDP				
	Linear Model	High Debt	Low Debt	P-value for difference in multipliers across states
1 year integral	1.31	2.33	0.80	HAC = .17
	(0.54)	(0.79)	(0.58)	AR = .13
2 year integral	1.38	2.04	1.00	HAC = .27
	(0.43)	(0.66)	(0.48)	AR = .10
3 year integral	1.35	2.27	1.09	HAC = .32
	(0.35)	(0.87)	(0.40)	AR = .05
4 year integral	1.10	1.95	0.86	HAC = .17
	(0.30)	(0.70)	(0.33)	AR = .05

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

7 Multipliers and the zero lower bound (ZLB)

One case in which it is especially plausible to presume that the central bank will not tighten their policy stance in response to an increase in government purchases is when monetary policy is constrained by the zero lower bound (ZLB) on the short-term nominal interest rate. This is a case in which it is reasonable to assume not merely that the real interest rate does not rise in response to a fiscal stimulus, but that the nominal rate does not rise either; this will actually be associated with a decrease in the real interest rate, to the extent that the fiscal stimulus is associated with increased inflation expectations. Hence, government purchases should have an especially strong effect on aggregate output when the central bank's policy rate is at the zero lower bound.[27] This is also a case of particular interest, since calls for fiscal stimulus become more urgent when it is no longer possible to achieve as much stimulus to aggregate demand as would be desired through interest-rate cuts alone. In practice, the zero lower bound is most likely to become a binding constraint on monetary policy when financial intermediation is severely disrupted. The effects of fiscal policy at the zero lower bound depend crucially on agents' perceptions about the likely duration of the liquidity trap. The ZLB duration in turn generally depends on a number of factors, including the parameters of the monetary

[27] In fact, it only matters that the policy rate is stuck at a level that the central bank is unwilling to go below; this effective lower bound needs not be zero.

Table 8: Estimates of Multipliers: before *versus* at the zero lower bound

GDP				
	Linear Model	ZLB	Before ZLB	P-value for difference in multipliers across states
1 year integral	0.87	1.60	0.89	HAC = .54
	(0.51)	(0.99)	(0.59)	AR = .10
2 year integral	1.26	2.31	1.23	HAC = .43
	(0.44)	(1.26)	(0.48)	AR = .03
3 year integral	1.22	2.35	0.94	HAC = .23
	(0.36)	(0.85)	(0.43)	AR = .04
4 year integral	0.98	0.18	0.78	HAC = .21
	(0.32)	(0.49)	(0.39)	AR = .27

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

policy rule, the type of shocks causing the liquidity trap, and the fiscal response. If the liquidity trap is very prolonged, the spending multiplier can be much larger than in normal circumstances. In order to address this issue, we replace equation 2, with the following one:

$$\sum_{j=0}^{h} y_{i,t+j} = I_{t-1}\left[\alpha_{A,i} + \mu_{A,t} + \Phi_{A,i,h}(L)x_{i,A,t-1} + m_{A,h}\sum_{j=0}^{h} g_{i,t+h}\right] + (1 - I_{t-1})\left[\alpha_{B,i} + \mu_{B,t} + \Phi_{B,i,h}(L)x_{i,B,t-1} + m_{B,h}\sum_{j=0}^{h} g_{i,t+h}+\right] + \epsilon_{t+h}, \quad (4)$$

using I_{t-1} as the definition of the ZLB period (2012-2015). Table 8 shows the cumulative multipliers from 1-year horizon to 4-year horizon in ZLB versus non-ZLB times. Multipliers in the Eurozone are much higher in ZLB times (dropping below 1 at 4-year horizon, however). In order to understand if this result depends on ZLB monetary policy or on the frequent coincidence between ZLB and periods of recession, we conduct a sensitivity analysis in Appendix E. The analysis confirms the results found in Sections 4 and 5.

8 Conclusion

The former vice-president of the ECB Vítor Constâncio (2020, p. 1) noticed that in the past few years "fiscal policy seems to emerge again as a necessary active policy tool in view of the clear diminishing returns of monetary policy". There remains an enormous range of views over the strength of fiscal policy's macroeconomic effect. However, most studies are focused on the US which has a smaller and differently articulated public sector with respect to that of the Euro area. In order to highlight the peculiarity of this area, we estimate (using Jorda's (2005) local projection method) the effects of the spending side of fiscal policies by exploring different non linearities arising from the states of the business cycle and from varying initial conditions and structural characteristics of the EZ economies.

As for the state of the business cycle, our results are a mix of those found in the relevant literature on state-dependent multipliers. On the one hand, we confirm Ramey and Zubairy (2018) about the absence of sizeable differences in multipliers over the phases of ordinary business cycles. On the other hand, our results match reasonably well Auerbach and Gorodnichenko (2012) analysis according to which fiscal multipliers are always above unity. By focusing on deep recessions it turns out that non linearities are likely to arise. In particular, we find support in favour of larger fiscal multipliers in deep recessions both at peak and overtime, whilst there is little difference between multipliers in normal times and in the linear model.

We find that nonlinearities arising from different structural characteristics of the EZ economies matter. Multipliers are statistically different between open and closed economies and are far larger in closed economies than in open ones. Our results also confirm the Keynesian intuition according to which, under rigid labour markets, wages do react slowly to aggregate demand increases ignited by a fiscal stimulus, leaving room for larger "quantity" changes, i.e. higher fiscal multipliers. We show that automatic stabilizers are crucial factors which drive fiscal multipliers, and that automatic stabilizers are negatively correlated to the size of fiscal multipliers in the EZ. Sizeable and statistically significant differences in the fiscal policy transmission mechanism also emerge across exchange rate regimes and between high debt and low debt countries, showing that the size of expenditure multipliers are not positively related to the the fiscal space as one might expect on the basis of "Ricardian" arguments. When testing for the impact of double non linearities (state of the business cycle together with structural characteristics) our findings are broadly confirmed. However differences in multipliers loose statistical significance. Finally, we show the key role played by monetary policy in multiplier estimation; multipliers are much higher at the ZLB. Taken together, our empirical findings cast doubts on the non-Keynesian effects argument, at least as far as the Euro area is concerned.

Many articles advocate a large fiscal policy intervention in Europe, particularly after the extraordinary shock of coronavirus (e.g. Galì, 2020; Group of concerned economists, 2020; Bénassy-Quére et al., 2020; Reichlin et al., 2020). We believe that our results can be employed as useful ingredients for correctly planning and implementing (now and in the future) such an intervention, independently of the specific financing method that will be chosen. Moreover, given the sign and size of the estimated expenditure multipliers our findings support the view that the aftermath of the sovereign debt crisis was not the right time to implement a front-loaded fiscal consolidation in many Eurozone countries. Considering not only output multipliers, but also employment multipliers is an important direction that is left to future research as well as investigating the (possibly state-dependent) impact of expansionary fiscal policies on the ensuing evolution of government deficit and debt (as in Auerbach, Gorodnichenko, 2017; De Long, Summers, 2012), which seems to be crucial for a deep revision of the Euro Area fiscal framework aimed at removing the existing pro-cyclicality (some preliminary results in Boitani and Perdichizzi, 2019).

References

[1] Alesina, A., S. Ardagna (1998). Tales of Fiscal Adjustment, *Economic Policy* 13(27), 489-585.

[2] Amendola, A., M. Di Serio, M. Fragetta, G. Melina (2020). The euro-area government spending multiplier at the effective lower bound, *European Economic Review*, 127, 103480.

[3] Anderson, T. W., H. Rubin (1949). Estimation of the parameters of a single equation in a complete system of stochastic equations, *Annals of Mathematical Statistics*, 20, 46-63.

[4] Atanasova, C. (2003). Credit market imperfections and business cycle dynamics: a nonlinear approach, *Studies in Nonlinear Dynamics and Econometrics*, 7, 1-22.

[5] Auerbach, A.J., Y. Gorodnichenko (2012). Measuring the Output Responses to Fiscal Policy, *American Economic Journal:Economic Policy*, 4(2), 1-27.

[6] Auerbach, A.J., Y. Gorodnichenko (2013). Fiscal Multipliers in Recession and Expansion. In Fiscal Policy after the Financial Crisis, edited by Alberto Alesina and Francesco Giavazzi. Chicago: University of Chicago Press.

[7] Auerbach, A.J., Y. Gorodnichenko (2017). Fiscal Stimulus and Fiscal Sustainability, *NBER Working Paper* No. 23789.

[8] Balke, N.S. (2000). Credit and economic activity: credit regimes and nonlinear propagation of shocks, *Review of Economics and Statistics*, 82, 344-349.

[9] Barrell, R., D. Holland, I. Hurst (2012). Fiscal Consolidation: Part 2. Fiscal Multipliers and Fiscal Consolidations. *OECD Economics Department Working Paper 933.*

[10] Batini, N., G. Callegari, G. Melina (2012). Successful austerity in the United States, Europe and Japan, *IMF Working Paper 12/190.*

[11] Batini, N., G. Melina, S. Villa (2019). Fiscal buffers, Private Debt and Recession: The Good, The Bad and the Ugly, *Journal of Macroeconomics*, 62.

[12] Baum, A., M. Poplawski-Ribeiro, A. Weber (2012). Fiscal Multipliers and the State of the Economy, *IMF Working Paper 12/286.*

[13] Bénassy-Quéré, A., R. Marimon, J. Pisani-Ferry, L. Reichlin, D. Schoenmaker, B. Weder di Mauro (2020). COVID-19: Europe needs a catastrophe relief plan, voxeu.org, 11 March.

[14] Blanchard, O., C. J. Erceg, J. Lindé (2017). Jump-Starting the Euro-Area Recovery: Would a Rise in Core Fiscal Spending Help the Periphery?, *NBER Macroeconomics Annual*, 31(1), 103-182.

[15] Blanchard, O., R. Perotti (2002). An empirical characterisation of the dynamic effects of changes in government spending and taxes on output, *The Quarterly Journal of Economics*, 117(4), 1329-1368.

[16] Boitani A., S. Perdichizzi (2019). Public expenditure multipliers in recessions. Evidence from the Eurozone, EACBN Conference, Banca de España, May 30-31.

[17] Born, B., F. Juessen, G. J. Mueller (2013). Exchange rate regimes and fiscal multipliers, *Journal of Economic Dynamics and Control*, 37, 2, 446-65.

[18] Caggiano, G., E. Castelnuovo, V. Colombo, G. Nodari (2015). Estimating Fiscal Multipliers:News from a Non-linear World, *Economic Journal*, 584, 746-776.

[19] Coenen, G., C. J. Erceg, C. Freedman, D. Furceri, M. Kumhof, R. Lalonde, D. Laxton, J. Lindé, A. Mourougane, D. Muir, S. Mursula, C. de Resende, J. Roberts, W. Roeger, S. Snudden, M. Trabandt, J. in't Veld (2012). Effects of Fiscal Stimulus in Structural Models, *American Economic Journal: Macroeconomics*, 4 (1): 22-68.

[20] Colander, D., P. Howitt, A. Kirman, A. Leijonhufvud, P. Mehrling (2008). Beyond DSGE models: toward an empirically based macroeconomics, *American Economic Review*, 98(2), 236-240.

[21] Constâncio V. (2020). The return of fiscal policy and the euroarea fiscal rule, *REM Working Paper* 0127-2020

[22] Corsetti, G., K. Kuester, A. Meier, G.J. Müller (2010). Debt consolidation and Fiscal Stabilization of Deep Recessions, *American Economic Review*, 100(2), 41-45.

[23] De Long, B., L.H. Summers (2012). Fiscal Policy in a Depressed Economy, *Brookings Papers on Economic Activity*, Spring.

[24] Di Serio, M., M. Fragetta, G. Melina (2021). The Impact of r-g on the Euro-Area Government Spending Multiplier. *IMF Working Paper No.2021/039.*

[25] Dolls, M., C. Fuest, A. Peichl (2012). Automatic Stabilizers and Economic Crisis: US vs. Europe, *Journal of Public Economics*, 96, 279-94.

[26] Dolls, M., C. Fuest, A. Peichl and C. Wittneben (2019). Fiscal Consolidation and Automatic Stabilization: New Results, *CESIFO Working Paper Series*, 8021.

[27] Draghi, M. (2020). Mario Draghi: We face a war and must mobilise, Financial Times, 25 March.

[28] Erceg, C.J., J. Lindé (2012). Fiscal consolidation in an open economy. *American Economic Review*, 102(3), 186-91.

[29] Ernst, E., S. Mittnik W. Semmler (2010). Interaction of labor and credit market frictions: a theoretical and empirical analysis, *Paper prepared for the Winter Meeting of the Econometric Society*, Atlanta.

[30] Fatás, A., L.H. Summers (2015). The permanent effects of fiscal consolidation. *CEPR DP* 13149.

[31] Ferraresi, T., A. Roventini, F. Fagiolo (2015). Fiscal policies and credit regimes: a TVAR approach. *Journal of Applied Econometrics*, 30(7), 1047-1072.

[32] Fisher, J.D.M., R. Peters (2010). Using Stock Returns to Identify Government Spending Shocks, *Economic Journal*, 120(544), 414-436.

[33] Forni, M., L. Gambetti (2010). Fiscal Foresight and the Effects of Goverment Spending, CEPR Discussion Papers 7840.

[34] Forni, M., L. Gambetti (2016). Government spending shocks in open economy VARs, *Journal of International Economics*, 99(C), 68-84.

[35] Galì, J. (2020). Helicopter money:The time is now, voxeu.org, 17 march.

[36] Gechert, S., A. H. Hallet, A. Rannenberg (2016). Fiscal multipliers in downturns and the effects of euro area consolidation. *Applied Economics Letters*, 23(16), 1138-1140.

[37] Giavazzi, F., M. Pagano (1990). Can severe fiscal contractions be expansionary? Tales of two small European countries, *NBER Macroeconomics Annual* Ed. by O. J. Blanchard and S. Fischer. Cambridge, MA, MIT Press:75-122.

[38] Gordon, R.J., R. Krenn (2010). The End of the Great Depression 1939-41: Policy Contributions and Fiscal Multipliers, NBER Working Papers 16380.

[39] Gòrnicka, L., C. Kamps, G. Koester, N. Leiner-Killinger (2020). Learning about fiscal multipliers during the european sovereign debt crisis: evidence from a quasi-natural experiment. *Economic Policy*, 35(101), 5-40.

[40] Gorodnichenko, Y., E.G. Mendoza, L.L. Tesar (2012). The Finnish Great Depression: From Russia with Love, *American Economic Review*, 102(4), 1619-44.

[41] Group of concerned economists (2020). The European Union and democracy must deliver, voxeu.org, 16 March.

[42] Guajardo, J., D. Leigh, A. Pescatori (2014). Expansionary austerity? International evidence, *Journal of the European Economic Association*, 12(4), 949-968.

[43] Guerini, M., A. Moneta, M. Napoletano, A. Roventini (2018). The Janus faced nature of debt: Results from a data driven cointegrated svar approach, *Macroeconomics Dynamics*, 1-31.

[44] Ilzetzki, E., E.G. Mendoza, C.A. Végh (2013). How big(small?) are fiscal multipliers? *Journal of Monetary Economics*, 60(2), 239-254.

[45] In't Veld, J. (2017). A Public Investment Stimulus in Surplus Countries and Its Spillovers in the EA, *National Institute Economic Review*, National Institute of Economic and Social Research, 239(1), 53-62, February.

[46] International Monetary Fund (2008). Fiscal Policy as a Countercyclical Tool, *World Economic Outlook*, october.

[47] Jordà, Ó. (2005). Estimation and Inference of Impulse Responses by Local Projections, *American Economic Review*, 95(1), 161-182.

[48] Keynes, J.M. (1936). The General Theory of Employment, Interest and Money, Collected Writings of John Maynard Keynes, London,Macmillan, vol. VII.

[49] Kirchner, M., J. Cimadomo, S. Hauptmeier (2010). Transmission of government spending shocks in the Euro area: time variation and driving forces, *ECB Working Paper Series 1219.*

[50] Leeper, E.M., A.W. Richter, T.B. Walker (2012). Quantitative Effects of Fiscal Foresight, *American Economic Journal: Economic Policy*, 4(2), 115-144.

[51] Leeper, E.M., N. Traum, T.B. Walker (2017). Clearing Up the Fiscal Multiplier Morass, *American Economic Review*, 107(8), 2409-54.

[52] Leeper, E.M., T.B. Walker and Shu-Chun S. Yang (2008). Fiscal Foresight: Analytics and Econometrics, NBER Working PaperS 14028.

[53] Leeper, E.M., T.B. Walker, Shu-Chun S. Yang (2013). Fiscal Foresight and Information Flows, *Econometrica*, 81(3), 1115-1145.

[54] Mountford, A., H. Uhlig (2009). What are the effects of fiscal policy shocks?, *Journal of Applied Econometrics*, 24(6), 960-992.

[55] Newey, W.K., K.D. West (1987). Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, *Econometrica*, 55(3), 703-708.

[56] Nickel, C., A. Tudyka (2014). Fiscal stimulus in Times of High Debt: Reconsidering Multipliers and Twin Deficits, *Journal of Money, Credit and Banking*, 46(7), 1313-1344.

[57] Olea, J.L.M., C. Pflueger (2013). A Robust Test for Weak Instruments, *Journal of Business and Economic Statistics*, 31(3), 358-369.

[58] Ramey, V. (2011). Identifying government spending shocks: it's all in the timing, *Quarterly Journal of Economics*, 126(1), 1-50.

[59] Ramey, V. (2019). Ten Years after the Financial Crisis: What Have We Learned from the Renaissance in Fiscal Research?, *Journal of Economic Perspectives*, 33(2), 89-114.

[60] Ramey, V., S. Zubairy (2018). Government spending multipliers in good times and in bad: Evidence from U.S.historical data, *Journal of Political Economy*, 126(2), 850-901.

[61] Reichlin, L., A. Turner, M. Woodford (2019). Helicopter money as a policy option, voxeu.org, 23 September.

[62] Riera-Crichton, D., C. A. Vegh, G. Vuletin (2015). Procyclical and countercyclical fiscal multipliers: Evidence from OECD countries, *Journal of International Money and Finance, 52(C), 15-31.*

[63] Staiger, D., J.H. Stock (1997). Instrumental Variables Regression with Weak Instruments, *Econometrica*, 65(3), 557-86.

[64] Stock, J.H., M.W. Watson (2007). Why has U.S. inflation become harder to forecast?, *Journal of Money, Credit and Banking*, 39(s1), 3-33.

[65] Uhlig, H. (2010). Some Fiscal Calculus, *American Economic Review*, 100(2), 30-34.

[66] Woodford, M. (2011). Simple Analytics of the Government Expenditure Multiplier, *American Economic Journal: Macroeconomics*, 3(1), 1-35.

INTERNET APPENDIX

Nonlinearities and expenditure multipliers in the Eurozone

Table A.1: Robustness Check: Endogeneity Problem

VARIABLES	FE	FE
L.gdpv	0.0111	
	(0.1051)	
L2.gdpv	0.0923	
	(0.6660)	
L3.gdpv	-0.0590	
	(-0.8334)	
L4.gdpv	-0.0115	
	(-0.1777)	
L.gv		0.2256
		(0.2293)
L2.gv		-0.1636
		(-0.1601)
L3.gv		0.2355
		(0.6760)
L4.gv		-0.3192
		(-0.7659)
Constant	-1.3015	3.4596
	(-0.6885)	(0.1959)
R-squared	0.133	0.127
Number of Country	10	10
Country FE	YES	YES
Year FE	YES	YES

Robust t-statistics in parentheses
** p<0.01, ** p<0.05, * p<0.1

A Robustness check: Endogeneity problem

We also conduct a robustness check regressing the expenditure shock $FE^G_{i,t}$ on the lags of GDP and government spending, and the results are shown in Table A.1. We do not find any statistically significant relation between our shock and respectively, GDP and government spending, relieving concerns about the endogeneity of our shock measure $FE^G_{i,t}$.

B Credit regimes and phases of business cycle

Table B.1: Estimates of Multipliers: Credit Regimes

	GDP					
	Tight Credit Regime Recession	Ordinary Credit Regime Recession	P-value for difference in multipliers across states	Tight Credit Regime Expansion	Ordinary Credit Regime Expansion	P-value for difference in multipliers across states
1 year integral	0.58	1.29	HAC =.66	0.88	1.35	HAC = .31
	(1.34)	(0.78)	AR = .10	(0.89)	(0.98)	AR = .26
2 year integral	1.01	1.27	HAC = .20	1.01	1.45	HAC = .56
	(0.82)	(0.60)	AR = .05	(.75)	(0.80)	AR = .29
3 year integral	2.62	0.82	HAC = .00	0.63	1.57	HAC = .37
	(0.89)	(0.56)	AR = .04	(0.70)	(0.71)	AR = .09
4 year integral	1.43	0.62	HAC = .54	0.79	1.67	HAC = .36
	(2.31)	(0.70)	AR = .48	(0.86)	(0.87))	AR = .05

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

C Robustness of slack estimates

We conduct robustness check by changing the definition of the slack state. We consider standard OECD recession indicators (see http://www.oecd.org/sdd/leading-indicators/CLI-components-and-turning-points.pdf) where I_{t-1} is a dummy variable which indicates the state of the economy when the shock hits. Using this definition, we find results in line with our baseline findings. During recession, multipliers are higher than one but not state-dependent in the Eurozone as shown in Table C.1. Instead, when we conduct a robustness check by changing the definition of "deep recession", we consider the OECD recession indicators as for GDP drops of at least 1 percent. In that case, again, we find results in line with our baseline findings: multipliers are significantly higher in deep recession in the Eurozone, as shown in Table C.2.

Table C.1: Estimates of Multipliers: Expansion *versus* Recession

GDP				
	Linear Model	Recession	Expansion	P-value for difference in multipliers across states
1-year integral	1.26	1.10	1.39	HAC = .63
	(0.50)	(0.79)	(0.64)	AR = .22
2-year integral	1.36	1.42	1.37	HAC = .97
	(0.41)	(0.55)	(0.70)	AR = .18
3-year integral	1.29	1.47	1.53	HAC = .85
	(0.34)	(0.42)	(0.58)	AR = .09
4-year integral	1.05	1.06	1.43	HAC = .61
	(0.29)	(0.40)	(0.59)	AR = .13

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

D Initial conditions and phases of business cycle

We inspect the estimates of multipliers when also the structural characteristics of the economies are jointly analyzed with the phases of the business cycle. In order to address this issue, we replace equation 2 with the following one:

$$\begin{aligned}\sum_{j=0}^{h} y_{i,t+j} = I_{t-1}\Big[&\alpha_{A,i} + \mu_{A,t} + \Phi_{A,i,h}(L)x_{i,A,t-1} + m_{A,h}\sum_{j=0}^{h} g_{i,t+h} \\ &+\bar{m}_{A,h}\sum_{j=0}^{h} g_{i,t+h}\Gamma_{i,t-1} + \delta\Gamma_{i,t-1}\Big] \\ +(1-I_{t-1})\Big[&\alpha_{B,i} + \mu_{B,t} + \Phi_{B,i,h}(L)x_{i,B,t-1} + m_{B,h}\sum_{j=0}^{h} g_{i,t+h} \\ &+\bar{m}_{B,h}\sum_{j=0}^{h} g_{i,t+h}\Gamma_{i,t-1} + \delta\Gamma_{i,t-1}\Big] + \epsilon_{t+h},\end{aligned} \tag{5}$$

using $\Gamma_{i,t-1}$ as the dummy indicating higher initial conditions and I_{t-1} as the definition of slack state (recession).

Table C.2: Estimation of Multipliers: Normal Times *versus* Deep Recession

GDP				
	Linear Model	Deep Recession	Normal Times	P-value for difference in multipliers across states
1-year integral	1.39	1.42	1.40	HAC = .90
	(0.58)	(1.47)	(0.58)	AR = .09
2-year integral	1.44	1.73	1.44	HAC = .68
	(0.46)	(1.18)	(0.49)	AR = .04
3-year integral	1.36	1.57	1.35	HAC = .57
	(0.36)	(0.77)	(0.41)	AR = .02
4-year integral	1.07	1.99	0.94	HAC = .20
	(0.30)	(0.94)	(0.36)	AR = .05

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

Table D.1: Estimates of Multipliers: Open *versus* Closed Economy

	GDP					
	Open Economy Recession	Closed Economy Recession	P-value for difference in multipliers across states	Open Economy Expansion	Closed Economy Expansion	P-value for difference in multipliers across states
1 year integral	0.80	0.93	HAC =.25	0.64	1.09	HAC = .22
	(1.21)	(0.81)	AR = .33	(0.56)	(0.90)	AR = .25
2 year integral	0.25	1.49	HAC = .01	0.32	1.68	HAC = .07
	(0.83)	(0.58)	AR = .16	(.83)	(0.91)	AR = .27
3 year integral	0.17	1.92	HAC = .00	0.45	1.94	HAC = .00
	(0.71)	(0.48)	AR = .05	(0.74)	(0.59)	AR = .10
4 year integral	0.61	1.92	HAC = .00	0.76	1.40	HAC = .01
	(0.65)	(0.42)	AR = .02	(0.69)	(0.56))	AR = .15

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

Table D.2: Estimates of Multipliers: High *versus* Low Labor Market Rigidity

	GDP					
	High Labor Market Rigidity Recession	Low Labor Market Rigidity Recession	P-value for difference in multipliers across states	High Labor Market Rigidity Expansion	Low Labor Market Rigidity Expansion	P-value for difference in multipliers across states
1 year integral	2.23	0.38	HAC =.60	0.80	0.85	HAC = .33
	(1.20)	(0.72)	AR = .24	(0.71)	(0.88)	AR = .33
2 year integral	2.05	0.70	HAC = .28	1.61	0.52	HAC = .48
	(0.97)	(0.65)	AR = .16	(.85)	(0.75)	AR = .19
3 year integral	2.03	0.98	HAC = .09	1.52	0.22	HAC = .76
	(0.86)	(0.57)	AR = .07	(0.91)	(0.74)	AR = .29
4 year integral	2.10	0.85	HAC = .08	2.04	-0.23	HAC = .78
	(0.84)	(0.48)	AR = .07	(1.09)	(0.81))	AR = .28

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

Table D.3: Estimates of Multipliers: High *versus* Low Automatic Stabilizer

	GDP					
	High Automatic Stabilizer Recession	Low Automatic Stabilizer Recession	P-value for difference in multipliers across states	High Automatic Stabilizer Expansion	Low Automatic Stabilizer Expansion	P-value for difference in multipliers across states
1 year integral	0.88	1.63	HAC =.09	2.31	0.90	HAC = .34
	(0.84)	(0.97)	AR = .23	(1.32)	(0.95)	AR = .17
2 year integral	1.90	1.71	HAC = .03	2.26	1.67	HAC = .10
	(0.63)	(0.78)	AR = .04	(1.99)	(1.00)	AR = .26
3 year integral	2.23	1.69	HAC = .02	2.85	1.50	HAC = .09
	(0.64)	(0.73)	AR = .04	(2.18)	(0.87)	AR = .25
4 year integral	1.52	1.47	HAC = .05	2.33	1.50	HAC = .07
	(1.00)	(0.75)	AR = .11	(3.17)	(0.83)	AR = .36

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

Table D.4: Estimates of Multipliers: Exchange Rate Regime

	GDP					
	Eurozone Recession	Before Eurozone Recession	P-value for difference in multipliers across states	Eurozone Expansion	Before Eurozone Expansion	P-value for difference in multipliers across states
1 year integral	1.03	1.21	HAC =.16	1.11	0.81	HAC = .17
	(0.73)	(0.65)	AR = .09	(0.81)	(0.55)	AR = .20
2 year integral	1.47	1.25	HAC = .01	1.30	0.95	HAC = .13
	(0.53)	(1.10)	AR = .06	(0.85)	(0.66)	AR = .20
3 year integral	1.71	-0.26	HAC = .00	1.51	1.13	HAC = .01
	(0.42)	(0.79)	AR = .04	(0.61)	(0.64)	AR = .10
4 year integral	1.41	-0.14	HAC = .00	1.33	1.27	HAC = .02
	(0.40)	(0.70)	AR = .06	(0.59)	(0.59)	AR = .08

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

Table D.5: Estimates of Multipliers: High *versus* Low Debt

	GDP					
	Low Debt Recession	High Debt Recession	P-value for difference in multipliers across states	Low Debt Expansion	High Debt Expansion	P-value for difference in multipliers across states
1 year integral	0.78	2.99	HAC =.03	0.46	1.69	HAC = .03
	(0.74)	(1.42)	AR = .21	(0.86)	(0.75)	AR = .10
2 year integral	1.31	2.30	HAC = .28	0.63	2.29	HAC = .01
	(0.59)	(2.13)	AR = .13	(1.06)	(0.88)	AR = .10
3 year integral	1.49	3.27	HAC = .29	0.86	1.71	HAC = .02
	(0.55)	(3.14)	AR = .10	(0.85)	(0.75)	AR = .18
4 year integral	0.49	3.55	HAC = .88	0.17	0.53	HAC = .94
	(3.27)	(2.40)	AR = .27	(2.60)	(7.19)	AR = .27

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

E Sensitivity analysis - the zero lower bound impact

Countries "entering" in a ZLB scenario are often those that are experiencing periods of recession. Given the empirical setting shown in Section 6, it would make more troublesome the interpretation that expenditure multipliers are not strongly state-dependent, and state dependency emerges only if deep recession is distinguished from ordinary downturns. One way to potentially address this issue would be estimate the following augmented version of equation 2 with the following one:

$$
\begin{aligned}
\sum_{j=0}^{h} y_{i,t+j} = I_{t-1}\Bigg[&\alpha_{A,i} + \mu_{A,t} + \Phi_{A,i,h}(L)x_{i,A,t-1} + m_{A,h}\sum_{j=0}^{h} g_{i,t+h} \\
&+\bar{m}_{Azlb,h}\sum_{j=0}^{h} g_{i,t+h} ZLB_{i,t-1} + \delta ZLB_{i,t-1}\Bigg] \\
+(1-I_{t-1})\Bigg[&\alpha_{B,i} + \mu_{B,t} + \Phi_{B,i,h}(L)x_{i,B,t-1} + m_{B,h}\sum_{j=0}^{h} g_{i,t+h} \\
&+\bar{m}_{Bzlb,h}\sum_{j=0}^{h} g_{i,t+h} ZLB_{i,t-1} + \delta ZLB_{i,t-1}\Bigg] + \epsilon_{t+h},
\end{aligned}
\tag{6}
$$

where $ZLB_{i,t-1}$ can be the ZLB times indicator - when the policy rate falls below 1 percent. In this way, it is possible to consistently estimate the fiscal multiplier that also consider the role of ZLB. Tables E.1, E.2 show multipliers by distinguishing respectively between periods of expansion versus recession, and normal times versus deep recession. They confirm the results found in Sections 4 and 5.

Table E.1: Estimates of Multipliers: Expansion *versus* Recession

GDP				
	Linear Model	Recession	Expansion	P-value for difference in multipliers across states
1 year integral	1.06	1.73	1.17	HAC = .24
	(0.55)	(0.78)	(0.73)	AR = .15
2 year integral	1.22	1.82	1.83	HAC = .49
	(0.43)	(0.53)	(0.70)	AR = .01
3 year integral	1.14	1.62	1.70	HAC = .45
	(0.37)	(0.37)	(0.56)	AR = .01
4 year integral	0.91	1.20	1.31	HAC = .40
	(0.34)	(0.27)	(0.58)	AR = .03

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.

Table E.2: Estimates of Multipliers: Normal Times *versus* Deep Recession

GDP				
	Linear Model	Deep Recession	Normal Times	P-value for difference in multipliers across states
1 year integral	0.87	1.95	0.47	HAC = .13
	(0.53)	(0.87)	(0.51)	AR = .20
2 year integral	1.23	2.30	0.81	HAC =.03
	(0.44)	(0.55)	(0.47)	AR = .03
3 year integral	1.20	2.18	0.81	HAC =.02
	(0.37)	(0.38)	(0.42)	AR = .01
4 year integral	0.94	2.02	0.60	HAC =.00
	(0.33)	(0.29)	(0.40)	AR = .01

The values in parentheses under the multipliers give the standard errors. HAC indicates HAC-robust p-values and AR indicates weak instrument robust Anderson-Rubin p-values.