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Nonlinearities and expenditure multipliers in the Eurozone

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Abstract

We analyze the non-linear effects of government spending for the Euro area in recession, by using local projection method and by testing whether the impact of the shock depends crucially on the levels of public debt or the depth of the recession. We provide three insights. First, expenditure multipliers are not strongly state-dependent but they are always above unity. Second, state dependency emerges as soon as deep recession is distinguished from ordinary downturns. Third, fiscal space matters: expenditure multipliers are larger in low fiscal space, high debt, South-EZ countries than in low-debt, North-EZ countries.

JEL CLASSIFICATION: E32, E62.

Keywords: Expenditure multipliers, State-dependent fiscal policy, Fiscal consolidation.

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1 Introduction

In a March 2020 *Financial Times* article, Mario Draghi states 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, Howitt et al., 2008]. Uncertainties about the real effects of expansionary fiscal policies become even more embarassing in the face of diminishing returns to monetary policy in confronting depress economies 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. Were expenditure multipliers small, an expenditure based fiscal stimulus may turn out to be no-expansionary, even when implemented in a slump, whilst still adding to government debt. The size of multipliers is pivotal in the cost - benefit analysis of fiscal policy in downturns. According to the supporters of the non-Keynesian effects, Keynes could actually be turned o 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; Gujardo et al., 2014].

A large empirical literature analyses the size of fiscal multipliers when the economy is in a recession. This literature includes Auerbach and Gorodnichenko (2012, 2013) and Ramey and Zubairy (2018). 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. Notice that Ramey and Zubairy (2018) employ shocks to military expenditures for the US, a shock variable which can hardly be used as for the Euro countries which display smaller and largely constant military expenditure. To verify that the kind of state-dependence considered by Auerbach and Gorodnichenko (2012) depends on the estimation method employed, we use Jorda's local projection method as Ramey and Zubairy (2018) but, differently from them, we identify the shock with the forecast error of public expenditure, as Auerbach and Gorodnichenko (2013).[1]

Our research features two other novel aspects. 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 the existing level of sovereign debt affects the impact of an unexpected government spending stimulus on GDP [Ilzetzki et al., 2013]. The main contribution of this paper is shedding light over Euro Area non linearities in multipliers. Focusing on the Euro area may also lead to revise policy conclusions which come from the largest number of studies devoted to the US. In particular, (i) on the size of fiscal multipliers; (ii) on their state-dependence when we compare extreme recessions *versus* normal times; and, (iii) on their dependence on the initial level of public debt. These may be of crucial importance because of the differences between US and Euro Area jurisdictions and, in particular, in view of the built-in pro-cyclical bias of European fiscal rules, coupled with the incompleteness of the Eurozone as a monetary union (i.e. lack of a "federal" fiscal facility).

[1] 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 (Alesina et al. 2015, 2019).

There are two distinct methods to derive fiscal multipliers: one is model-based, the other one is based on empirical estimation. 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]. The empirical estimation strand is mainly focused on the advanced economies, with the largest number of studies devoted to the US. Different approaches may explain why estimates vary so widely. The seminal paper by Blanchard and Perotti (2002) explores this issue in the context of a structural vector-autoregressive model (SVAR), which relies on the existence of a one-quarter lag between output response and fiscal impulse. The Blanchard and Perotti (2002) identification strategy has been debated by Ramey (2011) and Forni and Gambetti (2010, 2016). Ramey points out that what is an orthogonal shock for a SVAR may not be such for private forecasters. Forni and Gambetti (2010, 2016) show evidence that government-spending shocks are non-fundamental for the variables typically considered in standard closed-economy specifications (fiscal foresight). This implies that VAR models comprising these variables are unable to consistently estimate the shock. These findings confirm the result obtained in Ramey (2011) that the fiscal policy shock estimated with a VAR as in Perotti (2007) is predicted by the forecast of government spending from the Survey of Professional Forecasters. In short, there seems to be, at least for the US, a meaningful correlation among orthogonal shocks in a SVAR and private forecasts. In order to fix this, Barro and Redlick (2011) and Romer and Romer (2010) have suggested the use of a natural experiment approach or a narrative approach.[2]

We consider 10 Eurozone (EZ) countries in 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, that is the difference between the actual growth rate of government spending and the forecast growth rate prepared by professional forecasters, after

[2] Barro and Redlick (2011) use the military spending as the shock, Romer and Romer (2010) identify exogenous tax changes from the narrative record, such as presidential speeches and Congressional reports.

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 robustness check with respect to the endogeneity of our shock measure and we find no relation 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 state-dependent multiplier literature by highlighting some key methodological issues. First, we show that some of the most widely cited findings of below unity multipliers during recessions are due to data choice. The shock variable employed by Ramey and Zubairy (2018) is news about future military spending. However, as Ramey and Zubairy (2018) recognize, the shock variable chosen leads to delayed rises in government spending, and consequently in output. 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 estimate output multipliers for high-debt countries and low debt countries.

Three main results arise. First, we find multipliers greater than one both in expansion and in recession. However, we find no evidence of larger multipliers in 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 expenditure multipliers are greater in countries with a high government debt burden than in countries whit low debt to GDP ratios, particularly in the short run, confirming the findings of Auerbach and Gorodnichenko (2017). We also find that multipliers in high debt countries peak at a 1-year horizon, gradually decreasing over time. implying that the absence of "fiscal space" does not weaken but actually strengthens the effectiveness of expansionary fiscal policies.

The basic intuition becomes clear when we recall the role of the propensity to save in multipliers: ceteris paribus the higher the propensity to save the lower the multiplier. And the propensity to save is indeed lower in high debt South-EZ countries than in North low-debt countries. Moreover it can be shown that in the EZ countries aggregate savings out of disposable income actually decline as the debt to GDP ratio rises. Our third result casts doubts on the widely held view that expansionary fiscal policy should only be implemented in countries with a "sound" (i.e. low) government debt/GDP ratio.

The structure of the paper is as follows. Section 2 discusses the empirical methodology, describing the new dataset used in this study. In Section 3, we compare GDP multipliers in the Eurozone across different regimes, expansions and recessions. In Section 4, we analyse non-linearities when recessions are are deep downturns. In Section 5, we report our results on how differences in initial conditions across Eurozone countries can affect the size of multipliers.

2 Econometric Methodology

We construct semi-annual data from 1992-2015 for Euro-10 area (Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal and Spain).[3] The historical series include real GDP, real private consumption and the Debt-GDP ratio. We follow Auerbach and Gorodnichenko(2012) by providing a more precise measure of unanticipated shocks to fiscal policy, the forecasts of fiscal and aggregate variables.[4] We use OECD's Statistics and Projections Database.[5]

Since the early 2000s, the literature has begun to explore whether estimates of government spending multipliers vary depending on circumstances. Auerbach and Gorodnichenko (2012, 2013) consider the possibility that multipliers are higher

[3]We removed Austria and Greece because of missing data.

[4]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 Euro area, military spending represents 4.6 percent of total public expenditure on average, with a variance of 1.04 - *https://data.worldbank.org/indicator/.*

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

than normal during recessions. Auerbach and Gorodnichenko 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:

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

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 multipliers should be calculated as the integral of output response divided by the integral government spending response inasmuch the integral multipliers address the relevant policy question because they measure the cumulative GDP gain relative to the cumulative government spending in a given period.

In order to avoid the bias pointed at by Ramey and Zubairy (2018), first we use Gordon and Krenn's transformation (2010). Instead of taking logarithms of the variables, they divide all macroeconomic variables by an estimate of potential, or trend, GDP. This puts all macro variables in the same units, so that one can estimate the multiplier directly. We do this as well, using a polynomial to estimate trend real GDP, real government spending, and real private consumptions. 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[6] and we estimate the cumulative multiplier *á la* Ramey and Zubairy using the following equation in the linear specification:

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

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 time fixed effect. Our vector of the baseline control 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.[7]

Our measure of $shock_t$ is $FE^G_{i,t}$ 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* for time *t*. Moreover, using $FE^G_{i,t}$ 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; Zeev and Pappa, 2017 and others].[8]

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

[7]The results are identical if and only if all the regressions are estimated on the same sample.

[8]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

Second, we minimize the likelihood that estimates capture the potentially endogenous response of fiscal policy to the business cycle due to automatic stabilizers.[9]

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

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

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, $I_{t-1} = F(z_{i,t-1})$

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

$F(\cdot)$ 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

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(2008)].

[9] 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.

deviation of the output growth rate; i.e.

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

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 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 1 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 ($Y_{i,t}$). No correlation emerges between our shock and the cited variables, relieving concerns about the endogeneity of our expenditure shock.[10]

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 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 $FE^G_{i,t}$.

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, 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.

[10]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.

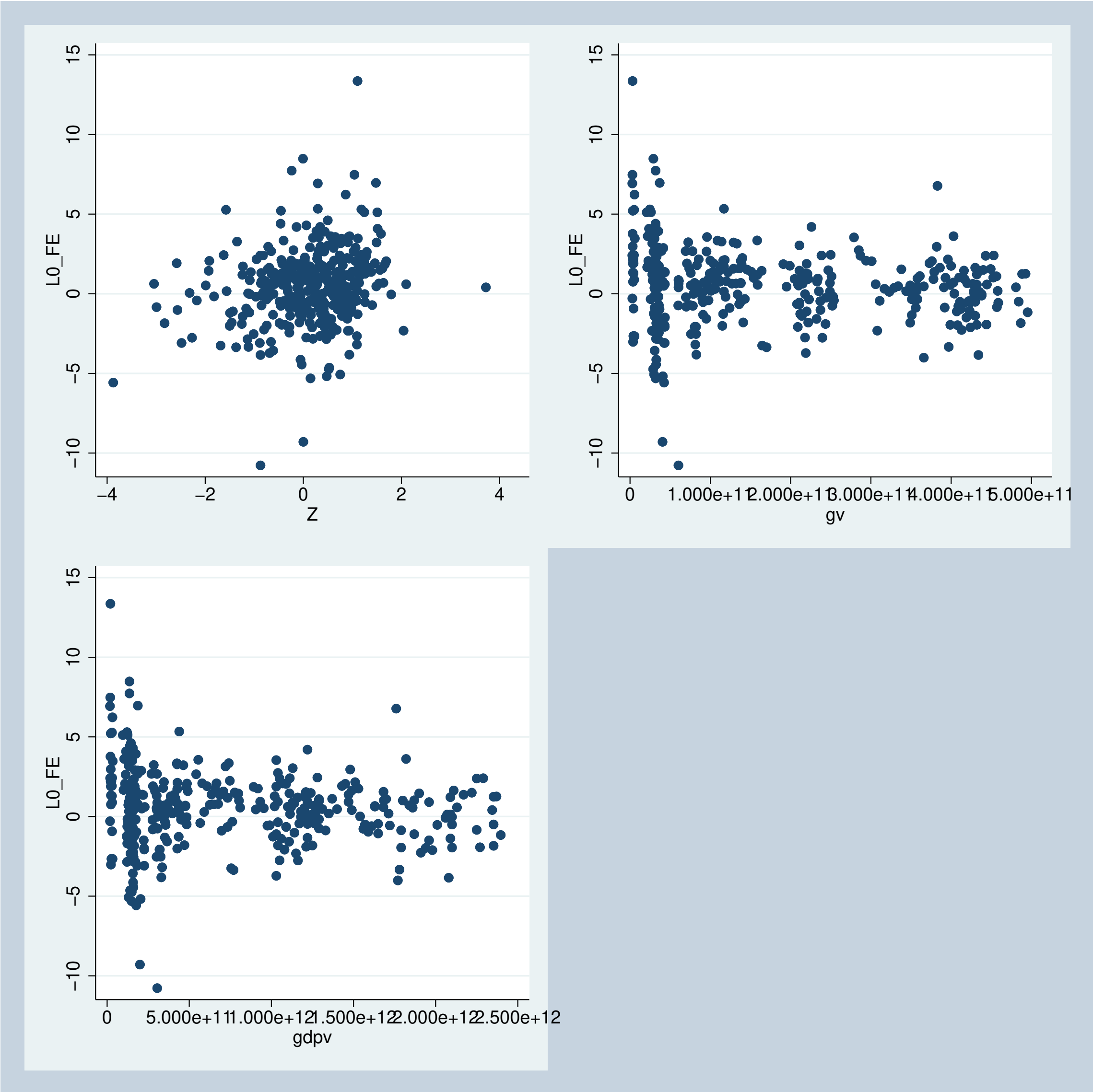
Table 1: Robustness Check: Endogeneity Problem

VARIABLES	GDP	G
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

Figure 1: Fiscal Policy shock vs Economic Cycle (Z), Government Spending (C+I, gv) and Gross Domestic Product (gdpv)



In the following sections, we test the instrument relevance across the different states.

3 Multipliers in expansion and recession

In this Section, we compare GDP multipliers in the Eurozone across different regimes, expansions and recessions.[11] We estimate multipliers using IV regressions. The question remains, however, whether it 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 effective F-statistics and thresholds.

Panel A of Figure 3 shows the difference between the first-stage effective F-statistic and the Olea and Pflueger (2013) thresholds.[12] 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 3. First, the linear case has potential relevance problems at very long horizons whereas the recession scenario has always high relevance. Second, moving beyond the first year or two, the expansion scenario effective F-statistic often falls below the threshold. Because of possible problems with instrument relevance for some horizons, we will also conduct some key hypothesis tests using Anderson and Rubin (1949) statistics, which are robust to weak instruments. These test have lower power, though.

In Panel B of Figure 3, the main results of our analysis are presented using

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

[12] 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.

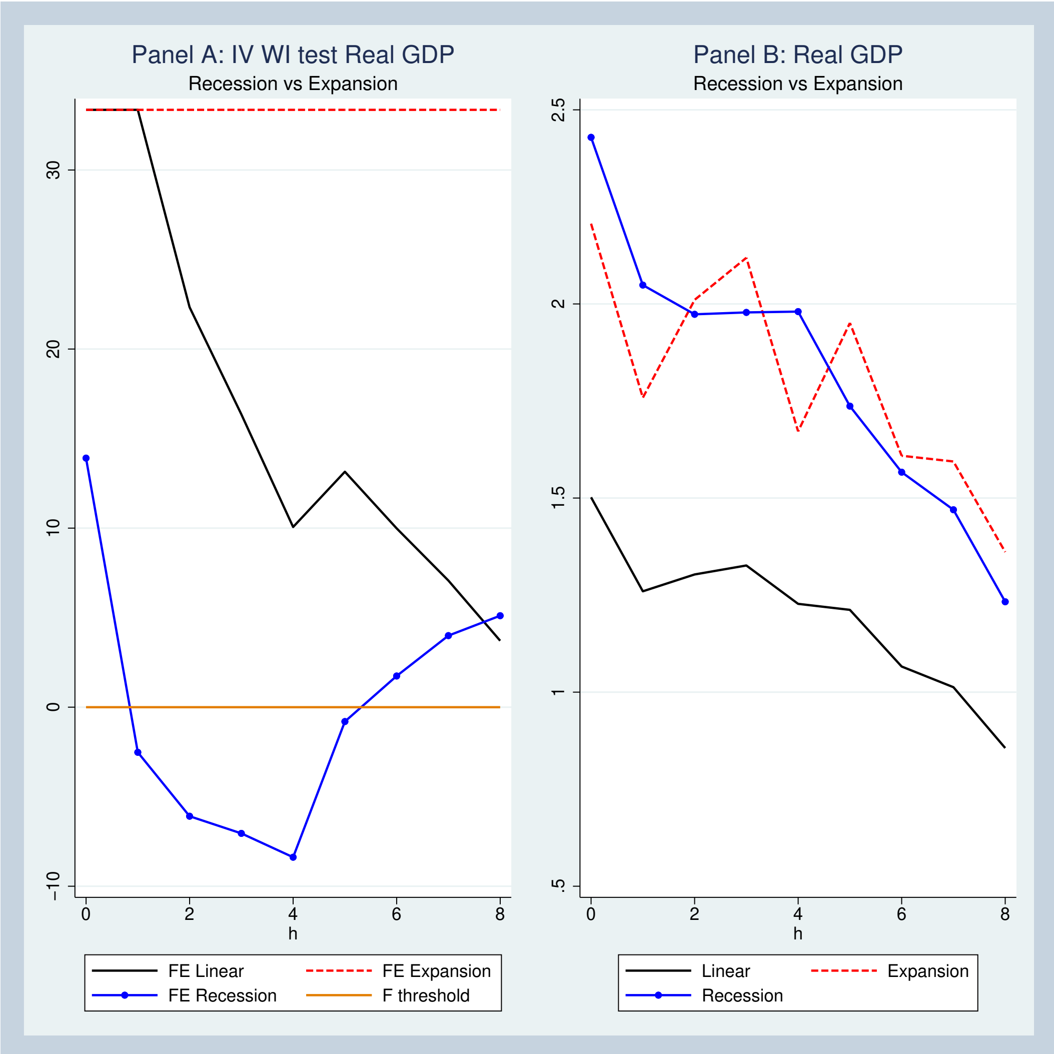


Figure 2: *Panel A*: Tests of instrument relevance. The lines show the difference between the effective F-statistic and the relevant threshold for the 10 percent level and are capped at 30. The effective F-statistics are from the regression of the sum of government spending through horizon h on the shock 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.

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 2, the implied multipliers are around 1.2.

The main 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 2, 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- and autocorrelation-consistent (HAC) standard errors and is valid only for strong instruments; the second is based on the Anderson and 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 differences in multipliers quantitatively.

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. The effectiveness of an expansionary 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 and the sample of countries under scrutiny.

We conduct robustness checks by changing the definition of the slack state. We

Table 2: ESTIMATES OF MULTIPLIERS

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.

consider standard OECD recession indicators[13], 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).

4 Multipliers in 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.[14]

Panel A of Figure 3 shows the difference between the effective F-statistics and the thresholds for the periods split into deep recession periods and normal times.

[13] http://www.oecd.org/sdd/leading-indicators/CLI-components-and-turning-points.pdf

[14] $F_z > 75\%$, 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

In the linear model and in normal times, the instrument loses relevance after 9 horizons, while the recession instrument has higher effective F-statistics for all horizons. 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 3 shows the impulse responses. The results suggest that output responds more and more persistently in deep recessions that it does in "normal" times (both expansions and mild downturns).

Table 3 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 3) - 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 reference the HAC-based tests since the instruments appear to be strong. This difference is due to large multipliers in deep recessions.

Our results corroborates, as for the Euro area, the findings by Caggiano et al. (2015) which suggests that deep recessions are associated with larger fiscal spending multipliers in Unites States. Auerbach, 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" recession 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.

Figure 3: *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.

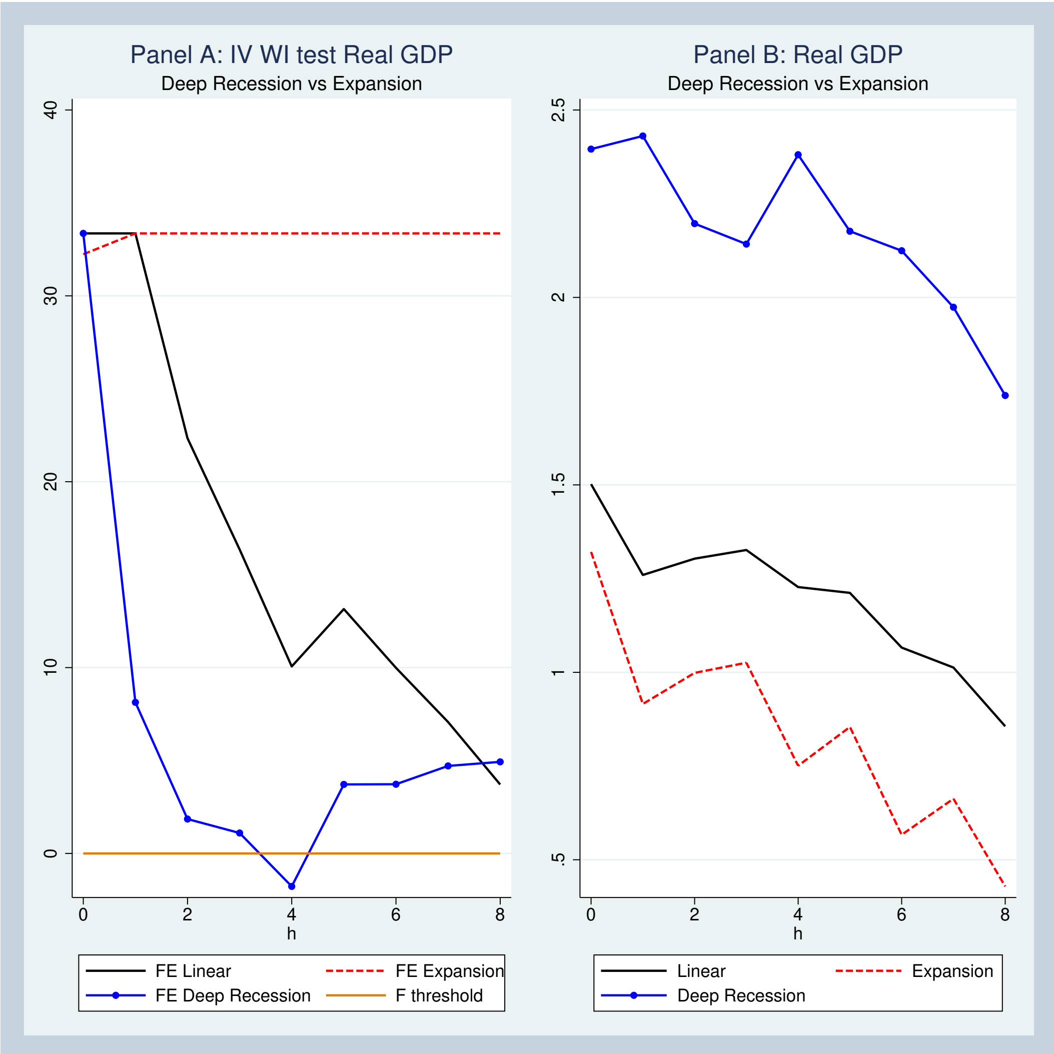


Table 3: ESTIMATES OF MULTIPLIERS

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.

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

5 Multipliers and initial conditions

We also enquire whether differences in initial macroeconomic conditions across EZ countries affect the size of multipliers. It may be expected that countries affected by high interest rates will experience lower effectiveness of a public spending expansion. As soon 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 inter-temporal substitution effects. For the same reason expanding public expenditure in countries with a low fiscal space is regarded as being little output effective (Ilzetski et al., 2013). 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 expectations of future tax hikes which induce people to save more and spend less. Moreover, 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 (Ilzetzki et al.,2013).

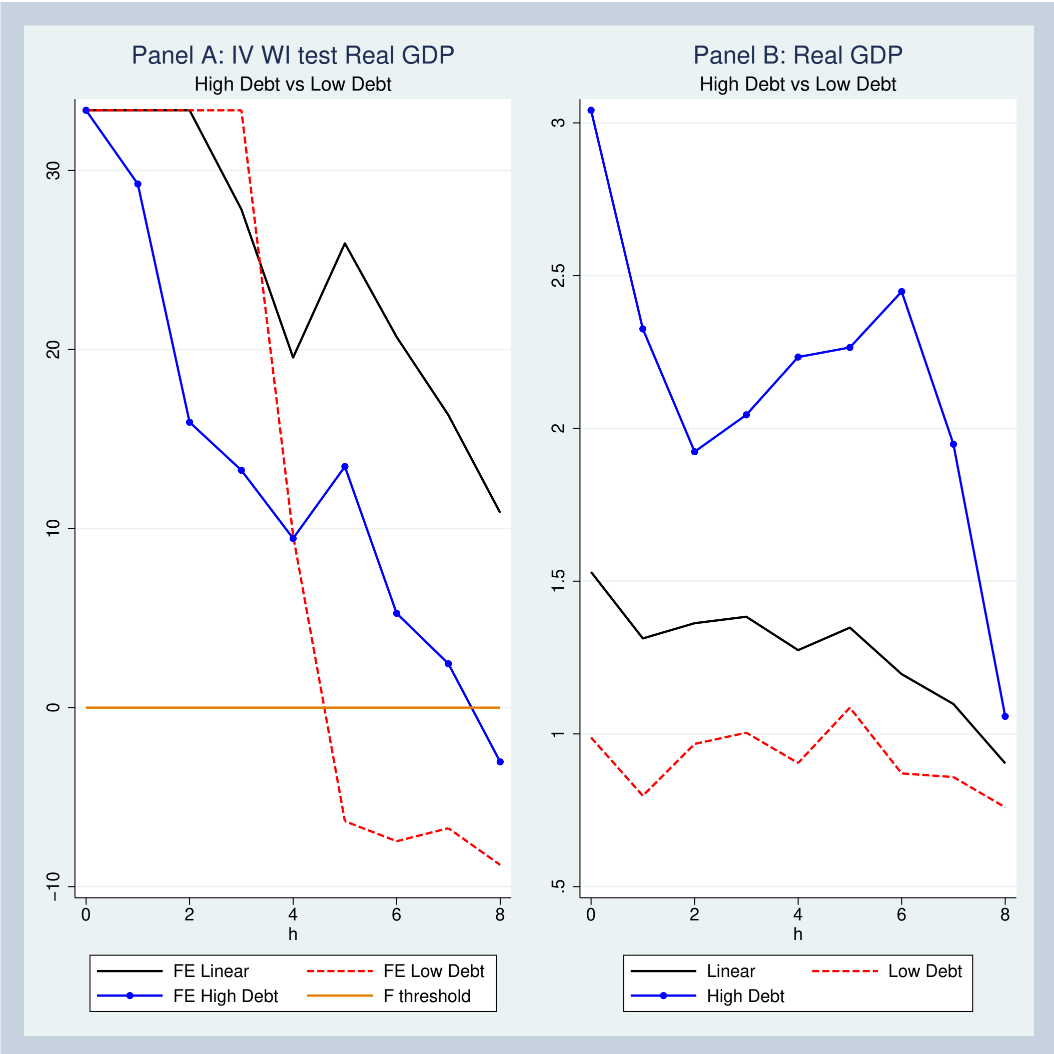
However, as argued by Auerbach and Gorodnichenko (2017) "a fiscal stimulus in recession can pay for itself: when economy is strong, additional government spending is unlikely to increase output considerably and thus a spending shock adds to debt without much improvement in the denominator of the ratio. 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 (due to e.g. automatic stabilizers, i.e., less countercyclical spending and higher taxes) 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 (via hysteresis) may be self-defeating and even lead to an increase in the debt to GDP ratio.

In an attempt at settling this issue, we follow Auerbach and Gorodnichenko (2017) in directly estimating GDP multipliers in high public debt and low public debt countries.Since there were significant differences in macroeconomic initial conditions 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. For the definition of the threshold we follow the European Fiscal Board (EFB) and use 80% Debt-GDP ratio as the threshold.[15]

Panel A in Figure 4 shows the difference between the effective F-statistics and the thresholds for our sample split into high-debt and low-debt countries. In high-debt countries, the instrument loses relevance after 5 horizons; in low-debt countries, the instrument loses relevance after 7 horizons; while, in the linear model

[15]On 11 September 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-debt Member States in the Eurozone, Country that have a debt-GDP ratio higher than 80%. $https://ec.europa.eu/info/publications/assessment-eu-fiscal-rules-focus-six-and-two-pack-legislation_en$

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), low debt countries (red dashed line), and high debt countries (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 low debt countries and the blue line is the response in high debt countries.



the instrument appears to be strong at all horizons.

To determine whether multipliers are different in high-debt and low-debt countries, we estimate our state-dependent model. We consider our sample 1992s1-2015s2. Panel B in Figure 4 shows the impulse responses. The results suggest that output responds more and more persistently in high debt countries. Differently, in low debt countries, output responds less and less persistently than in the linear model.

Table 4 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 evidenced by the p-values; we reference 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.[16]

Hence, we find that the fiscal multiplier is higher when debt burdens are high, particularly in the short run.[17] Overall, our results confirm those found by Auerbach and Gorodnichenko (2017) as for a panel of 25 Oecd countries. 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

[16]In the appendix 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.

[17]Panel A of Figure 4 shows that the high debt countries instrument loses relevance after 5 horizons.

Table 4: ESTIMATES OF MULTIPLIERS

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.

the crisis.[18] This suggests that the low and declining saving rate may be the reason why we find larger multipliers both in high debt countries and in deep recessions.

6 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 effects of the spending side of fiscal policies that can vary over the business cycle by using Jorda's (2005) local projection method, particularly in deep recession and in high-debt countries.

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) on the ab-

[18]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.

sence of sizeable difference 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. Finally, we find that the expenditure multipliers are higher in countries where government debt burdens are high, particularly in the short run, confirming the empirical results of Auerbach and Gorodnichenko (2017). We find little difference between multipliers in low debt countries and in the linear model. In high-debt countries, the multiplier peaks at 1-year horizon, remaining over time above multipliers in the linear model and in low debt countries. An intuitive rationale for our second and third results can be found in the negative correlation between aggregate saving rates and government debt/GDP ratios. A correlation that becomes stronger in the after 2008 economic crisis and especially so in Southern highly indebted countries. Multipliers are notoriously higher (*ceteris paribus*) the lower is the saving rate. All the above mentioned results survive several robustness checks.

Many articles, even by mainstream economists, advocate a large fiscal policy intervention, 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 estimatated expenditure multipliers our findings support the viewthat 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 [some preliminary results in Boitani and Perdichizzi, 2019], which seems to be crucial for a deep revision of the Euro Area fiscal framework aimed at removing the existing pro-cyclicalities.

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A APPENDIX

A.1 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 A.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 A.2.

Table A.1: ESTIMATES OF MULTIPLIERS

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.

Table A.2: ESTIMATES OF MULTIPLIERS

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.

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