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Government borrowing cost and budget deficits: is investment spending different?

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Abstract: We find that bond markets charge significantly higher interest rates for deficits due to higher government current spending than for deficits due to higher government investment. Thus, from a sovereign risk perspective, not all government budget deficits are created equal. To show this, we use a panel regression approach on European Commission data for 31 advanced economies from 1990 onwards. Econometrically, we address potential endogeneity by using forecasts of fiscal variables and by instrumental variable methods. Based on our preferred specifications, a higher deficit solely due to higher government investment would in fact decrease long-term government bond yields. These findings suggest that the policy debate about fiscal sustainability and fiscal rules should, at the very least, distinguish budget deficits that are the result of investment from those that are not.

JEL codes: E44, E62, H54, H62

Keywords: Government budget deficits, government investment, fiscal policy, long-term interest rates, OECD countries

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1 Introduction

On Wolfgang Schäuble's last day in office as Germany finance minister in October 2017, his staff bid him farewell by dressing in black, assembling in the courtyard of the ministry and forming a big circle. They were alluding to Schäuble's commitment to a "black zero", an always-balanced budget, a policy that his successor maintained until the COVID-19 pandemic hit. Elsewhere too, finance ministries have sat on their hands, even in the face of negative borrowing cost for Germany and – for much of Europe – a significant public investment need, an cyclical slowing-down and monetary policy with little room to act. Hence, the vast fiscal support initiated in the course of 2020 by many EU and OECD countries in response to the COVID-19 pandemic is noteworthy not just for its sheer magnitude but also because it throws into stark relief just how restricted the role of fiscal policy had previously been.

As far as we are aware, there is no plausible economic theory according to which a budget that is always balanced, regardless of economic circumstance and government expenditure type, would constitute good economic policy. That is why this paper seeks to explore the matter empirically: we ask what bond markets "think" of fiscal policy or budgetary stances. We do so by analysing whether government bond yields in 31 EU and OECD countries since 1990 respond differently to deficits due to different types of government expenditure, most importantly government current expenditure and government investment. This means that we are hearing the verdict on fiscal policy stances "from the horse's mouth", given the feedback loop between fiscal policy decisions and government bond yields that became apparent again during the sovereign debt crisis. In a nutshell, our findings suggest that markets indeed distinguish deficits that are the result of higher government current spending from those that stem from higher government investment, and penalise the former significantly more than the latter. In this sense, we find that some deficits appear to be considered more "excusable" than others.

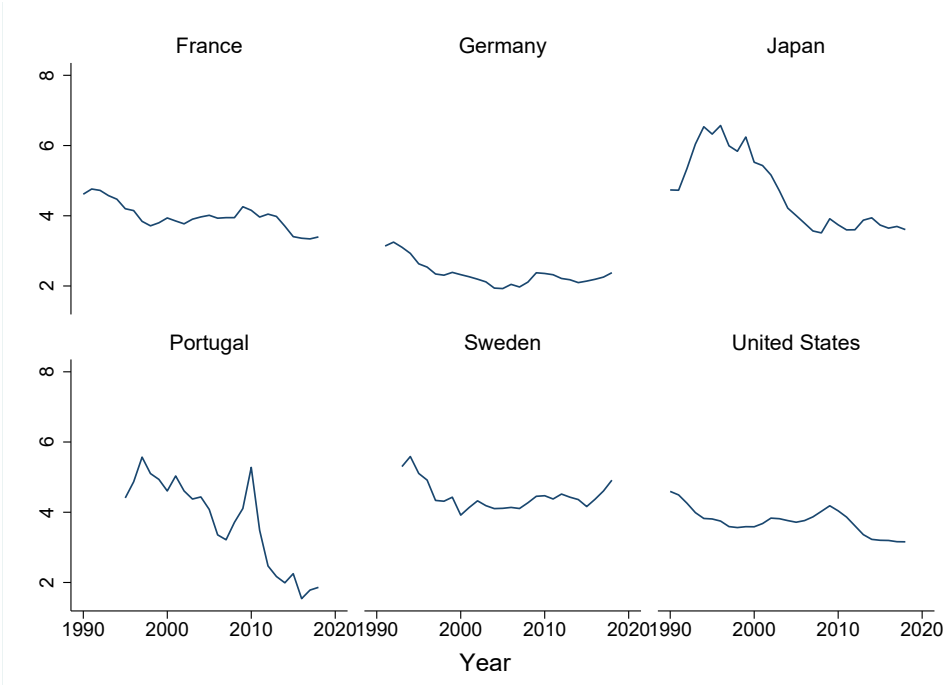
The existing empirical literature on the link between fiscal policy and interest rates has tended to disregard the reasons for which a government may increase its debt or run a budget deficit. A deficit may be the result of higher government current spending, higher government investment, or lower government revenue. Our analysis explicitly incorporates the current spending, investment and revenue components of the government budget deficit in an empirical analysis of the fiscal policy determinants of government bond yields: it thus takes seriously the intuitively plausible possibility that, from the perspective of bond markets, not all budget deficits are created equal.

Two key observations motivate the concern of this paper with government investment or asset accumulation and, hence, one of the underlying drivers of government budget deficits. First, in many OECD countries, government net worth ratios – that is, total government assets less total government liabilities, relative to GDP or national income – have declined substantially in recent decades (Atkinson, 2015; Buiter, 1985; IMF, 2018; Piketty and Zucman, 2014). This means that a considerable share of new debt in these countries was not used to finance investment, or that the process of asset accumulation through investment stalled. For example, government net worth was in negative territory in recent years in the US, UK, Germany and Japan,

having stood at more than 60% of national income before 1990 in all four countries (Atkinson, 1995; Piketty and Zucman, 2014; IMF, 2018). In fact, in the sample of countries the IMF considered in its 2018 Fiscal Monitor, one third of countries had negative government net worth. While such developments would be expected to spell trouble for individuals, corporates or banks, they seem to have gone largely unnoticed – at least in academic and policy debates – in the case of many sovereigns.

Second, although trend levels of government investment vary substantially across EU and OECD countries – they are typically around or just below 4% of GDP in France and the United States, but only about half that in Germany – they have declined noticeably in recent years in many places, both in countries facing immediate domestic sovereign debt crises, such as Portugal, but also in those that did not, such as Japan or the United States. Proxying government investment with gross fixed capital formation of general government, Figure 1 illustrates this fact. The IMF (2014) also notes a trend reduction of 25 percent in government investment in OECD countries, while the European Commission's recent Economic Governance Review points to a widespread and persistent decline in public investment in Europe over the last decade (2020).

Figure 1: Government investment, selected countries, 1990-2014



Gross fixed capital formation of general government in percent of GDP
Source: AMECO

The declines in government net worth and government investment are linked: any part of a government budget deficit not used to finance government investment will have contributed to the decline in government net worth. It also seems likely that the focus of fiscal policy on austerity following the financial crisis played a part – in aiming to reduce debt and deficits, policy makers seldom appeared to explicitly

consider implications for government asset accumulation and net worth. Consider the case of Germany, where a balanced-budget requirement was introduced in 2009. Germany's budget deficit fell from 3.2% of GDP in 2009 to 0.1% of GDP in 2013 – that is, it decreased by 3.1 percentage points. Over the same period, government net worth as a share of national income fell by 3.6 percentage points, due to a corresponding fall of 3.6 percentage points in government non-financial assets, which comprise roads, bridges, buildings and so on. Thus, one way of looking at the matter is that Germany paid for balancing its budget by shrinking government non-financial assets and net worth – a process that the IMF refers to as a "fiscal illusion" (2018) – all while facing the lowest borrowing cost on historical record.

The present paper hence explores the relevance of the composition of and reasons for government budget deficits for government bond yields, and thereby for government borrowing costs and fiscal sustainability. To do so, we use data on the investment, current spending and revenue components of the deficit drawn from the European Commission for a panel of 31 EU and OECD countries from 1990 onwards. To the best of our knowledge, the existing empirical literature on the links between fiscal policy and bond yields has not yet taken into account the underlying drivers of budget deficits through this kind of decomposition. In line with the literature, we confirm that higher government budget deficits (relative to GDP) increase government bond yields, with statistically significant yet quantitatively small effects. We then decompose the budget deficit to show that markets charge significantly higher interest rates for government budget deficits due to government current spending than for deficits due to government investment. Based on our preferred specifications, an increase in the deficit solely due to an increase in government investment would *decrease* bond yields, while an increase in the deficit solely due to an increase in government current spending would *increase* bond yields, ceteris paribus. This suggests that markets perceive government investment, on average, as favourable for growth or as having a positive return. Econometrically, we address the potential for endogeneity in a number of ways, including through timing shifts, instrumental variable approaches and the use of forecasts instead of actual values of fiscal variables.

Our findings reflect the perspective of government bond markets on sovereign risk, fiscal sustainability and government budget management. Given the need for fiscal policy to remain supportive for a few more years at least to stem the economic impact of the COVID-19 pandemic, these findings could have important policy implications. They imply that fiscal consolidation policies ought to focus more on government current (or non-investment) spending than government investment (or capital) spending, or at least distinguish the two in formulating deficit or debt reduction targets. They also suggest that fiscal rules in individual countries and monetary unions – such as the European Union's Maastricht criteria, which have aimed to limit budget deficits to 3% of GDP irrespective of economic circumstance and underlying government expenditure composition – should reflect to what extent government budget deficits are the result of government investment. More generally, these findings suggest that the focus of fiscal policy in much of the EU and OECD until early 2020 on indiscriminate deficit and debt reduction regardless of economic circumstance and government expenditure type may not have been optimal, nor always required to contain government bond yields and borrowing costs.

The remainder of this paper proceeds as follows. The related empirical literature on the links between government budget deficits and interest rates are discussed in Section 2. Section 3 introduces the data and econometric approach. Our main results, robustness tests and extensions are presented in Section 4. Section 5 concludes and discusses policy implications.

2 Government budget deficits and interest rates

Fiscal policy directly and indirectly impacts a vast number of macroeconomic outcomes. One way of empirically evaluating fiscal policy is to identify its effects on a macroeconomic outcome of interest. The approach of Reinhart and Rogoff (2010) is to bracket countries by the magnitude of their debt-to-GDP ratio, and compare different brackets' mean and median growth and inflation rates. An alternative approach is to use government bond yields, which reflect investors' perspectives on the country's growth and inflation prospects as well as its sovereign default risk, as the dependent variable and employ controls for the business cycle and the monetary policy stance to achieve identification of the effects of fiscal policy on these yields. This is the approach taken here.[1]

It is commonly stated that results from empirical research on the fiscal policy determinants of long-term government bond yields and hence borrowing costs have not been conclusive. However, recent panel-based empirical literature on the question – such as Ardagna et al. (2007), Gruber and Kamin (2012) or Beirne and Fratzscher (2013) – typically concludes that more expansionary fiscal policy, as reflected in a higher government debt ratio or a higher (primary) deficit relative to GDP, increases government bond yields or spreads. Econometric approaches and conclusions vary, including as regards the precise measure of fiscal policy that is found to matter, the importance of non-linear effects and the extent of spatial and temporal heterogeneity of effects.

Overall, to the best of our knowledge, the existing literature has not yet considered the relevance of the composition of government budget deficits for government bond yields. It has not, as far as we are aware, taken into account the current and investment spending components of the deficit in estimation. Doing so would amount to testing the validity of the restriction that, in a regression with the government bond yield as the dependent variable, all components of the deficit enter with coefficients that are equal in absolute magnitude. This restriction is frequently imposed in the existing literature and its validity will be examined here. Dai and Philippon (2006) distinguish deficits caused by changes in spending and changes in taxes, and Laubach

[1] Our approach is supported by the findings of Dai and Philippon (2006), who conclude that empirically, "in order to price long-term bonds correctly, it is important to take into account the fiscal position of the government, above and beyond inflation and real activity". In theory, the expectations hypothesis of the term structure of interest rates implies that fiscal policy can principally influence the long-term interest rate either by affecting current and expected future short-term nominal interest rates or by affecting the risk or term premium. The term premium, in turn, reflects the compensation risk-averse investors require to hold a longer-term bond instead of a series of shorter-term bonds and is thought to vary over time (Swanson, 2007).

(2009) similarly separates total revenue and total spending, but neither considers the investment and current components of spending separately. Ardagna et al. (2007) use a different decomposition of the deficit, stating that changes in the government wage bill, transfers, public investment and business and labour taxes matter for yields, but do not report these results. Yet taking into account the current spending and investment components of government budget deficits provides an insightful lens on the underlying drivers of deficits, and investor perceptions of these drivers. This paper thus adds to the existing literature by doing so.

3 Methodology

3.1 The data

The sample used for econometric analysis is based on annual data on government budget deficit components for 31 EU and OECD countries drawn from the European Commission DG ECFIN's Annual Macroeconomic database (AMECO) and covering, on average, 19 years per country.[2] It also includes annual interest rate and macroeconomic data from AMECO, the OECD and the IMF. The focus of all our fiscal policy measures and the surrounding discussion is on "general government", as defined in international accounting standards to include central, local and state government and social security funds (2008 SNA; ESA 2010). To address potential endogeneity, we also use forecasts of our fiscal variables of interest for EU countries drawn from the European Commission's "Stability and Convergence Programmes", which contain the country's own medium-term fiscal (and macroeconomic) projections.

The dependent variable is, almost always, the annual average of the 10-year constant-maturity secondary-market nominal government bond yield, as is standard in this literature ($GBY10$; see, for example, Ardagna et al., 2007; Gruber and Kamin, 2012), with data drawn from the OECD.

Data on the components of the primary government budget deficit ($GDEF$) – that is, the deficit excluding interest payments – are drawn from AMECO. They allow decomposing the primary deficit into an accounting identity as

[2]The sample covers Austria, Belgium, Bulgaria, Canada, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, the United Kingdom and the United States over a maximum time span from 1990 to 2014 and is unbalanced. Some data is available from before 1990, but focussing on more recent decades has a number of advantages. Firstly, financial liberalisation in the 1980s, particularly the abolition of capital controls, could have affected the relation between government bond yields and domestic fiscal variables. Secondly, the relationship in more recent times is likely to provide more relevant evidence for current debates about the effects of fiscal policies. Finally, focussing on data after 1990 means we avoid structural breaks in the data for Germany as a result of reunification. Results are robust to including available observations from before 1990 (cf. Table 4, column (7)). Post-2014 data is available from AMECO for some countries included here, but coverage for some countries ceases completely in more recent releases, so we use the release that ends in 2014 to maximise total observations and observations per country. It would have been topical and interesting – yet potentially also distorting, given Greece's drawn-out sovereign debt crisis and bailouts – to add Greece to the sample, yet available data covers too short a time period.

$$GDEF = GCEX + GINV - GREV. \tag{1}$$

Current spending ($GCEX$) includes, most saliently, social benefits and the compensation of government employees. Importantly, it does not include interest payments on the government's outstanding debt.[3] Investment spending ($GINV$) refers to government gross fixed capital formation and covers net acquisitions of fixed assets, such as investments in roads, railways, bridges and so on. Finally, government revenue ($GREV$) includes, most importantly, direct and indirect taxes as well as social contributions. It refers to all revenue accrued to the government in a given year. All fiscal variables are always measured in percent of GDP.

Data on a set of macroeconomic controls – including short-term interest rates (in particular, the three-month interbank money market rate and the monetary policy rate), inflation and real economic growth – are also mostly drawn from AMECO as well as the OECD and the IMF. Table 7 in the Appendix provides summary statistics, units of measurement and sources for all included variables.

Finally, as Table 8 in the Appendix demonstrates, the evidence for all series included in the analysis – in particular, long- and short-term interest rates as well as fiscal and other control variables – is in favour of stationarity. The only exception to this are liabilities as a share of GDP, which are found to be non-stationary and hence are not included in baseline specifications, in order to ensure the validity of the regression set-up with a stationary dependent variable. In line with the literature, the panel unit root test developed by Im, Pesaran, and Shin (2003; "IPS test") is used here. The test is applied to demeaned series to reflect the fact that all main specifications presented below include year fixed effects.[4]

[3] We subsume other capital expenditure ($GOCE$) into current expenditure ($GCEX$) in estimation. $GOCE$ includes capital expenditure that does not amount to new productive investment, comprising capital transfers payable, changes in inventories, net acquisitions of valuables such as gold and net acquisitions of non-financial non-produced assets, such as subsoil assets or patents. It thus often includes extraordinary or one-off items. Because $GOCE$ enters insignificantly in all specifications considered here – and with a coefficient for which the restriction that it is equal to that on $GCEX$ is not rejected – it is subsumed into $GCEX$. This also facilitates applying instrumental variable approaches, since the extraordinary nature of items typically included in $GOCE$ makes its lagged values relatively uninformative instruments for the components of the deficit. The OLS estimates of specifications which include $GOCE$ separately indicate that the two types of capital expenditure included ($GINV$ and $GOCE$) enter very differently. This may be because $GINV$ captures new productive investment, as reflected by government fixed capital formation, whereas $GOCE$ does not. For data availability reasons, $GINV$ is included as a gross measure, that is, it is not net of depreciation or consumption of fixed capital (see ESA 2010, P.51g).

[4] We reach the same conclusions regarding the stationarity properties of the data using other standard panel unit root tests. This is equivalent to estimation in terms of deviations from the cross-sectional mean. Interestingly, the existing literature has related bond yields and fiscal policy measures in $I(0)$ as well as $I(1)$ terms (see Ardagna et al. (2007) for both). Although the literature frequently allows for common effects by including year fixed effects in specifications, it does not appear to apply unit root tests to the demeaned series.

3.2 Model specification

We employ the following panel regression model to investigate the relevance of the composition of the government budget deficit for government bond yields:

$$y_{i,t} = \alpha_i + \beta F_{i,t} + \gamma C_{i,t} + \delta_t + \varepsilon_{i,t} \tag{2}$$

Here, $y_{i,t}$ refers to the cost of government borrowing in country i in year t. α_i is a country-specific fixed effect, controlling for time-invariant unobserved characteristics of country i that affect its borrowing cost, such as the quality of its fiscal institutions and governance (De Grauwe and Ji, 2013). $F_{i,t}$ includes the set of fiscal policy variables of interest, $C_{i,t}$ is a vector of controls for current economic conditions, and β and γ are vectors of coefficients. δ_t is a year-specific fixed effect, accounting principally for the common long-term downward trend in yields since the 1990s and the possibility that this trend is not adequately captured by the included country-specific explanatory variables.[5] Finally, $\varepsilon_{i,t}$ is the error term. This model is in line with, for example, the approaches of Ardagna et al. (2007) and Gruber and Kamin (2012).

The cost of government borrowing ($y_{i,t}$) is proxied with the 10-year government bond yield ($GBY10_{i,t}$) in estimation, the precise measurement of which is discussed in more detail in Section 3.1 above. The set of fiscal variables ($F_{i,t}$) typically comprises either the primary deficit ($GDEF_{i,t}$) or its decomposition into current spending ($GCEX_{i,t}$), investment ($GINV_{i,t}$) and revenue ($GREV_{i,t}$), all measured in percent of GDP. The set of macroeconomic controls ($C_{i,t}$) includes the short-term interest rate ($ISN_{i,t}$), the inflation rate ($CPI_{i,t}$), the real GDP growth rate ($GROWTH_{i,t}$) and a dummy ($EURO_{i,t}$) that is equal to 1 from the year onwards that country i joined the Eurozone. This set of controls and, in particular, the inclusion of a short-term interest rate as a control for the cycle and monetary policy are in line with the existing literature (Ardagna et al., 2007; Baldacci and Kumar, 2010; Faini, 2006; Gruber and Kamin, 2012, among others), but not innocuous. The inclusion of the short-term interest rate can be interpreted as an attempt at "holding monetary policy constant". However, this can, of course, mean many different things: this might refer to the path of the money supply, adherence to a Taylor rule or the inflation target (Woodford, 2011). Our results are hence informative about the response of long-term government bond yields to fiscal policy over and above any central bank reaction as captured by the short-term interest rate (Canzoneri et al., 2002).[6]

Based on the discussion in Section 2, the central question that this paper seeks to explore is whether, econometrically speaking, the coefficient on government current

[5] See Figure 2 for a graph of the long-term government bond yield.

[6] Thus, as regards the theoretical links between bond yields and fiscal policy discussed in Section 2, the effects identified below reflect the response of the term premium (and of shifts to expected future short-term interest rates) to fiscal policy, since the current short-term interest rate – via which the mechanisms analysed by most macroeconomic models are usually assumed to play out – is included as a control. Also, note that any central bank reaction function as captured by a regression of the short-term interest rate on any of the fiscal variables and controls does not yield significant coefficients on fiscal variables in our sample, in line with the findings of Ardagna et al. (2007).

spending is positive and significantly larger than that on government investment. In addition, total revenue should enter negatively. We would also expect both the short-term interest rate and the inflation rate to enter positively individually, but perhaps not significantly so when included jointly, since they may be capturing related information. The coefficient on the real growth rate is ambiguous: higher current real growth may reflect higher future growth and hence higher inflation expectations, which would suggest a positive coefficient. However, higher future growth might also reduce perceived default risk, since this would make any given fiscal policy stance more sustainable, which would suggest a negative coefficient. Finally, the coefficient on Eurozone membership is also ambiguous: on the one hand, on the assumption that joining the Eurozone provides governments with a lender of last resort, membership should reduce yields. On the other hand, upon joining the Eurozone, governments can no longer monetise or inflate away their debt, which could both reduce perceived inflation risk and increase perceived default risk (Bernoth et al., 2004).

3.3 Identification

The valid identification of the effects of fiscal policy on bond yields hinges on ensuring that potential sources of endogeneity of the fiscal variables are investigated and dealt with appropriately. Endogeneity might arise in this setting from (i) potential reverse causation from interest rates to fiscal policy decisions and (ii) the potential simultaneity of fiscal variables and interest rates with respect to both the economic cycle and institutional factors. The former is addressed by applying instrumental variable methods and by shifting the timing of dependent and fiscal explanatory variables relative to each other in order to confirm the robustness of our main results. The latter is dealt with by including macroeconomic explanatory variables in all specifications to control for the cycle and by examining the robustness of results to splitting expenditure and revenue measures into their cyclical and structural components, to changes in the set of controls as well as to the inclusion of additional explanatory variables that reflect time-varying institutional factors. Time-invariant institutional factors that might cause simultaneity are addressed by the use of country fixed effects in all specifications. Finally, we use forecasts of our main fiscal variables of interest instead of actual values to address both potential sources of endogeneity. While this is no panacea, it is an important step in the right direction (Laubach, 2009).[7]

The dependent variable – the secondary-market long-term government bond yield – exhibits a close degree of co-movement across countries and, in particular, a clear common downward trend since at least the 1990s (see Figure 2). As mentioned above, year fixed effects are therefore introduced in main specifications, in order to

[7]Laubach (2009) also states; "Moreover, deficits projected several years into the future may be informative about the longer-run fiscal position, and may therefore approximate investors' expectations about the eventual level of government debt relative to GDP. Such measures of expectations thus hold out the prospect of uncovering any causal relationship from fiscal variables to interest rates."

address the possibility that this downward trend in yields is not fully captured by the country-specific fundamentals included, such as inflation or growth rates.

Throughout, we report standard errors that are consistent in the presence of heteroskedasticity, serial correlation and a range of forms of cross-section dependence (Driscoll and Kraay, 1998).[8] All main results hold also when standard errors are clustered at the country level instead.

4 Results

4.1 Main findings

This section presents key results from estimating a model of the type presented in Equation 2. In essence, we investigate here whether bond markets accord importance to the composition of government budget deficits, in the sense of distinguishing deficits due to current spending and deficits due to investment.

Table 1 contains Fixed Effects ("FE") estimates of a set of main specifications of interest. We report Driscoll-Kraay (1998) standard errors. Column (1) estimates a specification that is common in the literature: here, only the primary deficit is included to reflect the fiscal policy stance, which amounts to imposing the restriction that all components of this deficit measure enter equally in absolute terms. The deficit enters significantly and with the anticipated positive sign: more expansionary fiscal policy, as reflected in a higher primary budget deficit relative to GDP, is associated with significantly higher government bond yields. Its coefficient is of a magnitude that is in line with the literature (see, for example, Gruber and Kamin, 2012), yet that suggests an effect that is very small in absolute terms: an increase in the primary budget deficit, relative to GDP, of one standard deviation would increase yields by about 10 basis points, based on column (1). Column (2) includes both the primary deficit and the government investment component of the deficit. The highly significant coefficient on the investment component implies that the restriction that the coefficients on all components of the primary deficit are equal in absolute value is strongly rejected. Column (3) then includes the full breakdown of the primary budget deficit into an accounting identity, as per Equation 1. The coefficient on government revenue is insignificant. The coefficient on government current spending has the anticipated positive sign and is statistically significant. In addition, the restriction that the coefficients on government current spending and government investment are equal is strongly rejected[9]: government investment enters not just with a smaller coefficient, but in fact negatively and highly significantly.

[8] There is evidence of both heteroskedasticity and serial correlation in the error term. Standard errors are adjusted according to the order of serial correlation found in residuals, namely first or second, but not higher, in case of central specifications of interest. Additionally, a formal test of cross-section dependence (Pesaran, 2004) rejects the null hypothesis of cross-sectional independence for some, though not all, specifications.

[9] With a p-value from a Wald test of 0.00 in column (3).

Table 1: Baseline results

Dep. var.: gov. bond yield		**Including deficit decomposition**			
	(1)	(2)	(3)	(4)	(5)
Primary budget deficit	2.585**	3.846***			
	(1.110)	(0.983)			
Gov. investment		-37.175***	-31.351***	-19.649***	-25.937***
		(9.008)	(8.473)	(4.452)	(6.059)
Gov. current expenditure			5.085***	6.834***	4.213***
			(1.333)	(1.362)	(1.189)
Gov. total revenue			1.725	-5.459***	1.736
			(2.332)	(1.200)	(2.150)
Short-term interest rate	0.414***	0.375***	0.371***	0.433***	0.383***
	(0.033)	(0.042)	(0.044)	(0.035)	(0.043)
Inflation rate	-0.089***	-0.064***	-0.059**	-0.005	-0.048*
	(0.022)	(0.024)	(0.024)	(0.028)	(0.025)
Real growth rate	-0.161***	-0.166***	-0.156***	-0.017	-0.103***
	(0.037)	(0.033)	(0.032)	(0.020)	(0.036)
Real growth × "Trouble"					-0.100**
					(0.043)
Eurozone dummy	0.245*	0.189	0.190	-0.029	0.103
	(0.142)	(0.125)	(0.125)	(0.157)	(0.118)
2011 dummy × "Trouble"					2.309***
					(0.189)
2012 dummy × "Trouble"					2.268***
					(0.294)
R-squared	0.647	0.651	0.653	0.767	0.710
Observations	572	572	572	363	572

Notes: Significance levels are denoted as * p<0.1; ** p<0.05; *** p<0.01. The dependent variable is the annual average of the 10-year government bond yield. Driscoll-Kraay standard errors are reported in brackets below coefficient estimates. OLS with country and year fixed effects. R2 is adjusted to exclude the impact of year fixed effects. Column (4) is estimated on the sample before 2008. "Trouble" is equal to 1 for Cyprus, Hungary, Ireland, Italy, Latvia, Portugal and Spain.

This is a fascinating and, in its magnitude and significance, perhaps surprising result, since it implies that, ceteris paribus, higher government investment – which is a type of government expenditure and thus might have been expected to decrease creditworthiness from a creditors' perspective – is associated with lower bond yields. It suggests that markets tend to view government investment, on average, as favourable for growth or as having a positive return (see, for example, Durlauf et al., 2005). The magnitudes of the estimated coefficients imply that an increase in the government budget deficit that is due solely to higher government investment would even decrease government borrowing cost.

Columns (4) and (5) address the fact that a key source of variation in this sample is that a substantial number of countries, but not all, were (directly or indirectly)

embroiled in the sovereign debt crisis. Affected countries witnessed large spikes in government bond yields at some point after 2008, often followed by fiscal austerity. To ensure that the large and highly significant negative effect of government investment on government bond yields is not an artefact of these particular and unusual circumstances, column (4) estimates the specification in column (3) on the sample before 2008. The coefficients on investment and current spending confirm the picture emerging from column (3) while, additionally, government revenue enters significantly and negatively, as originally anticipated.

Next, we split the sample into "troubled" and stable countries[10] based on their crisis experience. We create a time-invariant dummy called "Trouble" that is equal to 1 for those countries in the first category, and interact it with all fiscal and macroeconomic explanatory variables as well as year fixed effects. When estimated using a variety of approaches, only the interaction terms with the real economic growth rate and with the year fixed effects for years 2011 and 2012 are significant, so we keep only these three interaction terms in the specification. The specification that includes these three interaction terms is our preferred one and results are reported in column (5). Coefficients on the fiscal variables of interest are fully robust – they again suggest that bond markets accord significant importance to the composition of the deficit. It also appears that, from the perspective of bond markets, growth matters more in the "troubled" countries, likely reflecting the workings of a default risk channel. Additionally, the highly significant interaction terms with year fixed effects in 2011 and 2012 suggest that, in these years, common factors were not so common: investors might have been penalising certain countries in 2011 and 2012 irrespective of at least those fundamentals included in the specifications estimated here.

4.2 Robustness

This section presents a range of robustness tests. We focus on exploring the robustness of our central result – the significance that government bond markets accord to the underlying composition of the government budget deficit – to addressing possible endogeneity in a number of ways.

First, we explore the potential for endogeneity stemming from reverse causation from interest rates to fiscal policy decisions. Results are presented in Table 2. Columns (1) and (2) shift the timing of information sets. Column (1) uses a fourth-quarter average instead of an annual average of the dependent variable, the long-term bond yield. This is in order to reflect the fact that information about the budget deficit for year t emerges gradually over the course of the year and is finalised only towards the end, so that here, information sets are matched more closely.

[10] "Troubled" countries are those directly affected by the sovereign debt crisis, as evidenced by receiving EU emergency assistance (Cyprus, Hungary, Ireland, Latvia, Portugal, Spain) or by being sufficiently implicated to publicly commit to structural reform and fiscal consolidation during the Euro Summit on the debt crisis in October 2011 (Italy). Note that Greece and Romania are not included in the sample. Results are robust to alternative definitions of the set of "troubled" countries.

Table 2: Robustness: Timing shifts and instrumental variable methods

Dep. var.: gov. bond yield	**Q4 yield (dep. var.)**	**Lagged fiscals**	**2SLS (2nd stage)**
	(1)	(2)	(3)
Gov. current expenditure	7.139***	7.556***	11.055***
	(1.803)	(1.335)	(2.429)
Gov. investment	-15.131**	-17.797**	-21.506**
	(6.647)	(7.981)	(8.514)
Gov. total revenue	0.983	0.511	-1.352
	(1.397)	(1.979)	(3.393)
Short-term interest rate	0.346***	0.371***	0.346***
	(0.042)	(0.036)	(0.030)
Inflation rate	-0.011	-0.057**	-0.047*
	(0.026)	(0.029)	(0.025)
Real growth rate	-0.080**	-0.129***	-0.089***
	(0.031)	(0.029)	(0.020)
Real growth × "Trouble"	-0.125***	-0.100**	-0.093***
	(0.032)	(0.043)	(0.025)
Eurozone dummy	0.176	0.190	0.210
	(0.182)	(0.132)	(0.169)
2011 dummy × "Trouble"	3.152***	2.107***	2.297***
	(0.156)	(0.198)	(0.304)
2012 dummy × "Trouble"	1.489***	2.263***	2.379***
	(0.215)	(0.283)	(0.314)
R-squared	0.682	0.706	
Observations	572	560	545

Notes: Significance levels are denoted as * p<0.1; ** p<0.05; *** p<0.01. The dependent variable is the annual average of the 10-year government bond yield unless otherwise noted. Driscoll-Kraay standard errors are reported in brackets below coefficient estimates. OLS unless otherwise noted. Country and year fixed effects included. "Trouble" is equal to 1 for Cyprus, Hungary, Ireland, Italy, Latvia, Portugal and Spain. Column (3): p-value of underidentification test is 0.00 (H0: equation is underidentified). F-stat of weak identification test is 43.06 (H0: instruments are weak). Both Kleibergen and Paap (2006) / Sanderson and Windmeijer (2016). Test statistics are computed using Newey-West standard errors.

Column (2) uses fiscal variables from period $t-1$ instead of t. In both cases, results are highly robust. In Column (3), we apply Two-Stage Least Squares ("2SLS") estimation methods to address the scope for endogeneity of the fiscal variables, using own lags of fiscal variables as instruments. 2SLS results, using the first and second lags of fiscal variables as instruments, for our preferred specification (column (5) in Table 1) are highly promising econometrically.[11] Thus, endogeneity of the fiscal variables does not appear to be an issue from a purely econometric standpoint,

[11]Due to evidence of serial correlation in baseline specifications, the validity of using lagged values of fiscal variables as instruments for their contemporaneous values hinges here on the Hansen overidentification test not indicating the presence of any problems. A Hansen test does not reject the null hypothesis of joint validity of the instruments, with a p-value of 0.51. Hausman (1978) tests comparing coefficients estimated by OLS and by 2SLS do not reject the null hypotheses, for the coefficients of fiscal variables individually, of exogeneity. Furthermore, first-stage results suggest that first and, in part, second lags are informative instruments. Finally, there do not appear to be underidentification or weak identification issues (Kleibergen and Paap, 2006; Sanderson and Windmeijer, 2016). Newey-West standard errors are used to calculate these and Hansen test statistics since this facilitates computation, but additionally allowing for cross-section dependence does not affect conclusions. Note that the use of the F-statistic in first stages should be considered heuristic in the panel setting (Bazzi and Clemens, 2013). Results are very similar when two-step GMM is used instead of 2SLS. First-stage results are available upon request.

enabling consistent inference using OLS and lending support to our central results discussed above.

Second, we nonetheless persist and also use forecasts – instead of actual values – of our fiscal measures of interest, which effectively addresses the scope both for simultaneity relating to the business cycle and for reverse causation (Laubach (2009)). The forecasts are drawn from the European Commission's "Stability and Convergence Programmes" (SCPs) for EU countries over a maximum period from 1998 to 2014. This means that data is available only for a significantly reduced subset of our original sample (about 1/3 of observations), since the SCP data naturally covers only EU countries and this only from the year onwards that the country in question joined the EU.[12] As far as we aware, no previous research has used forecasts of *components* of the government budget deficit in an empirical analysis of this type. We use the longest-term available forecast (made in year t for three or four years ahead) in specifications, which is appropriate given the horizon of our dependent variable, the 10-year government bond yield. Results are reported in Table 3.

Table 3: Robustness: Forecasts of fiscal variables

Dep. var.: gov. bond yield	**Budget deficit**	**Adding investment**	**Full decomposition**
	(1)	(2)	(3)
Forecast of primary budget deficit	13.443**	12.642**	
	(5.897)	(6.214)	
Forecast of gov. investment		-22.264***	-20.378***
		(7.442)	(6.537)
Forecast of gov. current expenditure			8.942**
			(3.239)
Forecast of gov. total revenue			-9.793*
			(4.873)
Short-term interest rate	0.360***	0.361***	0.379***
	(0.083)	(0.080)	(0.080)
Inflation rate	0.127*	0.169*	0.171*
	(0.066)	(0.081)	(0.097)
Real growth rate	-0.213***	-0.207***	-0.211***
	(0.024)	(0.023)	(0.025)
Real growth × "Trouble"	-0.180**	-0.197***	-0.208***
	(0.071)	(0.066)	(0.059)
Eurozone dummy	0.293	0.297	0.186
	(0.526)	(0.542)	(0.569)
2011 dummy × "Trouble"	1.972***	1.935***	1.987***
	(0.076)	(0.067)	(0.077)
2012 dummy × "Trouble"	1.713***	1.622***	1.634***
	(0.250)	(0.216)	(0.213)
R-squared	0.652	0.654	0.641
Observations	170	170	170

Notes: Significance levels are denoted as * p<0.1; ** p<0.05; *** p<0.01. The dependent variable is the annual average of the 10-year government bond yield. Driscoll-Kraay standard errors are reported in brackets below coefficient estimates. OLS estimation with country and year fixed effects. R2 adjusted to exclude the impact of year fixed effects. "Trouble" is equal to 1 for Cyprus, Hungary, Ireland, Italy, Latvia, Portugal and Spain. Forecasts of fiscal variables are for 3 or 4 years ahead.

[12]Note that the SCPs submission deadline changed in 2009, from the end of the year to April. We consider the end-of-the-year-2009 forecast for 2010 (analogously for prior years) and the April 2011 forecast for 2011 (analogously for subsequent years) the $t+1$ forecasts.

We replicate a set of our key results, using forecasted instead of actual values of fiscal variables of interest. Results are strongly robust, as the clear distinction drawn by bond markets between government current expenditure and government investment expenditure, with the latter viewed more favourably than the former, is clearly present. Interestingly, forecasted government revenue here also enters negatively, as originally anticipated.[13]

Third, Table 4 presents a range of further robustness tests that, among other things, continue to explore the scope for simultaneity stemming from time-varying institutional factors. Thus, column (1) adds an indicator that reflects the ideological stance of the governing party or coalition – specifically, the share of left-leaning parties in government[14] – with the objective of controlling for at least part of time-varying institutional characteristics that might cause simultaneity. It enters insignificantly and does not affect our conclusions.

Column (2) addresses the fact that the use of the three-month interbank rate as a control might introduce the effects of changes in banking risk and liquidity by instead including the monetary policy rate, typically an overnight rate, as a control. While the sample shrinks somewhat due to data (in)availability, results are robust.

Column (3) includes the gross debt ratio as an additional indicator of the fiscal policy stance, which enters significantly positively and with a magnitude that is in line with prior literature. Although this is formally invalid due to the non-stationarity of the debt ratio, main results are unaffected.

Column (4) relates the bond yield spread relative to Germany to the usual set of fiscal and control variables, all expressed relative to Germany. This specification is similar to those used in a spread-based literature on fiscal sustainability, such as Hagen et al. (2011). Results are highly robust. Note that the presence of year fixed effects, which are commonly specified in the literature and throughout this paper, means that this spread-based specification is exactly equivalent to relating the level of the yield to country-specific fiscal and control variables as before, on the sample that excludes Germany.[15]

[13]Note that the forecast of the debt ratio also enters significantly positively, in line with previous research and our finding below, although concerns about regression balance remain.

[14]It measures the cabinet posts of social democratic and other left parties as a percentage of total cabinet posts weighted by number of days in office (Armingeon et al., 2015) and ranges from 0 to 100%.

[15]This is because the inclusion of year fixed effects controls for the evolution of yields in a reference country such as Germany. It is interesting to note that in spite of this, explanatory variables used in research that investigates the fiscal policy determinants of bond yield spreads relative to a reference country (such as De Grauwe and Ji, 2013; Hagen et al., 2011) tend to differ from those used in research that does so for the level of the bond yield (such as Ardagna et al., 2007).

Table 4: Robustness: Further tests

Dep. var.: gov. bond yield	**Political factors**	**Policy rate**	**W/ debt ratio**	**Spreads vs. Germany**
	(1)	(2)	(3)	(4)
Gov. current expenditure	4.148***	3.820***	1.573	4.492***
	(1.270)	(0.675)	(1.256)	(1.322)
Gov. investment	-26.679***	-31.345***	-13.830**	-26.268***
	(8.307)	(6.007)	(6.033)	(7.202)
Gov. total revenue	1.447	2.008	0.898	1.433
	(2.144)	(1.834)	(2.074)	(2.072)
Left-wing share of gov.	-0.104			
	(0.076)			
Monetary policy rate		0.303***		
		(0.049)		
Debt ratio			1.225***	
			(0.262)	
Short-term interest rate	0.387***		0.403***	0.386***
	(0.042)		(0.036)	(0.048)
Inflation rate	-0.048*	0.004	-0.064**	-0.050*
	(0.027)	(0.031)	(0.027)	(0.027)
Real growth rate	-0.106***	-0.086***	-0.108***	-0.106***
	(0.033)	(0.021)	(0.033)	(0.033)
Real growth rate × "Trouble"	-0.097**	-0.107***	-0.090**	-0.097**
	(0.042)	(0.039)	(0.041)	(0.043)
Eurozone dummy	0.157	-0.097	0.229	0.079
	(0.156)	(0.134)	(0.148)	(0.150)
2011 dummy × "Trouble"	2.342***	2.331***	2.253***	2.304***
	(0.192)	(0.234)	(0.165)	(0.186)
2012 dummy × "Trouble"	2.275***	2.505***	2.191***	2.270***
	(0.298)	(0.355)	(0.254)	(0.282)
R-squared	0.697	0.682	0.712	0.677
Observations	543	508	571	548

Notes: Significance levels are denoted as * p<0.1; ** p<0.05; *** p<0.01. The dependent variable is the annual average of the 10-year government bond yield except where otherwise noted. Driscoll-Kraay standard errors are reported in brackets below coefficient estimates. OLS with country and year fixed effects. R2 adjusted to exclude the impact of year fixed effects. "Trouble" is equal to 1 for Cyprus, Hungary, Ireland, Italy, Latvia, Portugal and Spain.

We also address concerns about simultaneity stemming from underlying macroeconomic conditions by investigating whether the cyclical components of government revenue and current spending enter differently than their structural components. These results are reported in Table 9 in the Appendix. The structural components of revenue and expenditure correspond to discretionary spending, while the cyclical

ones reflect automatic stabilisers.[16] When current expenditure and total revenue are split into their cyclical and structural components, only the structural component is significant in the case of expenditure and neither is significant in the case of revenue, in line with results above. The large standard errors on the coefficients of cyclical components suggest that these components may be highly collinear with the included macroeconomic controls, yet are reassuring insofar as they indicate that these control variables are in fact adequately controlling for cyclical conditions.

Finally, Table 10 in the Appendix reports results from using "mean groups" estimation approaches, where coefficients of explanatory variables are allowed to be country-specific (Pesaran and Smith, 1995; Eberhardt and Teal, 2010; Eberhardt, 2013) and then averaged across countries. Results are sufficiently similar to pooled results to indicate that the pooling approach taken here is not misleading.[17]

4.3 Heterogeneity

Table 5 explores some aspects of possible temporal and spatial heterogeneity in estimated effects. Columns (1) and (2) in Table 5 address the conjecture that the recent financial crisis awoke bond markets from their "sleeping beauty" state of being to the realisation that government bonds do involve default and other risks, which means that effects of fiscal variables may have changed since the crisis. Column (1) is similar to column (4) of Table 1[18], and reports results from estimating the baseline specification on the sample prior to 2008, while column (2) does so on the sample from 2008 onwards. Results are qualitatively unchanged.

[16]Note that the macroeconomic models discussed in Section 2 typically focus on the interest rate response to discretionary government spending changes. However, the default risk channel also mentioned above might plausibly reflect worry both about discretionary spending as well as automatic stabilisers, since both can ultimately result in insolvency. Data on cyclically adjusted government revenue and current expenditure, but not investment, are also provided by AMECO, though for a smaller subset of country-year observations. Column (1) presents results from estimating our preferred specification on this subset.

[17]Additional avenues that we explored but do not report here include adding inflation and GDP growth forecasts from the WEO for 1 to 5 years ahead to specifications, in order to more appropriately reflect the forward-looking nature of financial markets, but these forecasts were never significant and did not affect results. Furthermore, we used a measure of the output gap as an alternative control for the economic cycle, but results were unaffected. Additionally, measures of the effective exchange rate, sourced from BIS, were added to a range of baseline specifications, but did not change results. We explored dynamic models that include the lagged dependent variable, and found that the long-run effects of fiscal variables are very similar to those obtained in the static models reported here. Finally, the relevance of hitting the zero lower bound (ZLB) in short-term nominal interest rates, liberally defined as rates below 50 basis points, was assessed, but our main results were unaffected. Results – not reported here – are also highly robust when alternative ways for controlling for the common downward trend in bond yields are applied, such as including linear trend segments or a mean bond yield in place of year fixed effects.

[18]Column (1) here additionally includes the interaction term between the growth rate and our "trouble" dummy.

Table 5: Heterogeneity

Dep. var.: gov. bond yield	**Pre-crisis sample**	**Post-crisis sample**	**Excl. EA 1998-2007**	**Non-EA obs.**	**EA obs.**
	(1)	(2)	(3)	(4)	(5)
Gov. current expenditure	6.679***	4.970***	4.808***	4.350**	2.840***
	(1.313)	(1.170)	(1.465)	(1.716)	(1.071)
Gov. investment	-19.577***	-44.705***	-24.869***	-14.145**	-56.436***
	(5.189)	(15.600)	(6.411)	(6.631)	(13.173)
Gov. investment × Crisis					
Gov. total revenue	-5.339***	6.295	2.211	1.595	7.112
	(1.408)	(4.558)	(1.802)	(1.942)	(6.068)
Short-term interest rate	0.428***	0.277***	0.362***	0.363***	
	(0.037)	(0.084)	(0.036)	(0.032)	
Inflation rate	-0.002	-0.017	-0.041	-0.057	-0.055
	(0.030)	(0.032)	(0.029)	(0.037)	(0.050)
Real growth rate	-0.013	-0.188***	-0.118***	-0.100**	-0.072***
	(0.027)	(0.030)	(0.037)	(0.043)	(0.023)
Real growth rate × "Trouble"	-0.020	-0.083	-0.091**	-0.111**	-0.120**
	(0.031)	(0.070)	(0.045)	(0.048)	(0.057)
Eurozone dummy	-0.162	-0.444	-0.007		
	(0.131)	(0.430)	(0.182)		
2011 dummy × "Trouble"		2.117***	2.073***	1.426***	2.675***
		(0.183)	(0.222)	(0.256)	(0.176)
2012 dummy × "Trouble"		1.956***	2.048***	1.040***	2.371***
		(0.266)	(0.299)	(0.285)	(0.398)
R-squared	0.767	0.618	0.727	0.675	0.276
Observations	363	209	459	351	221

Notes: Significance levels are denoted as * p<0.1; ** p<0.05; *** p<0.01. The dependent variable is the annual average of the 10-year government bond yield. Driscoll-Kraay standard errors are reported in brackets below coefficient estimates. OLS with country and year fixed effects. R2 is adjusted to exclude the impact of year fixed effects. "Trouble" is equal to 1 for Cyprus, Hungary, Ireland, Italy, Latvia, Portugal and Spain.

Note, however, the relatively small sample size and short time series available for the results reported in column (2). The real growth rate becomes more important and enters significantly negatively in column (2), which suggests the workings of a default risk channel and is in line with the conjecture that since the crisis, the spectre of government default has returned to investors' minds (cf. Beirne and Fratzscher, 2013; Muellbauer, 2013). This also demonstrates that imposing the restriction that coefficients on control variables are stable over time is not innocuous, although doing so does not affect our main conclusions reached.

Columns (3) to (5) address the fact that the introduction of the Euro led to a convergence in government bond yields for Euro area countries, especially for the period from its introduction until the beginning of the financial crisis. Column (3) excludes observations from Euro area countries during the period from 1998 to 2007. Column (4) estimates a baseline specification on the sample of non-Euro area

observations, while column (5) focusses on Euro area observations – specifically, it includes country i from the year immediately before it joined the Euro.[19] Results are robust. Thus, although Euro area countries are different in an important respect due to the introduction of the common currency, our central result of interest – the significant difference between the effects of government investment and government current expenditure for bond yields – appears to not be driven by Euro area-specific developments.

5 Conclusion

Do sovereign bond markets account for the reasons underlying government budget deficits? We find that they do, and that in this sense, not all government budget deficits are created equal: markets charge significantly higher interest rates for deficits that are the result of higher current expenditure than for deficits that are the result of higher government investment. In this sense, we find that some deficits appear to be considered more "excusable" than others. Based on our preferred specifications, an increase in the deficit solely due to higher government investment would in fact decrease long-term government bond yields. We address the potential for endogeneity by using forecasts of fiscal variables and by instrumental variable methods. Our results imply that markets tend to view government investment, on average, as favourable for growth or as having a positive return.

These findings could have important policy implications, insofar as the normative perspective on fiscal policy that financial markets provide is considered a useful indicator of the appropriateness, validity or sustainability of any given fiscal policy stance. In any case, they could be relevant for policy insofar as governments typically pay attention to financial markets' perspective, not least due to its impact on the opportunity cost of fiscal policy changes via interest rate changes.

For one thing, then, our findings suggest that fiscal consolidation policies ought to focus more on government current expenditure than on government investment, or at least distinguish between these two expenditure types in mandating deficit or debt reduction targets. This is especially important since it may be easier politically in the short term to reduce government investment, such as on road maintenance or by postponing major government investment projects, than government current expenditure, such as on wages or pensions of public employees. Indeed, Blanchard (2019) notes that a decrease in public investment is "one of the main ways in which countries unfortunately have implemented fiscal austerity", and that this "is unlikely to increase welfare". With the COVID-19 pandemic having suddenly propelled fiscal policy into vastly expansive territory, our findings are of particular salience. Fiscal policy will need to remain accommodative for a few years still, but when consolidation is started, it is key that it is conducted in a way that considers the underlying reasons

[19]The short-term interest rate is equal across Euro area countries from the introduction of the Euro area onwards and hence not included in column (5). Interesting future research could investigate the role of fundamentals for Euro area countries' yields over time using "attention" functions as in Muellbauer (2013).

for – and thus composition of – government budget deficits, but also government balance sheets (see Peppel-Srebrny, 2018).

Relatedly, by suggesting that bond markets' perspective on deficits and debt depends on what use deficits and debt are put to, our findings also imply that fiscal rules – in contrast to the current implementation of the EU's Maastricht criteria, for example – should consider the underlying composition of government budget deficits, and thus distinguish budget deficits that are the result of government investment from those that are not. Interestingly, the European Commission's Economic Governance Review process that is under way at the time of writing appears to appreciate the relevance of the underlying drivers of government budget deficits – it explicitly notes that as a result of current rules, "the composition of public finances has not become more growth-friendly, with Member States consistently opting to increase current expenditure rather than protect investment" (2020).

More generally, our findings suggest that the fiscal policy consensus in many EU and OECD countries up until early 2020 – which Blanchard (2019) sums up as "high public debt is widely perceived as economically, and even morally, destructive" – may not have been appropriate. Indiscriminate deficit and debt reduction regardless of economic circumstance and government expenditure type may not be optimal, nor always required to contain government bond yields and borrowing cost.

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A Additional tables

Table 6: Comparison of interest rate effects across models

Increase in current ("unproductive") government expenditure								
Model	**Agents**	**Rigidity (p, w)**	**Mon. pol.**	C	L	I	Y	**Nom. i**
IS-LM (1)	NR	Prices sticky	exogenous	↑	↑	↓	↑	↑
NK (2)	R	Both sticky	Taylor rule	↓	↑	↓	↑	↑
RBC (3)	R	Both flexible	irrelevant	↓	↑	↑	↑	↑

Increase in investment ("productive") government expenditure

Production function with a non-zero elasticity of output with respect to public capital

Model	**Agents**	**Rigidity (p, w)**	**Mon. pol.**	C	L	I	Y	**Nom. i**
IS-LM	NR	Prices sticky	exogenous	↑	↑	↓ or ↑	↑	↑ less or ↓
NK (4)	R	Both sticky	Taylor rule	↓ or ↑	↑	↑	↑	↑ less or ↓
RBC (3)	R	Both flexible	irrelevant	↑	↑	↑	↑	↑ more

"NR": Non-Ricardian. "R": Ricardian. (1) as per Galí et al. (2007). (2) as per Smets and Wouters (2003) – Taylor rule with $\phi_y > 0$, $\phi_\pi > 0$. (3) as per Baxter and King (1993). (4) as per Linnemann and Schabert (2005) – Taylor rule with $\phi_y = 0$, $\phi_\pi > 0$. In IS-LM, money supply is assumed to be constant. In RBC case, impacts on C, L, I and Y are in equilibrium. In NK, the stickiness of both prices and wages is not required for these results to obtain.

Table 7: Summary statistics for included variables

Variable	**Mean**	**St. dev.**	**Min.**	**Max.**	**N×T**
(1) Government bond yield (%)	4.84	2.12	0.55	14.00	572
(2) Short-term interest rate (%)	3.63	2.89	0.01	18.77	572
(3) Inflation rate (%, yoy)	2.44	2.13	-1.71	16.26	572
(4) Real growth rate (%, yoy)	2.33	3.20	-14.81	11.90	572
(5) Primary deficit (% of GDP)	-0.00	0.04	-0.21	0.29	572
(6) Non-primary deficit (% of GDP)	0.02	0.05	-0.19	0.32	572
(7) Gov. current exp. (% of GDP)	0.37	0.06	0.22	0.54	572
(8) Gov. investment (% of GDP)	0.04	0.01	0.02	0.07	572
(9) Gov. other cap. exp. (% of GDP)	0.01	0.02	-0.01	0.22	572
(10) Gov. total revenue (% of GDP)	0.42	0.07	0.30	0.59	572
(11) Gov. liabilities (% of GDP)	0.60	0.35	0.04	2.46	571

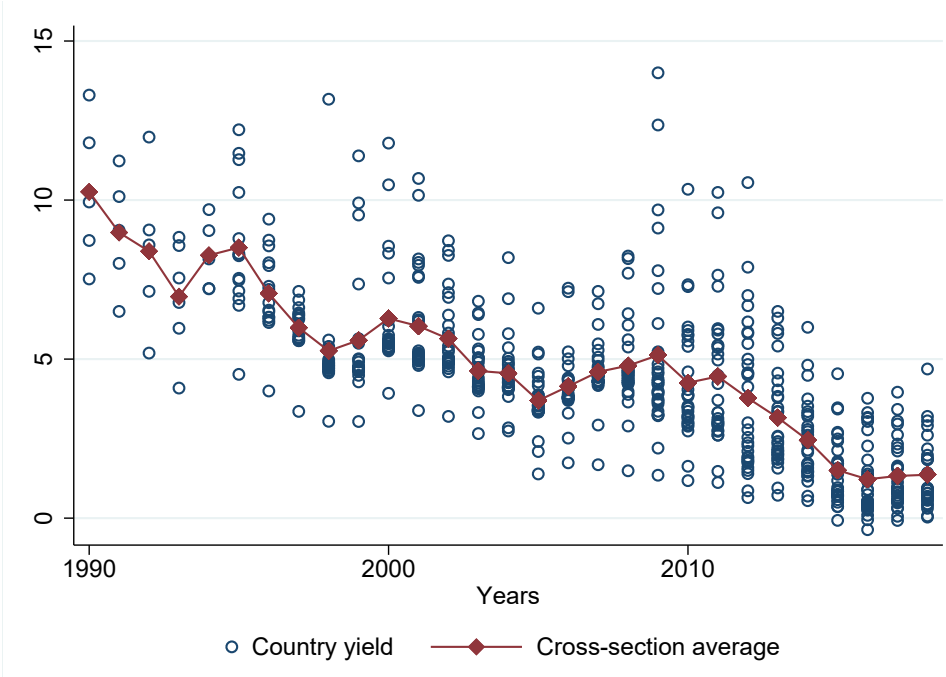
Sources: (1)-(4) OECD and AMECO; (5)-(11) AMECO. Countries included (31 in total): Austria, Belgium, Bulgaria, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States.

Table 8: Testing for unit roots

Im, Pesaran and Shin (2003) test	
Variable	**p-values**
Government bond yield	0.00
Primary budget deficit	0.00
Gov. current expenditure	0.00
Gov. investment	0.00
Gov. other cap. expenditure	0.00
Gov. total revenue	0.01
Gov. liabilities	0.32
Short-term interest rate	0.00
Inflation	0.00
Real growth rate	0.00

Im et al. (2003) test for unit roots. Lag length selected by AIC. Null hypothesis: all panels contain unit roots ($\phi_i = 0 \; \forall \, i$). Series are cross-sectionally demeaned.

Figure 2: Long-term government bond yield, 1990-2014



In percent
Source: AMECO, OECD

B Robustness

Cyclical and structural components of fiscal variables

Table 9: Robustness: Cyclical and structural components

Dep. var.: gov. bond yield	**Baseline**	**Split**
	(1)	(2)
Gov. current expenditure	5.993***	
	(1.298)	
Gov. current exp., structural component		5.347***
		(1.157)
Gov. current exp., cyclical component		9.185
		(6.092)
Gov. investment	-22.318***	-20.402**
	(8.347)	(9.006)
Gov. total revenue	1.914	
	(2.935)	
Gov. total rev., structural component		2.161
		(2.801)
Gov. total rev., cyclical component		-30.306
		(58.158)
Short-term interest rate	0.421***	0.424***
	(0.051)	(0.054)
Inflation rate	-0.031	-0.033
	(0.030)	(0.035)
Real growth rate	-0.106***	-0.097**
	(0.036)	(0.044)
Real growth × "Trouble"	-0.087*	-0.088*
	(0.047)	(0.045)
Eurozone dummy	0.329*	0.352**
	(0.168)	(0.157)
2011 dummy × "Trouble"	2.235***	2.235***
	(0.208)	(0.209)
2012 dummy × "Trouble"	2.265***	2.240***
	(0.328)	(0.318)
R-squared	0.803	0.818
Observations	477	477

Notes: Significance levels are denoted as * p<0.1; ** p<0.05; *** p<0.01. The dependent variable is the annual average of the 10-year government bond yield. Driscoll-Kraay standard errors are reported in brackets below coefficient estimates. OLS with country and year fixed effects. R2 adjusted to exclude the impact of year fixed effects. "Trouble" is equal to 1 for Cyprus, Hungary, Ireland, Italy, Latvia, Portugal and Spain.

"Mean groups" estimation

In a panel data context, applying the "mean groups" estimation approach generally involves estimating a separate regression for each group and then averaging estimated coefficients across groups (Pesaran and Smith, 1995; Eberhardt, 2013).

Table 10 reports results from estimating a baseline specification – column (3) in Table 1 – using "mean groups" approaches, thus allowing all coefficients to be country-specific rather than pooling them across countries. The fact that year fixed effects are specified in pooled regressions is here reflected by, for results reported in columns (1) and (2), demeaning all variables prior to estimation. Column (1) reports unweighted means of country-specific regression coefficients. Column (2) reports the outlier-robust mean of country-specific regression coefficients. Column (3) (Eberhardt and Teal, 2010) is generated by first estimating a pooled regression that includes year fixed effects, and then including the estimated year fixed effects when subsequently running the country-specific regressions. Here, coefficients reported are again unweighted means of the country-specific regression results.

Table 10: "Mean groups" estimation

Dep. var.: gov. bond yield	**Mean groups (MG)**	**Outlier-robust MG**	**Augmented MG**
	(1)	(2)	(3)
Gov. current expenditure	10.537*	4.727	8.899**
	(5.537)	(3.417)	(3.639)
Gov. investment	-21.211**	-22.367**	-24.491*
	(9.533)	(9.899)	(14.613)
Gov. total revenue	-2.363	-4.139	-6.409
	(4.148)	(3.704)	(5.036)
Short-term interest rate	0.270***	0.257***	0.448***
	(0.076)	(0.048)	(0.055)
Inflation rate	0.033	0.019	0.004
	(0.042)	(0.044)	(0.045)
Real growth rate	-0.081***	-0.085***	-0.073***
	(0.024)	(0.024)	(0.019)
Eurozone dummy	0.941	0.475	0.154
	(0.715)	(0.477)	(0.153)
Observations	572	572	572

Notes: Significance levels are denoted as * p<0.1; ** p<0.05; *** p<0.01. Standard errors are reported in brackets below coefficient estimates.

(1) and (2): on demeaned series to reflect use of year fixed effects in baseline specifications.

(3): on regular series since estimation procedure involves year fixed effects.

(1) and (2): Pesaran and Smith (1995); (3) Eberhardt and Teal (2010)