Public debt and r-g risks in advanced economies: Eurozone versus stand-alone

Philipp Heimberger

Vienna Institute for International Economic Studies, Rahlgasse 3, Vienna, Austria

ARTICLE INFO

ABSTRACT

Differentials between interest rates on government bonds (r) and economic growth rates (g) are a key determinant of public debt dynamics. What are the predictors of r-g, and what risks do policy-makers face? Applying regression methods to data on 22 OECD countries over 1970–2018 shows that higher public debt levels are not predictive of more unfavourable r-g in both Eurozone and stand-alone countries, where the latter issue debt in their own currency. The Euro Crisis – a period characterised by doubts over whether the ECB would backstop government bond markets – is linked with more unfavourable r-g, but only in Euro periphery countries. Our results suggest that the Eurozone's institutional architecture affects r-g risks. While we find that predicted probabilities of future r – g < 0 are typically significantly higher than 50 % across OECD economies under conditions similar to the pre-Covid-19 years, r-g risks are most significant in the Euro periphery.

1. Introduction

Olivier Blanchard's American Economic Association (AEA) presidential address in January 2019 moved the differential between interest rates on long-term government bonds (r) and economic growth rates (g) into the limelight. By using US data, Blanchard (2019) shows that government bond yields have more often than not been lower than growth rates. He argues that, in such an r – g < 0 environment, public debt may not only come without substantial fiscal costs, but also with limited welfare costs. The call for a "richer discussion of the costs of debt and of fiscal policy than is currently the case" (Blanchard, 2019, p. 1197) has been met with extensive debates in academia and policy-making circles geared towards gaining a better understanding of r-g. While the budget constraint is softer when the r-g differential is favourable (r < g) – governments can run primary fiscal deficits and still see a falling public-debt-to-GDP ratio (e.g. De Grauwe and Ji, 2019) –, others have stressed that the risks related to an unfavourable development in the interest-growth environment should not be underestimated given the volatility of r-g and the proneness of governments to running fiscal deficits that are too high (e.g. Wyplosz, 2019). Furthermore, the increase in public-debt-to-GDP ratios due to the COVID-19 crisis (e.g. IMF, 2021) triggered growing concerns that countries with higher public debt levels may face elevated r-g risks.

This paper contributes to the literature by analysing the predictors of r-g differentials and future r-g risks for a large group of advanced economies that are OECD members. Exploring the predictors of r-g is important, because what matters for fiscal policy and debt dynamics is not so much the level of interest rates but interest-growth differentials (Blanchard, 2023). With favourable interest-growth differentials (r < g), the intertemporal budget constraint may no longer bind the government.

However, in an unfavourable r-g environment (r > g), a sovereign debt that previously seemed manageable may turn unsustainable. Hence, we address the question what economic, fiscal and institutional factors are important in explaining differences in r-g differentials and future r-g risks across OECD countries. In this context, we conceptualise the interest-growth environment as a risk factor for fiscal policy-makers, as (future) r-g differentials determine the extent to which governments can run primary fiscal deficits without pushing the public-debt-to-GDP ratio up. In doing so, we contribute to a better understanding of the evolution of r-g risks and their predictors. Recent literature already provides some insights for groups of advanced and developing countries (Mauro and Zhou, 2021; Mehrotra and Sergeyev, 2021; Lian et al., 2020; Checcherita-Westphal and Domingues Semeano, 2020; Escolano et al., 2017; Turner and Spinelli, 2011); however, an in-depth empirical investigation for a larger group of OECD countries is missing. A particular contribution of this paper is that we provide evidence about whether the predictors of r-g differentials and related risks differ when we compare Eurozone member countries with 'stand-alone' countries, where the latter issue government debt in their own currency (e.g. UK, Japan). We distinguish between Eurozone and stand-alone countries because the institutional architecture in the Eurozone is special: a fully integrated monetary union is not matched by fiscal union, as fiscal policy competences largely remain in the hands of national fiscal policy-makers. Therefore, the sovereign debt position of individual Eurozone member countries is more fragile: Eurozone governments can experience self-fulfilling rollover crises as they issue debt in Euros, a currency over which they de-facto do not have control. This makes them prone to being pushed into liquidity problems – which is not the case for advanced stand-alone countries whose central bank serves as a credible backstop for government debt (Bianchi and Mondragon, 2022; De Grauwe and Ji, 2013a). The literature therefore highlights that the Eurozone's institutional architecture gives rise to a special fragility (De Grauwe and Ji, 2022). This paper assesses both the impact of entering the Eurozone before the financial crisis as well as of the Euro Crisis on r-g differentials by taking macroeconomic and institutional differences between Eurozone countries and stand-alone countries into account.

We construct a panel data set for 22 OECD countries – 11 Eurozone, 11 stand-alone – over the time period 1970–2018, which shows that there are substantial differences in the occurrence of negative r-g episodes across countries. We use the data to conduct regression analysis. Our results highlight that public-debt-to-GDP ratios are consistently a poor predictor of r-g differentials. However, other explanatory variables relate significantly to r-g: the real long-term interest rate, inflation, primary fiscal balances, financial openness, and the safety of government bonds – although there are important differences in how some of these factors are associated with r-g when we compare Eurozone and stand-alone countries. In particular, we find that the safety of government bonds – measuring the historical correlation of government bond yields with a safety benchmark – played a special role in moderating the impact of a) entering the Eurozone and b) the Euro Crisis. Future r-g risks differ markedly across OECD countries: risks are highest in the Eurozone periphery, and this will further complicate the governance of the fragile monetary union.

The rest of the paper is structured as follows. Section 2 situates our contribution in the related literature. Section 3 presents the data set and descriptive statistics on r-g differentials. Sections 4–6 present the econometric results based on fixed-effects regressions, quantile regressions and probit regressions, respectively. Section 7 summarises and concludes.

2. Related literature

The public debt accumulation equation can be written as:[1]

$$PDebt_t - PDebt_{t-1} = \frac{1 + r_t}{1 + g_t} * PDebt_{t-1} + pFD \approx (r_t - g_t) * PDebt_{t-1} + pFD \qquad (1)$$

where PDebt is the public-debt-to-GDP ratio, pFD is the primary fiscal deficit in percent of GDP, r is the average long-term government bond yield and g is the nominal GDP growth rate. This tells us that the sustainability of public debt is influenced by the interest-growth regime (e.g. Escolano, 2010; Barrett, 2018). If interest rates on government bonds exceed GDP growth (r – g > 0), then the public-debt-to-GDP ratio (defined as the government's gross debt in percent of nominal GDP) will show an increasing trend as long as the government does not achieve a large enough primary fiscal surplus, where the latter means that tax revenues must exceed government expenditure after excluding interest payments. However, if interest rates are lower than GDP growth rates (r – g < 0), public debt dynamics are inherently stable, as the public-debt-to-GDP ratio will show a downward trend as long as there is not too large a primary fiscal deficit. Mian et al. (2022) argue that whether a modest permanent increase in the fiscal deficit can be sustained also depends on how strongly r-g reacts to changes in public debt. (Reis, 2021) proposes an analysis according to which there is still a well-defined government budget constraint with r<g if the economy is dynamically inefficient.

In any case, r–g is a major determinant of public debt dynamics. But what is the rationale for studying the impact of (initial) public debt levels and other factors on r-g, i.e. reverse causality? Blanchard (2023) shows that what matters for fiscal policy and debt dynamics is not so much the level of r but r minus g. The increase in public-debt-to-GDP ratios during the pandemic (e.g. IMF, 2021) has triggered concerns that countries with higher public debt levels may face larger risks of an unfavourable development in r-g differentials than countries with lower debt ratios. At higher public-debt-to-GDP levels, the probability of default may increase when problems in servicing the debt arise. This in turn may lead to an increase

---

[1] Note that the following ignores stock-flow adjustments for brevity (e.g. IMF 2011).

in government bond yields in the future and it may even reduce economic growth (e.g. Baum et al., 2013), thereby rendering r-g differentials more unfavourable. While some papers provide evidence suggesting a significant association of higher levels of government debt with higher government bond yields (e.g. Attinasi et al., 2010; Laubach, 2009), other papers find that the relationship is less clear and may be contingent on the time period and country sample (e.g. Beirne and Fratzscher, 2012; De Grauwe and Ji, 2013a). It is essentially an empirical question whether higher public debt levels are indeed linked to more unfavourable r-g differentials. This paper sets out to provide answers while controlling for other confounding factors such as economic and fiscal fundamentals and the safe asset status of government bonds (e.g. Habib et al., 2020).

While r-g differentials are a key determinant of public debt dynamics, this paper conceptualises r-g more broadly as a risk factor for fiscal policy, because the (future) interest-growth environment shapes the room for manoeuvre of fiscal policy makers: lower r-g differentials may ease the pressure of running primary fiscal surpluses; vice versa, higher r-g differentials complicate the life of fiscal policy-makers – especially in the Eurozone, where target levels of the public-debt-to-GDP ratio are a core control indicator in the EU's fiscal rules (e.g. European Fiscal Board, 2019). (Di Serio et al., 2021) show that fiscal policy can be more effective when r-g differentials are favourable due to higher fiscal multipliers.Furthermore, Di Serio et al. (2021) show that fiscal policy can be more effective when r-g differentials are negative due to higher fiscal multipliers. In this context, we view a higher (lower) probability of an unfavourable development in the r-g environment as a higher (lower) r-g risk, and study the factors that help predict (future) r-g differentials. Table 1 illustrates the risks of an unfavourable development in r-g for fiscal policy-makers. If the initial public-debt-to-GDP ratio is 60 % and the r-g differential favourable at -1 percentage point (r < g), then the government can run a primary fiscal deficit of 0.6 % of GDP and still stabilise the debt ratio at its initial level.[2] With an unfavourable r-g differential of 1 percentage point (r > g), however, the government would have to run a primary surplus of 0.6 % to ensure that public-debt-to-GDP does not rise. Table 1 further shows that with higher initial public debt levels, the r-g risks for fiscal policy-makers are magnified, because a stabilisation of the public debt ratio at the initial level requires more restrictive fiscal policies than at lower public debt levels. Favourable r-g differentials (r < g) in the years running up to the Covid-19 crisis in advanced countries provided arguments for more expansionary fiscal policy to boost economic growth (e.g. Blanchard, 2019; De Grauwe and Ji, 2019). However, given the rise to historically high levels of public debt in advanced countries during the Covid-19 crisis (e.g. IMF, 2021), there are now doubts about debt sustainability if r-g differentials turn unfavourable (e.g. Wyplosz, 2019; Rogoff, 2020). Hence, while it is an empirical question whether higher public debt levels in advanced economies predict more unfavourable r-g differentials (which will be analysed in the remainder of the paper), the mechanics of public debt accumulation make it unavoidable that risks for fiscal policy-makers related to a deterioration of r-g are magnified at higher debt levels.

One main contribution compared to previous studies that estimate predictors of r-g differentials based on groups of advanced and developing economies (Mauro and Zhou, 2021; Mehrotra and Sergeyev, 2021; Lian et al., 2020; Checherita-Westphal and Domingues Semeano, 2020; Escolano et al., 2017; Turner and Spinelli, 2011) is that we pay particular attention to the distinction between Eurozone countries and stand-alone countries. The motivation for this distinction is rooted in the Eurozone fragility theory put forward by De Grauwe (2012), which has found support in empirical tests (e.g. De Grauwe and Ji, 2013a; Saka et al., 2015). According to this theory, Eurozone member countries are more prone to experiencing rollover crises because of negative market sentiments. Stand-alone countries issue government debt in their own currency, fully backed by their own central bank, so that investors anticipate that governments will always obtain the liquidity required to pay them out at maturity. However, individual Eurozone members issue bonds in Euros, a currency over which they de facto do not have control, as they have delegated monetary policy competences to the ECB at the supranational level. This makes individual Eurozone countries more vulnerable to experiencing rollover crises that can also deepen an economic downturn when the ECB is not fully committed to its role of backstopping government bond markets (Bianchi and Mondragon, 2022; De Grauwe and Ji, 2022). Against this background, we will assess the impact of a) entering the Eurozone before the financial crisis and b) the impact of the Euro Crisis on r-g differentials, and we will pay attention to potential differences in the predictors of r-g compared to stand-alone countries, in particular when we consider the safety status of government bonds. Previous literature has highlighted that Eurozone membership in the run-up to the Euro crisis led to a fall in risk spreads as investors bet on a decline in the sovereign risk of several member countries, so that government bond yields in countries such as Italy and Spain converged towards the yield level in Germany (e.g. Baldwin et al., 2015; Turner and Spinelli, 2011). Furthermore, the literature has extensively dealt with the Eurozone crisis and its implications for the evolution of interest rates and economic growth across the monetary union (e.g. De Grauwe and Ji, 2012; Morys, 2014; Heimberger, 2017). However, this is the first paper to provide extensive empirical tests on the predictors of r-g differentials in Eurozone versus stand-alone countries by paying special attention to Euro membership and crisis episodes while accounting for economic and fiscal fundamentals as well as institutional factors.

3. Data

This section describes the data set for the empirical analysis. It covers 22 OECD countries, half of which are from the Eurozone, and the other half is "stand-alone", i.e. issuing sovereign debt in their own currency. The 11 stand-alone countries include: Australia, Canada, Denmark, Japan, Norway, New Zealand, South Korea, Sweden, Switzerland, UK, and USA. The

---

[2] Notably, for simplification we abstract from stock-flow adjustments.

Table 1
The fiscal stance required to stabilise the public debt ratio depends on the r-g differential.

Public-debt-to GDP	r-g	Required primary balance
60	1.0	0.6
60	−1.0	−0.6
100	1.0	1.0
100	−1.0	−1.0
160	1.0	1.5
160	−1.0	−1.5

Notes: own calculations. Public-debt-to-GDP refers to the initial public debt ratio in % of GDP; r-g is the interest-growth differential (in percentage points); required primary balance is the primary fiscal balance in % of GDP (i.e. government revenue minus expenditures excluding interest payments) required to stabilise the public-debt-to-GDP at the initial level in column 1 given the r-g differential in column 2.

11 Eurozone countries are split into a group of six core and five periphery countries. The Euro periphery includes Greece, Italy, Ireland, Portugal and Spain; and the Euro core lists Austria, Belgium, Finland, France, Germany and Netherlands. The distinction between Euro core and periphery is not arbitrary. The core and periphery country groups can be inductively derived from relevant macroeconomic data (Gräbner et al., 2020a). Core and periphery countries share certain distinguishing characteristics in terms of GDP per capita, industrial production, unemployment and inflation, respectively. Hence, the core-periphery classification has often been used in existing studies (e.g. Simonazzi et al., 2013; Gräbner et al., 2020b).

We obtain data on long-term government bond yields (r) and nominal GDP growth rates (g), which we use to calculate r-g differentials. We use data on average market interest rates for government bonds maturing in 10 years,[3] which provide good coverage for a large set of OECD countries over the last decades.[4] The level of government debt is measured in terms of the public-debt-to-GDP ratio (PDebt). For the set of explanatory variables, we also collect data on real long-term interest rates (i.e. nominal rates adjusted for inflation; realLTrate). The inflation rate is measured as the annual change in consumer prices (inflation). Furthermore, we consider data on population growth (popgrowth) and on the primary fiscal balance (i.e. the headline fiscal balance excluding interest payments; primaryFB). To test whether financial openness has an impact on r-g differentials, we use data on de-jure openness based on the Chinn-Ito Index (Chinn and Ito, 2006). The Chinn-Ito index captures changes in legally established barriers to financial transactions (Gräbner et al., 2021). Notably, it can be understood as a proxy for financial repression, which has been argued to reduce the cost of debt and, thereby, r-g differentials (e.g. Reinhart and Sbrancia, 2015; Escolano et al., 2017). We would expect a positive and significant coefficient in the regression analysis if lower financial openness (i.e. financial repression) were strongly associated with lower r-g differentials. Furthermore, we construct a set of dummy variables. The first dummy variable captures membership of Eurozone countries in the monetary union, which is set to 1 for the year when the respective country entered the Euro up to the year 2006. This captures whether Euro membership before the financial crisis had an impact on r-g differentials. We use a second dummy variable for the Euro Crisis period, which we set to 1 for all 11 Eurozone countries over the time period 2008 to 2012.[5] We use 2008 as the start year of the Euro crisis dummy because that is when worries about sovereign debt and financing costs in various Eurozone countries became more prominent against the backdrop of the recession triggered by the financial crisis (Mody and Sandri, 2012).[6] The intense phase of the Euro Crisis only ended in 2012 after ECB president Mario Draghi's „Whatever-it-takes" speech and the announcement of the ECB's Outright Monetary Transactions program (e.g. Saka et al., 2015). Finally, we construct a dummy variable for the same time period that we set to one for all 11 stand-alone countries.

We include the variable "safety" that captures whether government bonds are considered to be "safe haven assets". As the Eurozone's economically and politically strongest country, Germany is typically considered as a "safe haven" in the sense that when there is a flight to safety in times of crisis, investors move into bunds as they are considered to be safest (e.g. Gabor

---

[3] This choice differs somewhat from the concept of the average implicit interest rate on net government debt as in equation (1), which takes interest receipts earned on government assets into account. The problem is that there is substantial heterogeneity in the size of government asset holdings in different OECD countries, and there are severe data limitations on the implicit interest rate on net government debt. Furthermore, using the implicit rate on net government debt would not be suitable for regression analysis, because the implicit rate can easily increase very strongly when net government debt levels are low (Turner and Spinelli 2011).

[4] Blanchard (2019) makes adjustments to the nominal interest rate on long-term governments bonds: He uses the weighted average of one-year and ten-year interest rates with weights computed so as to match the average maturity of public debt (which changes over time). As Wyplosz (2019) explains in detail, it is not clear whether this adjustment is really desirable. What is more, Blanchard's adjustment procedure cannot be used in a multi-country data set. Hence, we will use the practice in other parts of the literature, by measuring r with the marginal rate on government debt, i.e. the market interest rate on new government borrowing or on the secondary market with a residual maturity of around 10 years – as previous studies have also done (e.g. Wyplosz 2019; Lian et al. 2020). Mauro and Zhou (2021) use effective interest rates (i.e. the ratio of interest expenses to government debt), but we prefer average market rates, because they respond less quickly to changes in global and financial conditions, and the data coverage is significantly better for our OECD sample.

[5] The most intense phase of the Euro Crisis ended in 2012 after Draghi's famous „Whatever-it-takes" speech and the announcement of the ECB's OMT program, leading to a fast and strong decline in government bond yields that had increased massively in several member countries over the course of the earlier Euro crisis years (e.g. Saka et al. 2015).

[6] Interest rate spreads between Germany and other Eurozone countries were still small (close to zero) during the summer of 2007, when the US subprime crisis and global financial stress were transmitted to Europe. After the Bear Sterns rescue and the Lehman Brothers bankruptcy in 2008, the Eurozone dimension of the banking crisis led to a modest increase in spreads; but spreads then widened more strongly in 2010 and 2011 when the crisis evolved into a full-blown phase (Mody and Sandri 2012).

and Vestergaard, 2018). Our variable "safety" is based on recursively computing the correlation of the long-term government bond yields of country i with the government bond yields of Germany (the "safety benchmark") between the beginning of the sample t_0 (typically the year 1970) and t-1:

$$safety_{i,t} = Correl_{t0,t-1}(r_i, r_{deu}) \qquad (2)$$

where r_i is the long-term government bond yield of country i and r_{deu} is Germany's government bond yield. This variable is an "inertia" term, as it captures whether the bonds issued by a respective country behaved more similar to German government bonds in the past: a strong positive correlation indicates that bond yields behaved similar to the safety benchmark of German yields. Higher (lower) values imply more (less) safe bonds. Table A1 in the appendix presents a summary of all the variables and their sources.

Descriptive statistics for all the variables in our data set are available in Table A2 of the appendix. To obtain some descriptive insights, Panel A) of Fig. 1 plots the 5-year moving average over 1970–2018 for r-g differentials – by distinguishing the Eurozone core, the Eurozone periphery and the stand-alone sample. We used GDP-weights to give more weight to observations from larger countries and correspondingly less weight to those from smaller countries. In the Eurozone core and in stand-alone countries, differentials of r-g were, on average, favourable in the 1970s (r < g). However, in the 1970s r-g was unfavourable in the periphery (r > g). Differentials of r-g then increased steeply in the 1980s in all three groups, turning unfavourable; they started to fall in the 1990s. The development towards more favourable r-g was temporarily reversed after the financial crisis, when r-g differentials in Eurozone periphery countries increased much more than in stand-alone and Eurozone countries.[7] However, in the last years of our data sample, r-g differentials again fell below zero for all three groups. Panel A of Fig. 1 shows that r-g differentials in OECD countries went through substantial swings, but negative r-g differentials were not a new phenomenon in the years running up to the Covid-19 crisis: both in the 1970s and in the years before the financial crisis, we report the occurrence of r – g < 0.

Panel B) of Fig. 1 shows the evolution of GDP-weighted public-debt-to-GDP ratios. During the 1970s and most of the 1980s, public debt levels were, on average, higher in the stand-alone sample than in the Eurozone. However, public debt levels did not increase in the stand-alone countries from the late 1980s up to the financial crisis. The impact of the crisis led to a rise in public-debt-to-GDP ratios. The Eurozone – and especially its periphery – already went into the crisis with higher public debt levels than in stand-alone countries, but public-debt-to-GDP increased further and more strongly over the course of the Euro Crisis than in stand-alone countries.

Observations with r-g < 0 represent 47.4 % of the sample (see Fig. 2). However, there are substantial differences across countries. While Japan spent about 70 % of the years covered in our sample with r < g, Eurozone periphery countries such as Greece and Italy only show a share of about 30 %. In the US and Germany, the proportion of r-g < 0 is slightly above 50 % of the years, respectively, which puts these countries in the extended top group, behind the stand-alone countries Japan, South Korea and Switzerland, but also behind the Eurozone core countries Austria and Netherlands.[8] The mean r-g differential for the whole sample is positive at 0.79 (and the median is somewhat lower at 0.24) – with a large standard deviation of 4.34, which indicates substantial volatility.[9]

Against this background, the regression analysis in the next sections proceeds in three steps. First, we analyse the predictors of r-g differentials by using fixed-effects panel regressions (Section 4). Second, we analyse whether public debt, the safety of government bonds and other factors are related to more unfavourable r-g differentials in the future based on quantile regressions (Section 5). Third, we quantify the probabilities of r > g in the future based on probit regressions (Section 6).

4. Panel regressions: Predictors of r-g differentials

The dependent variable rg was tested for panel unit roots and confirmed to be stationary; cointegration test results show that our variables are cointegrated.[10] We estimate the following baseline model:

$$rg_{i,t} = \alpha + \beta PDebt_{i,t-1} + \theta realLTR_{i,t-1} + \gamma X_{i,t} + \zeta_i + \varepsilon_{i,t} \qquad (3)$$

where $rg_{i,t}$ is the r-g differential (i.e. 10-year government bond yield, r, minus GDP growth rate, g); α is a constant; $PDebt_{i,t-1}$ is the lagged public-debt-to-GDP ratio; $realLTR_{i,t-1}$ is the lagged real long-term interest rate; $X_{i,t}$ is a vector with additional control variables (inflation, population growth, primary fiscal balance, financial openness, safety of government bonds); and ζ_i represents country-fixed effects, which we include to control for unobservable country heterogeneity.

---

[7] As shown by Figure A1 in the supplementary appendix, the strong rise in r-g in Euro periphery countries was due to both an increase in government bond yields and a fall in GDP growth rates. Figures A2 and A3 in the appendix provide further descriptive insights into our data by plotting government bond yields, GDP growth rates and r-g differentials separately for all the individual OECD countries in our sample.

[8] As Figure A5 in the appendix shows, the relationship between the length of r-g episodes and the initial level of public debt is essentially flat. This result is also confirmed by a panel regression of the length of negative r-g episodes on the public-debt-to-GDP ratio controlling for country-fixed effects and time-fixed effects (see Table A3).

[9] Figure A4 in the appendix presents a kernel density plot concerning the distribution of r-g differentials.

[10] We conducted unit root tests and cointegration tests before running the regressions. The Maddala-Wu panel cointegration test results suggest that the variables are cointegrated, so that estimating the models by using OLS is appropriate (see Table A4 in the appendix).
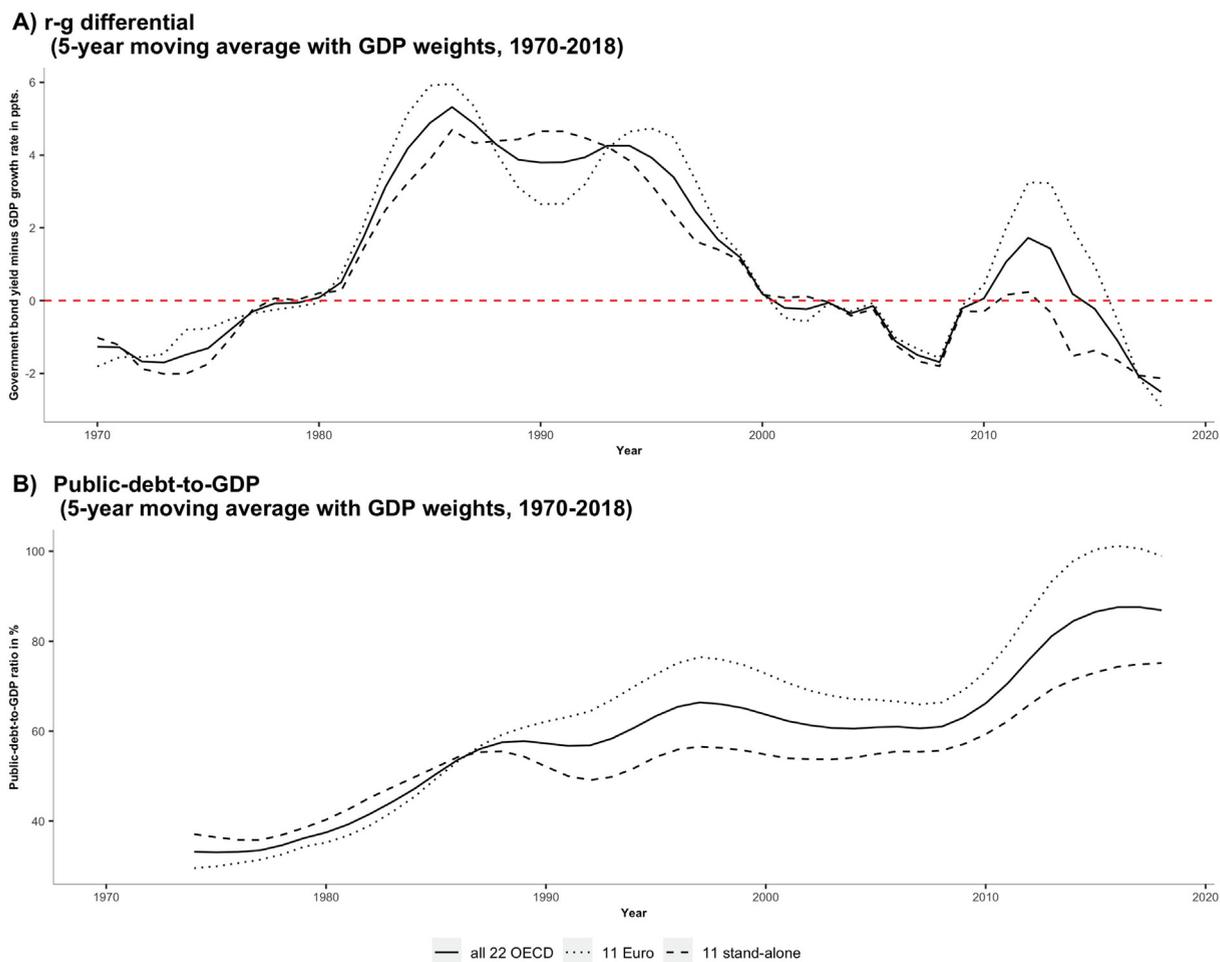
A) r-g differential
(5-year moving average with GDP weights, 1970-2018)

B) Public-debt-to-GDP
(5-year moving average with GDP weights, 1970-2018)

— all 22 OECD ···· 11 Euro – – 11 stand-alone

Fig. 1. R-g differentials and public debt ratios in advanced economies, 1970–2018. Source: OECD, IMF; own calculations (see Table A1 for more details on the variables and their sources). Euro periphery: Greece, Italy, Ireland, Portugal, Spain. Euro core: Austria, Belgium, Finland, France, Germany, Netherlands.

Table 2 shows the fixed-effects regression results. Column (1) is the baseline specification without interaction terms. We can see that the coefficient for the lagged public-debt-to-GDP ratio has the "wrong" sign (although it is very small and statistically insignificant); this rejects the hypothesis that higher public debt levels predict more unfavourable r-g differentials. However, we find that higher primary fiscal balances are significantly associated with more favourable r-g differentials: a one percentage point of GDP increase in the primary fiscal balance is associated with a decline in the r-g differential by 0.35 percentage points. Fiscal fundamentals matter when it comes to primary fiscal balances, but not when it comes to the level of public debt. Furthermore, we find that higher real long-term interest rates are related to higher r-g: a 1 percentage point increase in the real rate is related to a rise in r-g by 0.59 percentage points. Higher inflation is also significantly associated with more unfavourable r-g differentials. The other control variables are insignificant.

Column (2) introduces a dummy variable for Euro membership up to the financial crisis, a dummy for the Euro Crisis episode 2008-2012, and a dummy for the 2008-2012 episode for stand-alone countries. The three dummy variables are interacted with the "safety" variable capturing to what extent government bonds enjoyed safe asset status in the past. The results suggest that Euro membership before the start of the financial crisis is associated with more favourable r-g differentials. However, the positive and significant interaction term with the "safety" variable indicates that the safety of government bonds moderates the impact of Euro membership: when entering the Euro, governments with higher safety in government bonds benefited less in terms of lower r-g differentials when joining the Euro; vice versa, governments whose bonds were considered riskier in the past benefited more. This finding is consistent with the observation that government bond yields in Eurozone periphery countries declined when entering the Eurozone as investors saw a decline in individual member country's sovereign risk (e.g. Baldwin et al., 2015), which helped reduce r-g differentials. Countries such as Italy and Spain had to live with a bond yield risk premium vis-à-vis Germany in the 1980s and early 1990s as bond investors saw significant devaluation risk against the background of recurring exchange rate crises (e.g. De Grauwe and Ji, 2015). In entering the Eurozone, government bond yields of periphery countries declined towards the yield levels of Germany, i.e. the safe asset status of
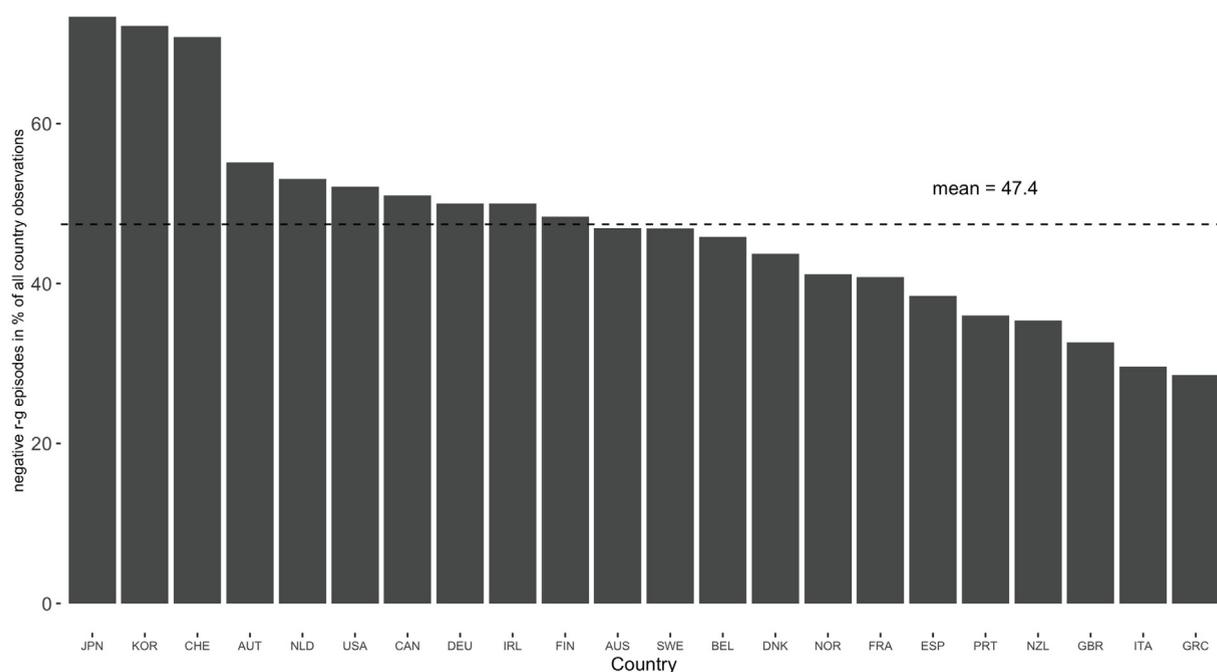
Fig. 2. Proportion of years when the differential between government bond yields and GDP growth rates was favourable (r – g < 0), 22 OECD countries over 1970–2018. Source: OECD; own calculations.

Table 2

Fixed-effects regressions on the predictors of r-g differentials, 22 OECD countries over 1970–2018.

	(1) all	(2) all	(3) excl DEU/US	(4) 3 yr avg	(5) euro	(6) standa	(7) peri	(8) core
PDebt $_{t-1}$	−0.004	−0.011	−0.013	−0.009	−0.007	−0.016**	−0.038	−0.002
	(0.014)	(0.011)	(0.012)	(0.011)	(0.020)	(0.007)	(0.031)	(0.027)
realLTrate $_{t-1}$	0.588***	0.480***	0.471***	0.646***	0.532***	0.161*	0.249	0.805***
	(0.093)	(0.093)	(0.104)	(0.132)	(0.144)	(0.094)	(0.219)	(0.120)
inflation	0.510***	0.404***	0.445***	0.581***	0.275**	0.548***	0.192	0.098
	(0.102)	(0.085)	(0.095)	(0.124)	(0.106)	(0.116)	(0.155)	(0.205)
popgrowth	−0.291	−0.304	−0.746*	−0.619	0.203	−0.178	−1.121	0.856
	(0.490)	(0.504)	(0.431)	(0.471)	(0.654)	(0.794)	(1.037)	(0.852)
primaryFB	−0.346***	−0.230***	−0.245***	−0.268***	−0.267***	−0.227***	−0.158*	−0.374***
	(0.046)	(0.048)	(0.058)	(0.072)	(0.082)	(0.063)	(0.094)	(0.084)
finopen	−2.484	−3.803	−3.127	−5.074*	−8.655***	3.473	−9.864***	−2.857
	(2.153)	(2.389)	(2.386)	(2.671)	(2.692)	(2.198)	(2.763)	(2.094)
safety	−0.923	−2.201	−2.034	−1.693	−1.252	−4.409***	−3.403	−0.105
	(1.320)	(1.380)	(1.451)	(1.721)	(1.557)	(1.341)	(2.417)	(2.616)
safety*EuroMember		2.673**	2.438*	0.161	1.645		3.804**	1.059
		(1.247)	(1.416)	(1.719)	(1.429)		(1.673)	(1.638)
safety*EuroCrisis		−15.383***	−15.355***	−22.385***	−15.929***		−14.944***	6.438
		(0.631)	(0.568)	(2.028)	(0.856)		(1.113)	(4.833)
safety*StandaCrisis		−2.863	−2.527	−0.076		−3.681**		
		(1.981)	(1.912)	(2.335)		(1.630)		
EuroMember		−2.153*	−2.072	0.665	−0.929		−3.194***	−0.270
		(1.230)	(1.392)	(1.642)	(1.325)		(1.076)	(1.369)
EuroCrisis		16.521***	16.355***	24.064***	17.189***		18.665***	−4.682
		(1.110)	(1.093)	(2.065)	(1.355)		(1.656)	(4.340)
StandaCrisis		3.210*	3.049*	1.215		3.934***		
		(1.644)	(1.602)	(2.435)		(1.100)		
Observations	606	606	533	205	322	284	123	199
Adjusted R²	0.311	0.416	0.428	0.601	0.506	0.300	0.597	0.392

Notes: The dependent variable in all columns is rg (the r-g differential). See Table A1 for a detailed description of all the variables. all… all 22 OECD countries included in the sample; excl DEU/US… sample excludes Germany and the US; 3 yr avg… 3-year data averages used; euro… sample only includes 11 Eurozone countries; standa… sample only includes 11 stand-alone countries; peri… sample only includes 5 Eurozone periphery countries; core… sample only includes 6 Eurozone core countries. Standard errors (in parentheses) were clustered at the country level. All regressions include country-fixed effects, where estimates are not shown for brevity. The constant is also not shown. ***, ** and * denote statistical significance at the 1 %, 5 % and 10 % level, respectively.

periphery government bonds improved, which went into reverse mode when the Euro Crisis hit. The Euro Crisis is significantly associated with an increase in r-g differentials. However, it is important to note that the interaction term of the Euro Crisis dummy with the "safety" variable is negative and significant. This indicates that Eurozone countries with a higher safety of government bonds experienced a substantially less severe deterioration in r-g differentials than countries whose bonds were considered as riskier in the past. Notably, the interaction term of the 2008–2012 dummy for the stand-alone countries with the safety variable is insignificant, which suggests that the moderating impact of safe government bonds played a special role in the Eurozone during the Euro Crisis.

In column (3), we exclude Germany and the US from our sample – the countries with the highest GDP weight in our sample inside and outside of Eurozone, respectively. The results prove highly robust compared to column (2), which means that our results are not sensitive to including or excluding these countries. In column (4) of Table 2, we use three-year data averages to check whether our results are driven by the choice of using annual panel data. The main results are again very similar to those in column (2). There are two deviations, however: the linear coefficient of the Euro membership dummy switches sign and loses significance; and the negative association of financial openness with r-g in column (3) is significant at the 10 % level.

Column (5) is based on the sub-sample of 11 Euro countries; column (6) only considers the data for 11 stand-alone countries. Using these sub-samples helps us to test whether the predictors of r-g differentials in Eurozone countries are different from stand-alone countries. Column (7) and column (8) split the Eurozone country sample further into Euro periphery countries and Euro core countries, respectively. Looking at core and periphery countries separately allows us to test whether the interaction between safe haven government bonds and the impact of the Euro Crisis differs in these two country groups.

Several findings are noteworthy with regard to the results shown in columns (5)–(8): First, while also controlling for other confounding factors, higher levels of public debt are not predictive of more unfavourable r-g differentials. Coefficients of the public-debt-to-GDP ratio consistently have the "wrong sign", as lagged public debt values are associated with *lower* contemporaneous r-g differentials. In stand-alone countries, there is even a significant negative association. Grosso modo, this suggests that – while controlling for unobserved country heterogeneity and other covariates – the public-debt-to-GDP ratio is not predictive of more unfavourable future r-g differentials in advanced economies. This finding contrasts with the analysis of the predictors of r-g by Checherita-Westphal and Domingues Semeano (2020) for 11 Eurozone countries over 1985–2017, because they find that higher public-debt-to-GDP ratios are significantly related to more unfavourable r-g differentials in most of their model specifications. One reason for this difference could be that we are able to look at a longer time period (1970–2018); another part of the explanation could lie in differences of explanatory variables. In any case, our results suggest that public debt levels are less significant as a predictor.[11] In the next sections, we will check the robustness of this finding. Second, we find that while inflation is, on average, positively associated with r-g differentials in the stand-alone country group, the inflation coefficients for the Euro sample are insignificant when we split into periphery and core. The association of long-term interest rates with inflation in the Euro core, the Euro periphery and the stand-alone sample is very similar in terms of magnitude and significance; however, while higher growth in Eurozone countries is associated with higher inflation, this is not the case in stand-alone countries,[12] which leads to a different overall association of inflation with r-g differentials when we compare the Eurozone and stand-alone sample. Third, there are differences in how de-jure financial openness relates to r-g: in the Eurozone periphery, the Chinn and Ito (2006) index is significantly related with more favourable r-g differentials, which is not the case for stand-alone countries and Euro core countries. This suggests that the reduction in legally established barriers to financial transactions over the course of the European integration process in the Euro periphery is associated with lower r-g differentials, and this is inconsistent with the hypothesis that financial repression – which implies lower de-jure financial openness – is reducing r-g differentials. At the same time, the relationship between lower legal financial barriers and r-g differentials in stand-alone countries points in a different direction, although it is not significant. The finding for the stand-alone countries is more consistent with previous findings by Mauro and Zhou (2021) and Escolano et al. (2017) who find that financial repression is associated with more favourable r-g differentials (for a group of mixed countries and developing countries, respectively). Further research efforts are needed to explain our finding that financial repression works more in the expected direction outside of the Eurozone (Reinhart and Sbrancia, 2015). Fourth, the real long-term interest rate is more of a significant predictor of r-g in stand-alone and Euro core countries than in the Euro periphery. Fifth, higher primary fiscal balances are significantly related with lower r-g differentials in all country samples. This underscores that primary fiscal balances are a better predictor of r-g differentials than public debt levels.

Sixth, the results in columns (7) and (8) of Table 2 indicate that the Euro Crisis episode is related with more unfavourable r-g differentials in the Euro periphery, while we do not find a similar impact in the Euro core. Finally, the interaction term of the Euro Crisis dummy with "safety" is only negative and significant in the periphery. This finding is consistent with arguments that countries whose government bonds were considered as most risky in the past were the first to be singled out by bond investors during the Euro Crisis (e.g. Mody and Sandri, 2012): investors worried that the periphery countries whose bonds were deemed less safe would not be able to meet all their (future) payment obligations, which led to negative market

---

[11] Notably, Mauro and Zhou (2021) and Escolano et al. (2017) also do not report robust evidence of a significant positive relationship of public debt levels with r-g. These two studies are, however, using different samples of a mix of countries and developing countries, respectively.

[12] In Table A5 and Table A6 of the supplementary appendix, we show regression results when – instead of r-g differentials – long-term interest rates and nominal GDP growth rates are the dependent variable, respectively. The results suggest that the association between long-term bond yields and inflation is very similar in the Euro and stand-alone samples. Higher GDP growth rates and higher inflation are, however, only significantly related in the Eurozone.

sentiments, a sell-off in government bonds and a corresponding increase in government bond yields (Bianchi and Mondragon, 2022). The resulting rollover crisis pushed countries into implementing more restrictive fiscal policies, which contributed to a stronger decline in economic growth rates compared to Euro core and stand-alone countries (e.g. De Grauwe and Ji, 2013b; Heimberger, 2017).

One possible objection could be that German government bond yields are not the right safety benchmark for stand-alone countries, as US bonds are the safest assets outside of the Eurozone (e.g. Krishnamurty and Vissing-Jorgensen, 2012). As a robustness check, we therefore reran the regressions in Table 2 by using the correlation of stand-alone countries' government bond yields with US bond yields as our safety proxy (see equation (2); for the Eurozone countries, Germany remains the benchmark). All the results discussed above are highly robust, as can be seen by checking Table A7 in the appendix. Another concern is potential endogeneity between the dependent variable (r-g) and public debt levels. Using lagged terms of regressors as instruments for the public-debt-to-GDP ratio may be problematic due to persistence in the debt stock. We therefore use an instrumental variable suggested by Checherita-Westphal and Rother (2012): the average public-debt-to-GDP ratio of the other OECD countries in the sample, which we calculate for every country in every year. This variable does not have a direct causal effect on r-g differentials assuming that there is not a strong relationship between public debt levels in other countries and domestic r-g, which seems plausible. The instrumental variable of public debt levels in other advanced economies is highly correlated with the instrumented variable; weak instrument tests reject that the instrument is weak, so that we can move forward with the assumption that the instrumental variable is sufficiently strong. Results from instrumental variable regressions suggest that all our main findings remain robust: importantly, higher public debt levels are still not a good predictor of more unfavourable r-g differentials when we use our instrumental variable approach. Detailed results are available in Table A8 of the appendix. As a final robustness check, we specify a dynamic panel model that includes the lag of the dependent variable (r-g differential) as an explanatory variable. We use system-GMM to estimate the model (Blundell and Bond, 1998), where we take the t-2 lags of the r-g differential and the public-debt-to-GDP ratio as instruments. The GMM results reported in Table A9 of the appendix underscore the main findings discussed above. Notably, we confirm that the interaction term of the safety of government bonds with the Euro Crisis dummy is negative and significant. Initial public debt levels are not a good predictor of more unfavourable r-g – neither in the Eurozone nor in the stand-alone sample.[13]

Summing up, the results from the fixed-effects panel regression suggest that higher public-debt-to-GDP is not predictive of more unfavourable r-g differentials. Population growth also turns out to be a poor predictor, as it is insignificant in all specifications. There are some important differences in how economic and fiscal fundamentals (such as inflation, the real-long term interest rate and de-jure financial openness) are associated with r-g differentials in the Euro core, Euro periphery and stand-alone countries, respectively. We also find that considering inertia in the safety status of government bonds helps explain variation in r-g, especially in interaction with Euro membership and the Euro Crisis.

5. Quantile regressions: Do future r-g risks increase with higher public debt levels?

To assess the relationship between public debt levels and downside risks of r-g in more depth, we continue by estimating the distribution of future r-g differentials conditional on the contemporaneous level of public-debt-to-GDP and other covariates. The estimation of the conditional r-g distribution is based on using quantile regressions, where the idea is derived from the growth-at-risk approach (Adrian et al., 2019; Lian et al., 2020; Kiley, 2021). The quantile regressions are related to the panel regressions in the previous section as they use the same set of control variables, but they move beyond the panel regressions as they allow us to predict three-year-ahead r-g differentials in different quantiles, where the distribution of r-g is modelled as a function of the public debt level and the other factors already introduced above.

We estimate the following equation:

$$\beta_\tau = \arg\min \sum_{i=1}^{T-3} \left(\tau \cdot 1_{(rg_{i,t+3} \geq x_{i,t}\beta)} \, | \, rg_{i,t+3} - \beta_\tau X_{i,t} \, | + (1-\tau) \cdot 1_{(rg_{i,t+3} < x_{i,t}\beta)} \, | \, rg_{i,t+3} - X_{i,t}\beta_\tau \, | \right) \tag{4}$$

where $rg_{i,t+3}$ is the annualised three-year ahead r-g differential in country i and year t. $1_{(\cdot)}$ denotes the indicator function. We estimate the distribution of future $rg_{i,t+3}$ as a function of a constant, the current public-debt-to-GDP ratio (PDebt) and a set of additional control variables, which are captured in the vector X (where we include the same control variables as in Table 2: the real long-term interest rate, inflation, population growth, the primary fiscal balance, de jure financial openness, and a proxy for safe asset status of government bonds in the past).

The predicted value from equation (4) is the quantile $rg_{i,t+3}$ conditional on $X_{i,t}$: $Q_{rg_{i,t+3}|X_{i,t}}(\tau|X_{i,t}) = X_{i,t}\beta_\tau$. Different from OLS, the quantile regression minimises the sum of absolute errors (rather than the sum of squared errors), and it puts differential weights on the errors depending on whether the error term is above or below the quantile (Koenker and Bassett, 1978). Quantile regression estimates are more robust to outliers than OLS estimates; and they allow us to provide a more comprehensive analysis of the relationship between r-g and its predictors: in particular, we are able to predict the average future r-g in our sample for different levels of the current public-debt-to-GDP ratio, so that we can answer the question whether higher

---

[13] The validity of the GMM estimates depends on the absence of second-order autocorrelation. We cannot reject the null hypothesis of no second-order autocorrelation. We further perform a Hansen test for overidentification restrictions (instrument validity). The relevant p-values are>0.5; hence, we cannot reject the null hypothesis that the instruments are valid.

public-debt-to-GDP ratios are related to more unfavourable future r-g differentials across different quantiles, and whether the increase of the upper quantile is steeper than the increase of the median r-g differential. We conduct a corresponding analysis concerning the relationship between predicted forward r-g differentials and the safety of government bonds.

Fig. 2 shows the estimated 10th, 50th and 90th quantiles of three-year-ahead r-g differentials. Panel A) presents the estimation for the dataset consisting all 22 OECD countries. The lines for the three quantiles are all essentially flat, implying no relation between contemporaneous public debt levels and predicted future r-g. This contrasts with the results reported in Lian et al. (2020) who show quantile regressions for a mixed sample of 31 advanced and 25 emerging market economies. They report that higher public debt levels are related to more unfavourable future r-g across quantiles, and the increase of the 90th quantile is the strongest. Our findings suggest that the public-debt-to-GDP ratio may be a worse predictor of future r-g differentials in OECD countries than in developing countries. However, panel B) shows that when we look at the relation between the safety of government bonds and future r-g, the lines of all the quantiles are downward sloping. This suggests that future r-g risks are lower for countries whose long-term government bonds enjoy higher safe asset status, and – vice versa – risks are higher for countries with riskier government bonds, which holds across the whole distribution.

To check whether there are differences between Eurozone and stand-alone countries, we again split the samples. Panels C) and D) of Fig. 3 show the results for Eurozone countries, panels E) and F) for stand-alone countries. We confirm for both the Euro sample and the stand-alone sample that higher contemporaneous public-debt levels are not predictive of higher future r-g risks – no matter what quantile we look at. However, we also find that the 90th quantile in the Eurozone benefits more in terms of lower future r-g risks as the safe asset status of government bonds increases – vice versa, this means that in the highest quantile, Eurozone countries are "punished" more in terms of unfavourable forward-looking r-g differentials if their bonds were deemed riskier in the past. We do not find a similar pattern in the 10th and 50th quantile: in the median quantile, the relationship between "safety" and future r-g is less steep than in the 90th quantile. In stand-alone countries, the
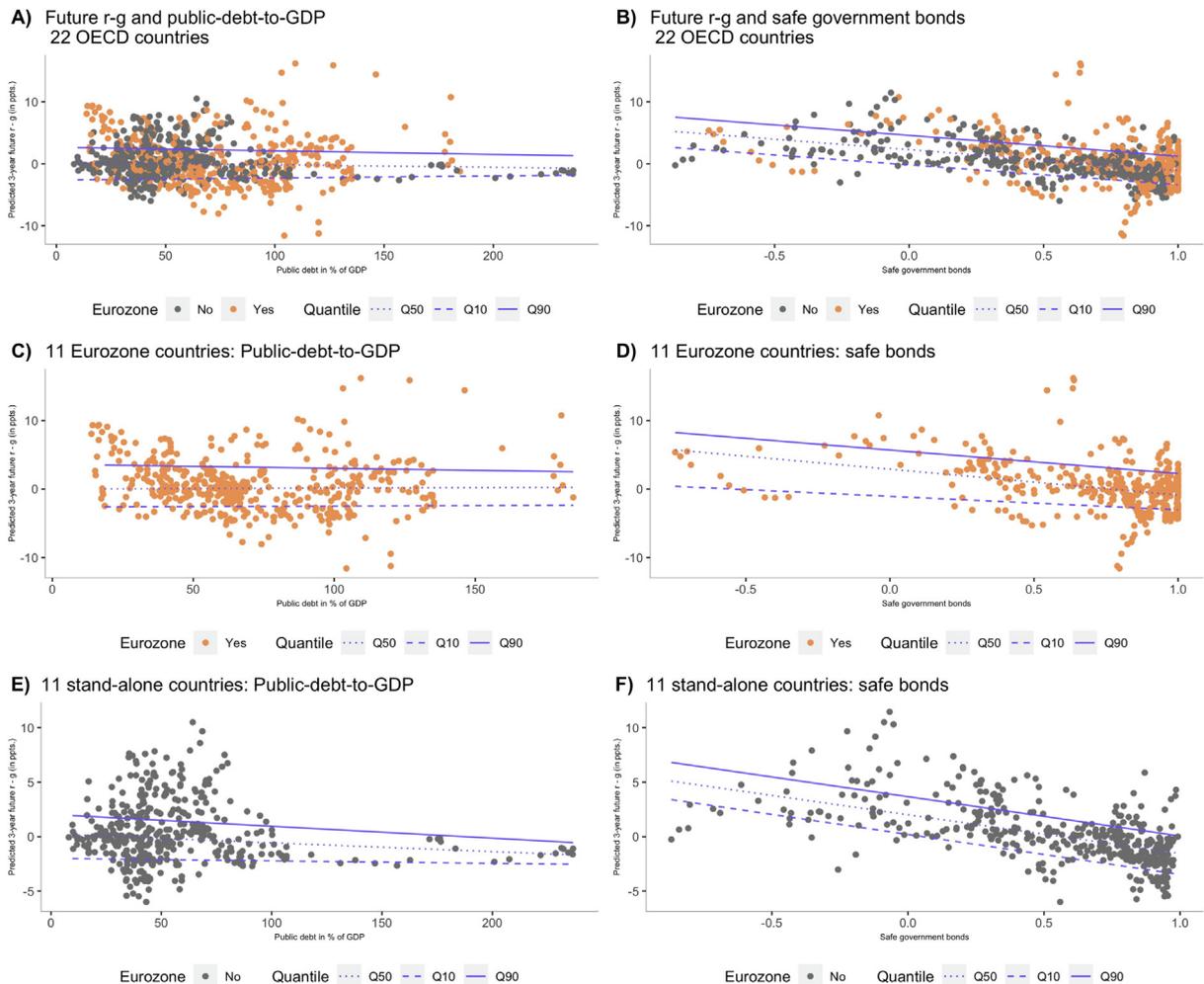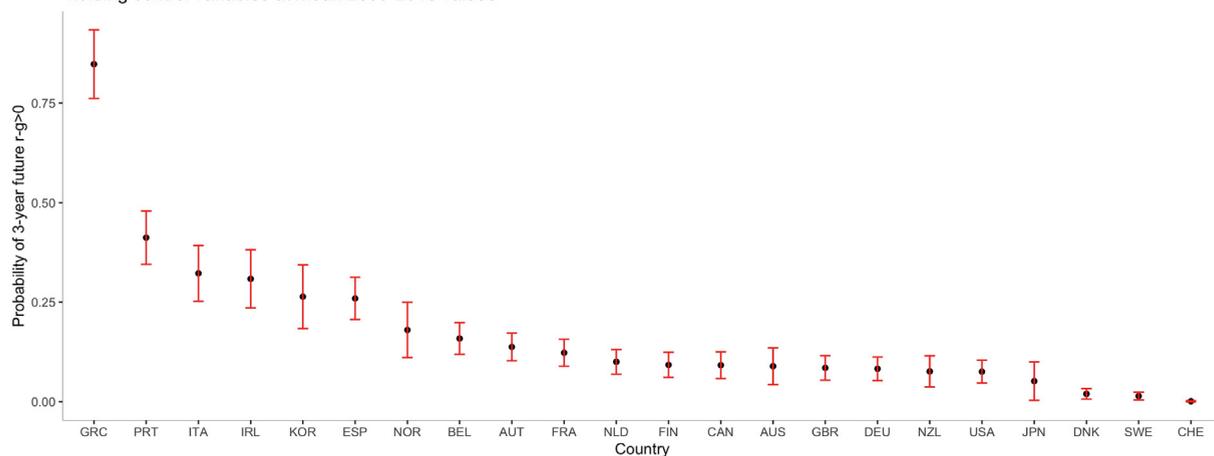

Fig. 3. Quantile regression results. Notes: Quantile regression results based on estimating equation (4). Own calculations. See Table A1 for a detailed description of all the variables.

A) Predicted probabilities for individual countries
holding control variables at mean 2009–2018 values

B) Predicted probabilities for individual countries
holding control variables at mean 2016–2018 values

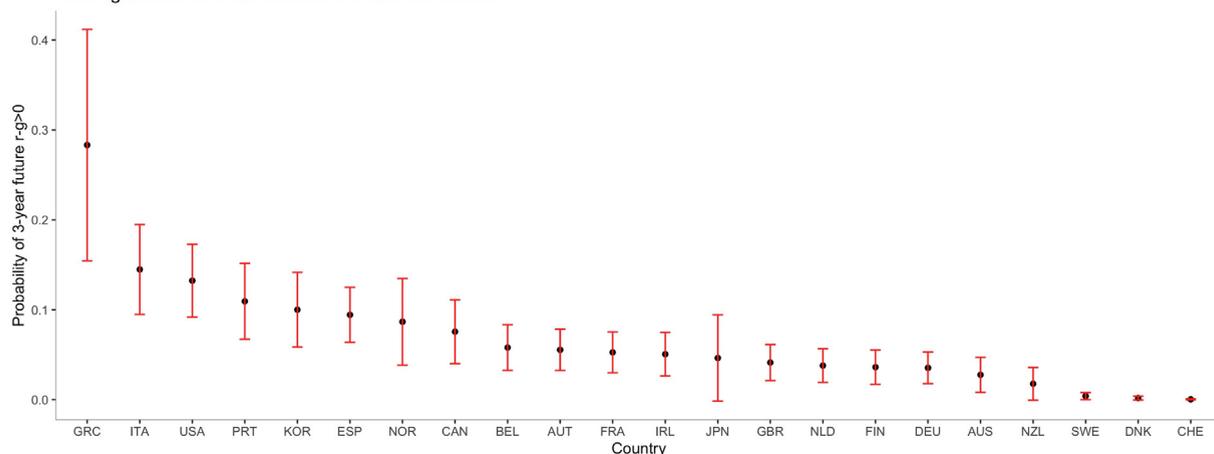**Fig. 4.** Predicted probabilities for unfavourable r–g differentials (r > g) Notes: Predicted probabilities based on probit regressions (see equation (5); and columns (2) and (3) in Table A10 in the appendix). One-standard error bands are depicted in red. Note that 0.1 on the vertical axis denotes a probability of 10 %, 0.3 of 30 % etc. Own calculations. See Table A1 for a detailed description of all the variables. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

lines for all the quantiles are consistently downward sloping when we look at the relationship between predicted r–g differentials and "safety". As a robustness check, we estimated equation (4) by using the five-year ahead (instead of three-year ahead) r–g differentials. The results, shown in Fig. A6 in the appendix, prove very robust.

6. Probabilities of unfavourable r-g differentials

In this paper, we conceptualise r–g as a risk factor, where a higher probability of an unfavourable development in the r–g environment points to higher r–g risk. Hence, this section quantifies r–g risks in different OECD countries. The probit regressions presented here are linked to the analysis in the two previous sections as they employ the same set of variables based on the same data for 22 OECD countries over 1970–2018.

The r–g differentials were clearly favourable in most OECD countries in the years before the COVID-19 crisis hit (see Fig. 1).[14] Unfavourable r–g differentials (r > g) in the future would make it more difficult to reduce public debt levels and may push governments towards tighter fiscal policies. What is the probability that r–g will be unfavourable in the future conditional on contemporaneous public debt levels and other covariates? Is the public-debt-to-GDP ratio significantly correlated with the probability of future r–g > 0, so that governments in advanced countries with higher public-debt-to-GDP face higher r–g risks? To answer this question, we estimate the following probit model:

---

[14] Figure A3 in the appendix shows single country plots for r–g differentials over time.

$$P(rg_{i,t+3} > 0|X) = \Phi(c + \beta PDebt_{i,t} + \gamma X_{i,t} + \epsilon_{i,t}) \tag{5}$$

where $rg_{i,t+3}$ is the 3-year-ahead average r-g differential in country i; c is a constant; $\beta PDebt_{i,t}$ captures the contemporaneous public-debt-to-GDP ratio; $X_{i,t}$ is a vector with additional control variables, including the real long-term interest rate, inflation, population growth, the primary fiscal balance, de jure financial openness, and the proxy for safety of government bonds; and $\Phi(\cdot)$ is the standard normal Cumulative Distribution Function. We estimate equation (5) by using Maximum Likelihood methods.

We use probit regression results based on equation (5) for the Eurozone and stand-alone sample, respectively, to predict the probabilities of unfavourable future r-g differentials (r > g) for individual OECD countries.[15] Panel A of Fig. 4 shows the predicted probabilities when we hold the public-debt-to-GDP ratio and the other explanatory variables at their mean values over the last ten years in our data sample (2009–2018).

Strikingly, the point estimates for the probability of an unfavourable 3-year future r-g differential (r > g) are below 50 % for almost all countries. This implies that the probability of favourable r-g differentials is consistently higher than the probability of unfavourable r-g differentials. However, there are substantial differences across OECD countries. The countries with the highest probabilities of r > g are from the Eurozone periphery: in Greece, the probability is close to 85 % if we use the values over 2009–2018 for our prediction; in Portugal, it is over 40 %, in Italy and Ireland slightly above 30 %. South Korea and Norway are the only stand-alone countries with probabilities higher than 10 %. The countries with the lowest probabilities are all from the stand-alone sample; for Denmark, Sweden, and Switzerland, the point estimates are well below 5 %; Japan is at 5 % and the US at 7.5 %. Germany is the Euro country with the lowest probability (8.3 %) of an unfavourable r-g differential over the 3-hear-ahead horizon. The other Euro core countries are in a relatively narrow range from 9.2 % (Finland) to 15.9 % (Belgium).

Does the picture change when we hold the explanatory variables in equation (5) at different values to perform the predictions? Panel B) of Fig. 4 uses the 2016–2018 mean values, i.e. values for the last three years in our sample. The first striking finding is that the probabilities for several countries decline substantially, as even those with the highest future r-g risks now show point estimates for the probabilities that are well below 50 %. Greece still faces the highest probability although it has more than halved to about 30 %. The other Euro periphery countries still belong to the extended "top" group of countries with the highest probabilities for unfavourable future r-g (Ireland is the exception, as it has moved well into the middle of the pack). In the middle and at the bottom, there are some slight changes in the rankings of countries, but the countries with the lowest probabilities remain the same. This suggests that under a constellation as in the years right before the Covid-19 crisis, we could expect that most OECD countries will continue to operate in a favourable r – g < 0 environment with high probabilities. However, changes in macroeconomic circumstances may shift probabilities of an unfavourable r-g differential upwards in the future, which would first hit the Euro periphery, where r-g risks are highest. Fig. A7 in the appendix shows that our results concerning the predicted probabilities are robust to using 5-year-ahead r-g differentials (instead of 3-year ahead).

7. Discussion and conclusions

Blanchard (2019) called for more in-depth research on the role of fiscal policy in different interest-growth (r-g) environments. This paper has contributed to a growing r-g literature by analysing the factors that contribute to explaining r-g differentials in a sample of 22 OECD countries over 1970–2018. We have introduced the r-g differential as a risk factor for fiscal policy-makers: unfavourable (future) r-g differentials (r > g) restrict the room for fiscal manoeuvre if the public-debt-to-GDP ratio is to decline; and favourable r-g differentials (r < g) tend to ease restrictions. We contribute to a better understanding of the evolution of r-g risks by testing the role of fiscal, economic and institutional predictors and by quantifying probabilities of (un)favourable future r-g differentials.

A major contribution of our empirical analysis is that it distinguishes between Eurozone and stand-alone countries (where the latter issue debt in their own currency). This is motivated by the literature suggesting that Euro member countries changed the nature of their government debt fundamentally by entering the Euro (e.g. De Grauwe, 2012; Saka et al., 2015; Bianchi and Mondragon, 2022). We hypothesise that entering the monetary union and the Euro Crisis had a distinct impact on r-g differentials for different groups of Eurozone member countries (core and periphery), respectively. Our panel regression results lend empirical support to this hypothesis. We find that the safety of government bonds mattered, since countries in the periphery (Greece, Italy, Spain, Ireland, Portugal) with riskier government bonds benefited more from entering the monetary union before the financial crisis in terms of more favourable r-g differentials; however, the countries historically deemed riskier were then "punished" as the first to be singled-out by bond sell-offs during the Euro Crisis (e.g. Mody and Sandri, 2012), so that their r-g differentials increased strongly. We do not find evidence for a similar moderating impact of the safety of bonds on r-g differentials for Euro core countries and stand-alone countries. Our results further highlight that public debt levels are not a good predictor of r-g differentials and future r-g risks in advanced economies. When it comes to fiscal fundamentals, we find that lower primary fiscal balances are consistently a better predictor of more unfavourable r-g

---

[15] Probit regression results showing the individual coefficient estimates are available in table A7 of the supplementary appendix.

differentials. When it comes to other explanatory variables such as financial repression and inflation, we have pointed to differences in how they relate to r-g in Eurozone and stand-alone countries, respectively.

What are the main policy implications? First, public debt levels seem to be less important as predictors of r-g risks in advanced economies than previously thought. Institutional factors, however, may play a bigger role, in particular in the Eurozone context. The Eurozone institutional architecture, despite several rounds of reform since the financial crisis of 2007/2008, remains that of a monetary union accompanied by a comparable lack of fiscal integration, which increases fragility for individual members when it comes to experiencing rollover crises whenever the ECB does not credibly backstop the government bond markets (Bianchi and Mondragon, 2022). During the Euro Crisis, the fragmentation in Eurozone government bond markets contributed to a deterioration in r-g differentials in periphery countries, which were then also pushed into harsher fiscal consolidation that further reduced economic growth (De Grauwe and Ji, 2013b), so that r-g differentials turned more unfavourable. While our results suggest that r-g risks are highest in the Euro periphery, the fragility of these countries is further magnified by the fact that their public debt levels are, on average, markedly higher than in the Euro core and other advanced economies. Due to the mechanics of public debt accumulation, the risks fiscal policymakers face when the interest-growth environment deteriorates are magnified at higher public debt levels, because more restrictive fiscal policies are required to stabilise the public debt ratio than at lower debt levels (see Table 1). In this context, the debate on r-g differentials in the Eurozone should be related to discussions on the institutional architecture of the common currency. It might be possible to reduce the r-g risks by ensuring that the ECB is always in a position to credibly backstop government bond markets – as this can contribute to mitigating a deterioration in r-g differentials, especially in the periphery – and by moving towards more fiscal integration (e.g. via completing the banking union), as this could serve to increase the safety status of government bonds. However, a reduction of public debt levels in the Euro periphery, supported by an increase in growth, would help avoid a magnification of risks related to possible deteriorations in r-g for future governments.

A major limitation of this paper is that it lacks an in-depth analysis of the mechanisms through which certain economic, fiscal and institutional factors do or do not affect r-g. Future research could try to gain a better understanding of the underlying channels, e.g. by explaining why financial repression is correlated more with lower r-g differentials in stand-alone countries than in the Eurozone, or why higher inflation is more weakly correlated with r-g differentials in the Eurozone than in the stand-alone sample. Potential mechanisms to be tested include the role of the central bank, whose policy stance may serve to make it more or less likely that economic factors (e.g. inflation) or political factors (e.g. the political orientation of governments) affect bond yields and growth. International openness is another mediating channel that could be analysed in more depth. Finally, we find that under the macroeconomic conditions in the years before the Covid-19 crisis, predicted probabilities of unfavourable future r-g differentials in the short-to-medium-run are typically well below 50 %. However, there is the risk of a shift in the macroeconomic environment promoted by the repercussions of the war in Ukraine, where higher inflation and increasing real interest rates may raise the probabilities of unfavourable r-g differentials, especially if growth remains stagnant for a prolonged period of time. Future research could use updated data for the Covid-19 years and the energy crisis in the context of the war in Ukraine to provide extensions and robustness checks. It would also be important to compare this paper's findings with fresh evidence for developing and emerging-market economies, where the factors driving r-g risks could differ from the advanced economies covered in this paper. Finally, future research could undertake more efforts to understand the macroeconomic and institutional environment that shapes different r-g environments and changes between r < g and r > g in different parts of the global economy.

CRediT authorship contribution statement

Philipp Heimberger: Conceptualization, Data curation, Writing – original draft, Visualization, Investigation, Writing – review & editing.

Data availability

Data and replication code are available via: https://github.com/heimbergecon/rg-eurozone-standalone.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jimonfin.2023.102877.

References

Adrian, T., Boyarchenko, N., Giannone, D., 2019. Vulnerable growth. Am. Econ. Rev. 109 (4), 1263–1289.
Attinasi, M., Checherita, C., Nickel, C., 2010. What explains the surge in euro area sovereign spreads during the financial crisis of 2007/09. Public Finance Manage. 10 (4), 595–645.
Baldwin, R., Beck, T., Benassy-Quere, A., Blanchard, O., Corsetti, G., De Grauwe, P., den Haan, W., Giavazzi, F., Gros, D., Kalemli-Ozcan, S., Micossi, S., Papaioannou, E., Pesenti, P., Pissarides, C., Tabellini, G., Weder di Mauro, B. (2015): Rebooting the Eurozone: Step 1 – agreeing a crisis narrative, CEPR Policy Insight No. 85.
Barrett, P., 2018. Interest-growth differentials and debt limits in advanced economies, IMF Working Paper No. 08/266.
Baum, A., Checherita-Westphal, C., Rother, P., 2013. Debt and growth: New evidence for the euro area. J. Int. Money Financ. 32 (C), 809–821.
Beirne, J., Fratzscher, M., 2012. The pricing of sovereign risk and contagion during the European sovereign debt crisis. J. Int. Money Financ. 34 (C), 60–82.
Bianchi, J., Mondragon, J., 2022. Monetary independence and rollover crises. Q. J. Econ. 137 (1), 435–491.
Blanchard, O., 2019. Public debt and low interest rates. Am. Econ. Rev. 109 (4), 1197–1229.
Blanchard, O., 2023. Fiscal policy under low interest rates. MIT Press, Cambridge, MA.
Blundell, R., Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data. J. Econ. 87 (1), 115–143.
Checherita-Westphal, C., Domingues Semeano, J., 2020. Interest rate-growth differentials on government debt: an empirical investigation for the euro area, ECB Working Paper No. 2486.
Checherita-Westphal, C., Rother, P., 2012. The impact of high government debt on economic growth and its channels: an empirical investigation for the euro area. Eur. Econ. Rev. 56 (7), 1392–1405.
Chinn, M., Ito, H., 2006. What matters for financial development? Capital controls, institutions, and interactions. J. Dev. Econ. 81 (1), 163–192.
De Grauwe, P., 2012. The governance of a fragile Eurozone. Aust. Econ. Rev. 45 (3), 255–268.
De Grauwe, P., Ji, Y., 2019. Rethinking fiscal policy choices in the euro area, VoxEU (October 14th 2019).
De Grauwe, P., Ji, Y., 2012. Mispricing of sovereign risk and macroeconomic stability in the Eurozone. J. Common Mark. Stud. 50 (6), 866–880.
De Grauwe, P., Ji, Y., 2013a. Self-fulfilling crises in the Eurozone: an empirical test. J. Int. Money Financ. 34 (C), 15–36.
De Grauwe, P., Ji, Y., 2013b. From panic-driven austerity to symmetric macroeconomic policies in the Eurozone. J. Common Mark. Stud. 51 (S1), 31–41.
De Grauwe, P., Ji, Y., 2015. The fragility of two monetary regimes: The European Monetary System and the Eurozone. Int. J. Financ. Econ. 20 (1), 1–15.
De Grauwe, P., Ji, Y., 2022. The fragility of the Eurozone: has it disappeared? J. Int. Money Financ. 120, 102546.
Di Serio, M., Fragetta, M., Melina, G., 2021. The impact of r-g on euro-area government spending multipliers. J. Int. Money Financ. 119, (10) 102493.
Escolano, J., Shabunina, A., Woo, J., 2017. The puzzle of persistently negative interest-rate-growth differentials: financial repression or income catch-up? Fisc. Stud. 38 (2), 179–217.
Escolano, J., 2010. A practical guide to public debt dynamics, fiscal sustainability, and cyclical adjustment of budgetary aggregates, IMF Technical Notes and Manuals No. 10/02.
European Fiscal Board, 2019. Assessment of EU fiscal rules with a focus on the six and two-pack legislation, August 2019.
Gabor, D., Vestergaard, J., 2018. Chasing unicorns: the European single safe asset project. Compet. Chang. 22 (2), 139–164.
Gräbner, C., Heimberger, P., Kapeller, J., Schütz, B., 2020a. Structural change in times of increasing openness: assessing path dependency in European integration. J. Evol. Econ. 30 (5), 1467–1495.
Gräbner, C., Heimberger, P., Kapeller, J., Schütz, B., 2020b. Is the Eurozone disintegrating? Macroeconomic divergence, structural polarisation, trade and fragility. Cambridge J. Econ. 44 (3), 647–669.
Gräbner, C., Heimberger, P., Kapeller, J., Springholz, F., 2021. Understanding economic openness: a review of existing measures. Rev. World Econ. 157 (1), 87–120.
Habib, M., Stracca, L., Venditti, F., 2020. The fundamentals of safe assets. J. Int. Money Financ. 102, (3) 102119.
Heimberger, P., 2017. Did fiscal consolidation cause the double-dip recession in the euro area? Rev. Keynes. Econ. 5 (3), 439–458.
IMF, 2011. Appendix 4 – Stock-flow adjustments and their determinants, IMF Fiscal Monitor April 2011.
IMF, 2021. A Fair Shot, Fiscal Monitor April 2021.
Kiley, M., 2021. Growth at risk from climate change, Finance and Economics Discussion Series 2021-054.
Koenker, R., Bassett, G., 1978. Regression quantiles. Econometrica 46 (1), 33–50.
Krishnamurty, A., Vissing-Jorgensen, A., 2012. The aggregate demand for treasury debt. J. Polit. Econ. 120 (2), 233–267.
Laubach, T., 2009. New evidence on the interest rate effects of budget deficits and debt. J. Eur. Econ. Assoc. 7 (4), 858–885.
Lian, W., Presbitero, A., Wiriadinata, U., 2020. Public debt and r – g at risk, IMF Working Paper No. 20/137.
Mauro, P., Zhou, J., 2021. r – g < 0: can we sleep more soundly? IMF Econ. Rev. 69 (1), 197–229.
Mehrotra, N., Sergeyev, D., 2021. Debt sustainability in a low interest rate world. J. Monet. Econ. 124, S1–S18.
Mian, A., Straub, L., Sufi, A., 2022. A Goldilocks theory of fiscal deficits, NBER Working Paper No. 29707.
Mody, A., Sandri, D., 2012. The eurozone crisis: how banks and sovereigns came to be joined at the hip. Econ. Policy 27 (70), 199–230.
Morys, M., 2014. Gold standard lessons for the Eurozone. J. Common Mark. Stud. 52 (4), 728–741.
Reinhart, C., Sbrancia, M., 2015. The liquidation of government debt. Econ. Policy 30 (82), 291–333.
Reis, R., 2021. The constraint on public debt when r < g but g < m, BIS Working Papers No. 939.
Rogoff, K., 2020. Falling real interest rates, rising debt: a free lunch? J. Policy Model 42 (4), 778–790.
Saka, O., Fuertes, A., Kalotychou, E., 2015. ECB policy and Eurozone fragility: was De Grauwe right? J. Int. Money Financ. 54 (4), 168–185.
Simonazzi, A., Ginzburg, A., Nocella, G., 2013. Economic relations between Germany and Southern Europe. Camb. J. Econ. 37 (3), 653–675.
Turner, D., Spinelli, F., 2011. Explaining the interest-rate-growth differential underlying government debt dynamics, OECD Economics Working Paper No. 919.
Wyplosz, C., 2019. Olivier in Wonderland, VoxEU, June 17th 2019.