EUROPEAN CENTRAL BANK

EUROSYSTEM

Interest rate-growth differentials on government debt: an empirical investigation for the euro area*

Cristina Checherita-Westphal**

European Central Bank

Irish Fiscal Council Path for the Public Finances 2021 conference: "Ensuring debt sustainability in a post-Covid world"

8 February 2021

***The views expressed in this presentation and the related paper are those of the authors and do not necessarily reflect those of the European Central Bank (ECB)**

** Based on the joint paper with J. João Domingues Semeano "Interest rate-growth differentials on government debt: an empirical investigation for the euro area", ECB Working paper No 2486/2020.

Motivation

- Interest rate-growth differential ($i - g$): key variable for debt dynamics and sovereign sustainability analysis $\Delta b_t = \left(\frac{i_t - g_t}{1+g_t}\right) b_{t-1} - pb_t + dda_t$
- Steady decline in ***interest rates*** in advanced economies since 1980s
  - in the wake of the 2007 global financial crisis and more recently the COVID 19-crisis, interest rates, including on government debt, plummeted to exceptionally low levels
- But this decline is linked, *inter alia*, to a decline in ***potential and nominal output growth***
- The question thus remains about the ***differential between the two variables:*** sign, trend and determinants

Literature review

Most of the theoretical and empirical literature has so far assumed or inferred that the interest rate–growth differential should be positive over the longer-run, at least in advanced, mature economies, close to their steady-state

Theoretical and empirical debates:

- Current debate on the role of fiscal policy with a persistently negative differential
- In most models, the government is assumed to borrow at the "safe rate", while accounting for sovereign credit risk would raise the cost of public debt ⇔ which debt is risk free, under which conditions and for how long (given some market clearing in equilibrium)?
- **Does the summary in Blanchard et al. (1991, pp 15) still holds?**
  - whether the configuration of negative $i - g$ "could be easily rejected based on theoretical or empirical grounds remains a theoretical curiosum. […] Still, there is general agreement that the condition of an excess in the interest rate over the growth rate probably holds, if not always, at least in the medium and long run"

Literature review: theoretical models

Standard economic growth theory ⇔

positive $i - g$

- $i - g$ for the economy as a whole (in the neoclassical growth model), as well as for the government (in endogenous growth models), should be positive in economies that operate at their steady-state.
- Blanchard and Fischer (1989) and Turnovsky (2010): to be viable (non-exploding), the LR equilibrium must satisfy the transversality conditions requiring that the after-tax marginal return of capital or the real interest rate (r) is larger than the real growth of the economy.
- Piketty (2014): $r > g$ (for private capital) "fundamental inequality" in advanced market economies.

OLG models with uncertainty and models with rational bubbles ⇔

negative $i - g$ under certain conditions

- Some OLG models with non-diversifiable uncertainty (see Blanchard 2019) or models with rational bubbles (see Martin and Ventura, 2017 for a review) allow for $r < g$ to co-exist with competitive equilibria.
- The presence of non-diversifiable uncertainty creates a wedge between the risk free rate (R_F, associated in these studies with the interest rate on safe government debt) and the marginal product of capital (MPK), so that $R_F < g < MPK$ can be compatible with a dynamically efficient economy.

Literature review: some recent empirical conclusions

Blanchard (2019):

persistently negative interest rate-growth differential (US example)

- Reignite debate on the role of fiscal policy: with a negative i-g, public debt may have no fiscal cost. It may still have welfare costs, but these may also be lower than typically assumed.
- This is because the (US) safe interest rate (a proxy of marginal bond rates) is below the nominal GDP growth rate and this is more the historical norm rather than the exception.
- The author stressed, however, that the purpose of his lecture was not to argue for higher debt per se, but to allow for a richer discussion of debt policy and appropriate debt rules than is currently the case.

Wyplosz (2019):

$i - g < 0$ is not the norm for advanced economies

- Observations with $i - g < 0$ somewhat less than half of a sample since 1961 for 22 advanced economies (895 obs.) and average at 0.1%;
- The differential is very volatile ⇔ very difficult to know the "norm"
- The deficit bias implies that debt tends to increase even in periods of negative i-g

Mauro and Zhou (2020):

$i - g < 0$ more often than not in advanced economies, but heterogeneity of results and with a word of caution in terms of policy implications

- Negative differentials have occurred more often than not in both advanced and emerging economies over a long period spanning up to 200 years.
- Yet, while for the full sample of advanced economies, the central tendency indicators (both median and mean) are negative, for the longest period covered in the sample (before WWII) and for the most recent period (post-1980s), they are positive. It is mainly the post-WWII period and the high inflation years in the 70s that drive the results.
- The paper also asks the question whether "one can sleep more soundly" with such negative (automatic debt reduction) differentials. The answer the authors give is "not really": in fact, governments tended to loosen fiscal positions and accumulate more debt and lower differentials are not found to be associated with a lower frequency of sovereign defaults over the period of analysis.

Stylised facts on $i-g$ in the euro area

For most mature euro area economies, the long-term historical average of $i - g$ since the early 1980s or over the EMU period (since 1999) is positive

(COVID-19 crisis – not hereby reflected - induced another massive, albeit temporary, increase in i-g)

	1970-2019			1985-2019			1999-2019		
	$i-g$	IIR	GDP growth	$i-g$	IIR	GDP growth	$i-g$	IIR	GDP growth
BE	1.1	6.7	5.5	1.8	5.8	4.0	0.6	4.1	3.5
DE	1.4	5.8	4.2	1.6	5.0	3.5	0.9	3.5	2.6
IE	-4.0	6.9	10.8	-2.6	5.5	8.1	-3.5	4.0	7.5
GR	-	-	-	-	-	-	2.1	4.1	2.1
ES	-3.4	5.9	9.1	0.1	6.1	6.0	0.1	4.1	4.0
FR	0.5	5.7	6.2	1.6	5.2	3.6	0.7	3.6	2.8
IT	-1.2	7.3	8.4	2.4	6.8	4.5	2.0	4.2	2.2
LU	-	-	-	-	-	-	-3.4	2.8	6.2
NL	1.4	6.0	5.3	1.3	5.3	4.0	0.2	3.7	3.5
AT	-0.1	5.4	5.4	1.0	5.1	4.1	0.6	4.0	3.4
PT	-2.5	8.2	11.3	0.0	7.4	7.4	0.9	4.1	3.2
FI	-0.1	7.3	7.2	1.6	6.1	4.5	0.2	3.6	3.4
DK	2.9	8.9	6.0	2.9	6.8	3.9	1.4	4.7	3.3
UK	-1.0	6.9	7.8	1.0	6.3	5.2	0.6	4.5	3.9
SE	-0.6	6.3	6.8	0.3	5.4	5.1	-0.9	3.3	4.2
JP	-	-	-	1.0	2.7	1.7	0.9	1.2	0.2
US	2.7	9.0	6.2	2.6	7.5	4.9	1.5	5.7	4.2

Source: Based on Checherita-Westphal and Domingues-Semeano (2020). The main source of data for calculations is Ameco (Spring 2020 vintage). Where data is not available, the series were extrapolated with the growth rate of respective variables from other sources. Data for LU available as of 1990, JP 1981, FR 1978, PT 1977, NL 1976, DE, IE, DK 1972, GR 1995 (from Ameco). Implicit interest rate calculated in annual terms as the ratio between government interest payments in year t and the debt stock in year t-1, then averaged over the respective period. Extreme outliers for Ireland as a result of GDP statistical reevaluations in 2015 are excluded throughout the analysis.

Stylised facts on $i-g$ in the euro area (cont.)

For the euro area aggregate, the differential has been positive, on average, over the EMU period. Only as of 2015, it has turned negative.

i-g	Overall period 1999-2019	Period before Great Financial Crisis (GFC) 1999-2007	Period of GFC 2008-11	Period after GFC 2012-19	Recent period 2015-2019
EA-19 aggregate	0.8	0.6	2.8	0.1	-1.0

The differential is much higher in bad economic times and in high debt countries

	Overall	Low public debt (< 90% GDP)	High public debt (≥ 90%)
1985-2017	0.9	0.4	1.9
1999-2017	0.6	0.0	1.7
	Overall	**Normal and good economic times (OG ≥ -1.5)**	**Bad economic times (OG < -1.5)**
1985-2017	0.9	0.1	2.9
1999-2017	0.6	-0.5	3.0
	Overall	**Bad economic times and low debt (OG < -1.5 and Debt < 90%)**	**Bad economic times and high debt (OG < -1.5 and Debt ≥ 90%)**
1985-2017	2.9	2.4	3.7
1999-2017	3.0	2.5	3.8

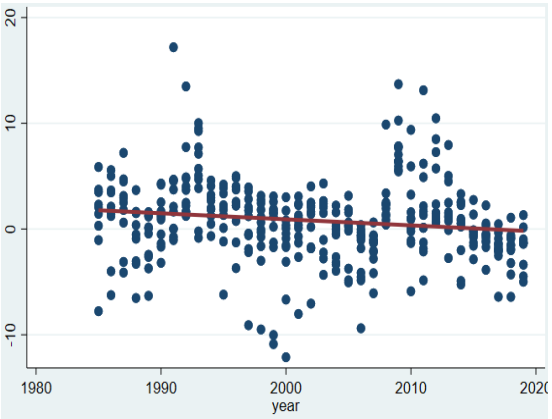
Source: Based on Checherita-Westphal and Domingues-Semeano (2020) and Checherita-Westphal (2019). The main source of data for calculations is Ameco. EA aggregate is the GDP-weighted average of the 19 euro area countries (for each individual variable entering the i-g calculation)

Stylised facts on $i-g$ in the euro area (cont.)

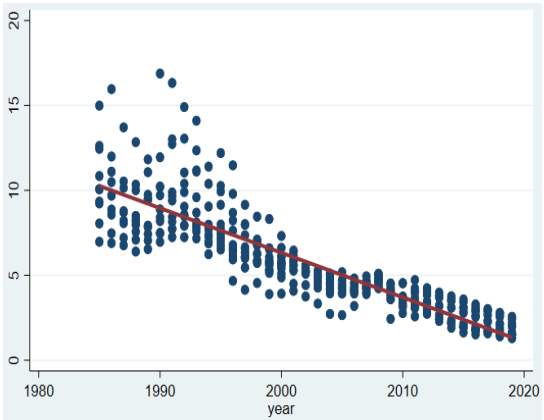
- While recent policy discussions have focused on the declining (equilibrium) interest rates since the 1980s, potential and nominal output growth have also dropped.
- The average cross-country $i-g$ on government debt has followed a less pronounced decline and showed no apparent trend until more recently

Interest rate-growth differential on government debt across EA-12 over 1985-2019

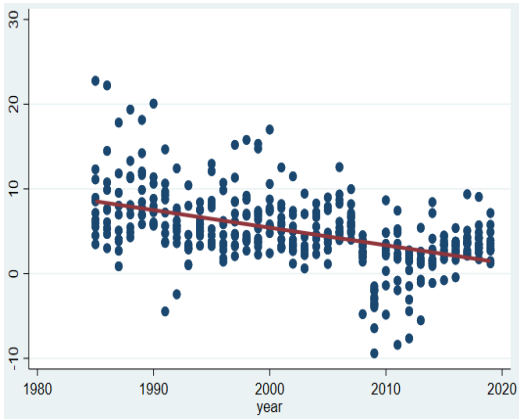
Interest rate growth differential $(i-g)$



Implicit interest rate (i)



Nominal GDP growth (g)



Notes: Own calculations based mainly on the European Commissions' Ameco dataset (Spring 2020 vintage). EA-12 comprises Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, Luxembourg, the Netherlands and Portugal. Extreme outliers for Ireland as a result of GDP statistical reevaluations in 2015 are excluded throughout the analysis. Implicit (average) interest rate on government debt calculated as the ratio between government interest payments in year t and the debt stock in year t-1.

Empirical analysis on determinants of $i-g$ in the euro area

Main results from panel data analysis (EA-12 over 1985/1999 – 2017):

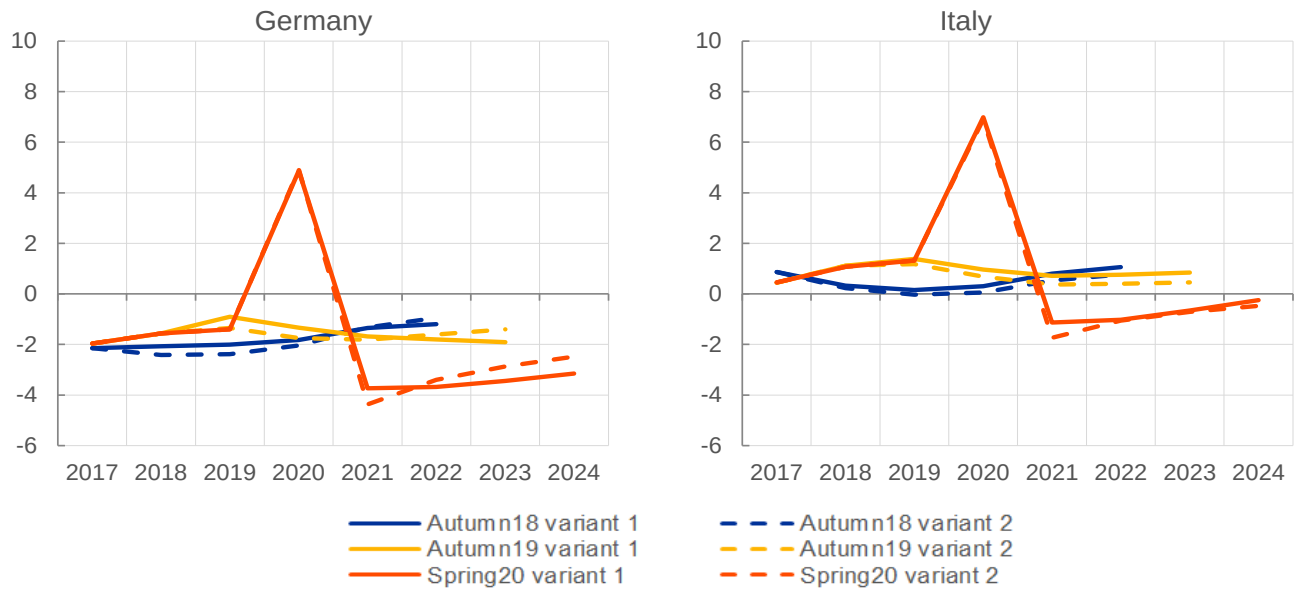
- Countries with a higher public debt burden or build-up of public debt more likely to have a higher $i - g$ (even after controlling for the position in the economic cycle)
  - ✓ *Results consistent with Turner and Spinelli (2011), Escolano et al. (2017), Lian at al. (2020)*
- For the euro area period, monetary policy loosening is associated with a lower differential.
- Technological progress or any other factors that increase total factor productivity (TFP) growth promote a decrease in i-g.
- Some evidence that the global saving glut hypothesis is associated not only with a decline in interest rates, but also in the interest rate-growth differential.
- The impact of ageing is more difficult to disentangle:
  - A higher dependency ratio is generally found to be associated with lower i-g, while slower population growth tends to increase the differential.
  - This result could be justified in so far as ageing induces predominantly a higher saving-lower interest rate configuration, while lower population growth may have a more pronounced and quicker effect on growth.
  - Impact of ageing may also be partly captured by debt, albeit large future liabilities from ageing in many advanced economies not reflected in current measures of debt, entailing large fiscal risks ⇔ see discussions in Rogoff (2020) and Goodhart and Pradhan (2020)

Empirical analysis: panel BVAR forecast 2020-24

Main results panel BVAR (EA-10 sample over 1999-2019, with three EC forecast vintages):

- Differentials for most euro area countries will likely remain negative after the COVID 19-crisis, but increasing over the medium-term
- The peak experienced due to the pandemic will push the average differential over 2018-22 above what was previously forecast.
- High debt countries consistently present the highest differentials and higher probability of positive values
- Results surrounded by large uncertainty

BVAR model median forecast for i-g in selected countries



Source: Based on Checherita-Westphal and Domingues-Semeano (2020). Author's calculations based on real time AMECO data and forecasts (EC autumn 2018, autumn 2019 and spring 2020 forecasts). Notes: EA-10 excludes IE and LU as outliers from the previous sample. Variants 1 and 2 are panel Bayesian VARs with the short term interest rates and a fiscal variable (debt ratio in Variant 1 and primary balance ratio in Variant 2) as endogenous variables and TFP growth and dependency ratio variation as exogenous variables. The forecast starts in year 2018 for the autumn 2018 vintage, 2019 for the autumn 2019 vintage and 2020 for the spring 2020 vintage.

Conclusions

- Overall, $i-g$ in EA countries is projected to remain well below its historical average over the medium term according to most models
- ….but, this analysis advises caution, especially for the high debt countries
- Results of the empirical analysis shows that $i-g$ may increase over the medium to long term from the currently low projected levels on account of:
  - higher debt levels (including on account of the cost of ageing)
  - monetary policy tightening
  - any deviation from baseline scenarios of steady-state growth
  - a reversal in the global saving glut originating from emerging economies.
- Whereas effective public spending and investment can lift a country's medium-term growth potential and mitigate the negative cyclical effects of a downturn, particularly in an environment of low interest rates for long, currently high debt burdens in many economies remain a source of vulnerability.

Thank you for your attention

BACKGROUND SLIDES

Empirical analysis on determinants of $i-g$ in the euro area

Paper Table 1: Main explanatory factors for interest rate-growth differential in EA-12 over 1985-2017

	Model 1	**Model 2**	**Model 3**	**Model 4 (M4)**	**Model 5**	**Model 6**
MODEL/ VARIABLES	Annual data contempora-neous Xi, country FE	Annual data 1-year lagged Xi, country FE	Annual data 1-year lagged Xi, country FE	Annual data contemporaneous Xi, country FE and common time effect	5-year non-overlapping averages, country FE	5-year nor overlappir averages, country an year FE
Government debt ratio	0.0382**	0.0585***		0.0426**	0.0485***	0.0439**
	(0.0154)	(0.0144)		(0.0147)	(0.0176)	(0.0181)
Primary balance ratio	-0.278***	-0.404***		-0.248***	-0.190*	-0.202*
	(0.0628)	(0.0774)		(0.0525)	(0.103)	(0.104)
Output gap	-0.386***	0.105	0.0302	-0.390***	-0.0918	
	(0.0785)	(0.125)	(0.137)	(0.0880)	(0.123)	
Current account balance (private)	-0.223***	-0.349***	-0.270***	-0.204***	-0.233***	-0.244***
	(0.0560)	(0.0824)	(0.0742)	(0.0507)	(0.0835)	(0.0823)
TFP growth	-0.945***	-0.560***	-0.360**	-0.826***	-0.997***	-1.109***
	(0.0644)	(0.146)	(0.132)	(0.0820)	(0.207)	(0.224)
Dependency ratio	-0.358***	-0.280***	-0.163**	-0.341***	-0.474***	-0.408***
	(0.0447)	(0.0555)	(0.0550)	(0.0436)	(0.0908)	(0.0948)
Population growth	-2.424***	-1.715**	-2.206***	-2.088***	-3.472***	-3.626***
	(0.227)	(0.734)	(0.695)	(0.264)	(0.811)	(0.878)
Short-term interest rate	0.189**	0.235***	0.0708	0.0984	0.0731	
	(0.0633)	(0.0592)	(0.0785)	(0.0801)	(0.0662)	
Change in government debt			0.283***			
			(0.0700)			
(i-g) US				0.304***		
				(0.0757)		
Observations	371	367	371	371	76	76
Number of countries	12	12	12	12	12	12
R2 within	0.659	0.326	0.318	0.677	0.690	0.761

Notes: Standard errors in parentheses. Significance level: *** p<0.01, ** p<0.05, * p<0.1. Models 1-4 use the Driscoll-Kraay fixed effects (FE) estimator, Models 5-6 (with restricted time periods and N>T) use the Newey FE estimator.

Empirical analysis on determinants of $i-g$ in the euro area

Paper Table 3: Main explanatory factors for interest rate-growth differential in EA-12 over 1999-2017

MODEL/ VARIABLES	**Model 1** Annual data contemporaneous Xi, country FE	**Model 2** Annual data 1-year lagged Xi, country FE	**Model 3** Annual data 1-year lagged Xi, country FE	**Model 4 (M4)** Annual data contemporaneous Xi, country FE and common time effect	**Model 5** Annual data contemporaneous Xi, country and year FE
Government debt ratio	0.0256*	0.0919***		0.0313***	0.0370***
	(0.0133)	(0.0293)		(0.00902)	(0.0111)
Primary balance ratio	-0.226***	-0.518***		-0.221***	-0.258***
	(0.0503)	(0.0883)		(0.0452)	(0.0558)
Output gap	-0.314***	0.117	-0.0646	-0.347***	-0.337***
	(0.0560)	(0.150)	(0.120)	(0.0540)	(0.0630)
Current account balance (private)	0.0610*	-0.0863	0.0155	0.0438	0.0320
	(0.0335)	(0.0801)	(0.0406)	(0.0340)	(0.0355)
TFP growth	-0.955***	-0.374**	-0.194	-0.815***	-0.755***
	(0.0388)	(0.165)	(0.172)	(0.0662)	(0.0839)
Dependency ratio	-0.489***	-0.132	0.0305	-0.466***	-0.457***
	(0.0483)	(0.132)	(0.190)	(0.0503)	(0.0612)
Population growth	-1.343***	1.456	0.503	-1.122**	-0.925*
	(0.393)	(1.142)	(0.892)	(0.388)	(0.450)
Short-term interest rate	0.320***	1.118***	0.727**	0.283***	0.397***
	(0.0661)	(0.347)	(0.289)	(0.0764)	(0.0990)
Change in government debt			0.311***		
			(0.0884)		
(i-g) US				0.221***	
				(0.0548)	
Observations	226	226	226	226	226
Number of countries	12	12	12	12	12
R2 within	0.814	0.417	0.403	0.825	0.835

Notes: Standard errors in parentheses. Significance level: *** p<0.01, ** p<0.05, * p<0.1. All models use the Driscoll-Kraay fixed effects (FE) estimator.

Empirical analysis on determinants of $i-g$ in the euro area

Paper Table 3: Main explanatory factors for interest rate-growth differential in EA-12 over 1999-2017

MODEL/ VARIABLES	**Model 1** Annual data contemporaneous Xi, country FE	**Model 2** Annual data 1-year lagged Xi, country FE	**Model 3** Annual data 1-year lagged Xi, country FE	**Model 4 (M4)** Annual data contemporaneous Xi, country FE and common time effect	**Model 5** Annual data contemporaneous Xi, country and year FE
Government debt ratio	0.0256*	0.0919***		0.0313***	0.0370***
	(0.0133)	(0.0293)		(0.00902)	(0.0111)
Primary balance ratio	-0.226***	-0.518***		-0.221***	-0.258***
	(0.0503)	(0.0883)		(0.0452)	(0.0558)
Output gap	-0.314***	0.117	-0.0646	-0.347***	-0.337***
	(0.0560)	(0.150)	(0.120)	(0.0540)	(0.0630)
Current account balance (private)	0.0610*	-0.0863	0.0155	0.0438	0.0320
	(0.0335)	(0.0801)	(0.0406)	(0.0340)	(0.0355)
TFP growth	-0.955***	-0.374**	-0.194	-0.815***	-0.755***
	(0.0388)	(0.165)	(0.172)	(0.0662)	(0.0839)
Dependency ratio	-0.489***	-0.132	0.0305	-0.466***	-0.457***
	(0.0483)	(0.132)	(0.190)	(0.0503)	(0.0612)
Population growth	-1.343***	1.456	0.503	-1.122**	-0.925*
	(0.393)	(1.142)	(0.892)	(0.388)	(0.450)
Short-term interest rate	0.320***	1.118***	0.727**	0.283***	0.397***
	(0.0661)	(0.347)	(0.289)	(0.0764)	(0.0990)
Change in government debt			0.311***		
			(0.0884)		
(i-g) US				0.221***	
				(0.0548)	
Observations	226	226	226	226	226
Number of countries	12	12	12	12	12
R2 within	0.814	0.417	0.403	0.825	0.835

Notes: Standard errors in parentheses. Significance level: *** p<0.01, ** p<0.05, * p<0.1. All models use the Driscoll-Kraay fixed effects (FE) estimator.

Empirical analysis on determinants of $i-g$ in the euro area

Paper Table 5: Comparison with other economies (main explanatory factors for interest rate-growth differential)

MODEL/ VARIABLES	Model 1 EA-12	Model 2 AE-17	Model 3 AE-24	Model 4 EA-12	Model 5 AE-17	Model 6 AE-24
	Annual data contemporaneous Xi, country FE 1985-2017			Annual data contemporaneous Xi, country and time FE 1999-2017		
Government debt ratio	0.0382**	0.0225*	0.0203**	0.0370***	0.0162*	0.0217**
	(0.0154)	(0.0109)	(0.00977)	(0.0111)	(0.00767)	(0.00800)
Primary balance ratio	-0.278***	-0.234***	0.0183	-0.258***	-0.239***	0.0116
	(0.0628)	(0.0628)	(0.0534)	(0.0558)	(0.0749)	(0.0713)
Output gap	-0.386***	-0.456***	-0.576***	-0.337***	-0.383***	-0.610***
	(0.0785)	(0.0748)	(0.109)	(0.0630)	(0.0555)	(0.115)
Current account balance (private)	-0.223***	-0.193***	0.0885	0.0320	-0.0019	0.264***
	(0.0560)	(0.0395)	(0.0865)	(0.0355)	(0.0320)	(0.0760)
TFP growth	-0.945***	-0.911***	-0.988***	-0.755***	-0.766***	-0.920***
	(0.0644)	(0.0528)	(0.103)	(0.0839)	(0.0845)	(0.0878)
Dependency ratio	-0.358***	-0.326***	-0.265***	-0.457***	-0.355***	-0.230***
	(0.0447)	(0.0392)	(0.0506)	(0.0612)	(0.0492)	(0.0519)
Population growth	-2.424***	-2.431***	-0.667**	-0.925*	-1.427***	0.0907
	(0.227)	(0.287)	(0.246)	(0.450)	(0.397)	(0.288)
Short-term interest rate	0.189**	0.184**	0.201***	0.397***	0.395**	0.0172
	(0.0633)	(0.0657)	(0.0504)	(0.0990)	(0.144)	(0.215)
Observations	371	525	675	226	318	451
Number of countries	12	17	24	12	17	24
R2 within	0.659	0.647	0.596	0.835	0.816	0.769

Notes: Standard errors in parentheses. Significance level: *** p<0.01, ** p<0.05, * p<0.1. All models use the Driscoll-Kraay fixed effects (FE) estimator. The model presented is Model 1 from Table 1 as preferred model M4 includes *i-g* for the US as an explanatory variable for the group of EA-12. The country groups are: EA-12, the core group of matured, high income economies in the euro area and first members. EA-17 includes in addition Denmark, Sweden, UK, Japan and US. EA-24 includes in addition the remaining 7 euro area countries.

Empirical analysis on determinants of $i-g$ in the euro area

Paper Table A3: Robustness across various estimators (EA-12)

MODEL/ VARIABLES	**Model 1** Fixed-effects, robust SE	**Model 2** Random-effects, robust SE (time FE)	**Model 3** Prais-Winsten estimator (country & time FE)	**Model 4** Arellano-Bond, robust SE	**Model 5** Arellano-Bond, robust SE	**Model 6** Arellano-Bond, robust SE	**Model 7** Arellano-Bond, robust SE
	1999-2017	1999-2017	1999-2017	1985-2017	1999-2017	1985-2017	1999-2017
Government debt ratio	0.0313***	0.0209**	0.0362**	0.0137*	0.0248**		
	(0.00965)	(0.00936)	(0.0168)	(0.00795)	(0.0104)		
Primary balance ratio	-0.221***	-0.132*	-0.159***	-0.0683	-0.179***		
	(0.0496)	(0.0799)	(0.0568)	(0.0495)	(0.0507)		
Change in government debt						0.122***	0.147***
						(0.0283)	(0.0323)
Output gap	-0.347***	-0.333**	-0.328***	-0.0879	-0.238***	-0.0966	-0.263***
	(0.106)	(0.146)	(0.0853)	(0.0696)	(0.0758)	(0.0774)	(0.0480)
Current account balance (private)	0.0438	0.0699*	-0.00066	-0.102**	0.0116	-0.120***	0.0243
	(0.0417)	(0.0414)	(0.0483)	(0.0408)	(0.0379)	(0.0360)	(0.0356)
TFP growth	-0.815***	-0.958***	-0.727***	-0.976***	-0.867***	-0.860***	-0.774***
	(0.0831)	(0.177)	(0.0933)	(0.0639)	(0.0933)	(0.0783)	(0.0879)
Dependency ratio	-0.466***	-0.0754	-0.565***	-0.152**	-0.376***	-0.110*	-0.307***
	(0.0999)	(0.101)	(0.127)	(0.0671)	(0.0896)	(0.0573)	(0.0663)
Population growth	-1.122**	-1.329***	-1.278**	-1.304***	-1.308***	-1.461***	-1.498***
	(0.503)	(0.422)	(0.526)	(0.313)	(0.486)	(0.352)	(0.517)
Short-term interest	0.283***	-0.197	0.375**	0.0450	0.234***	0.00507	0.114**
	(0.0535)	(0.235)	(0.183)	(0.0391)	(0.0720)	(0.0321)	(0.0570)
(i-g) US	0.221***			0.348***	0.183***	0.319***	0.155***
	(0.0675)			(0.0818)	(0.0522)	(0.0866)	(0.0601)
(i-g) L1.				0.466***	0.258***	0.431***	0.242**
				(0.0720)	(0.0930)	(0.0721)	(0.0977)
(i-g) L2.				0.0443	-0.102***	0.0626	-0.0641**
				(0.0351)	(0.0277)	(0.0385)	(0.0261)
Observations	226	226	226	366	225	366	225
Number of countries	12	12	12	12	12	12	12

Empirical analysis: panel BVAR forecast 2020-24

Paper Table 8: Selected $i - g$ data and statistics used for the BVAR model forecast and the EC forecast under different vintages

Country	BVAR full sample statistics (1999-2019)			EC Autumn 2018 forecast vintage			EC Spring 2020 forecast vintage				
				History	Forecast		History			Forecast	
	1999	Min	Max	2017	2018	2019	2017	2018	2019	2020	2021
Belgium	1.9	-1.4	5.6	-1.0	-1.4	-1.2	-1.4	-0.9	-1	7.8	-6.6
Germany	3.1	-2	7.8	-2.1	-2	-2.4	-2.0	-1.6	-1.4	5.7	-6.6
Greece	1.5	-4.8	13.1	-0.3	-0.7	-1.2	-0.3	-0.6	0.2	11.4	-7
Spain	-1.3	-4.1	7.8	-1.6	-1.4	-1.4	-1.7	-0.9	-1.2	11.5	-6
France	1.5	-1.3	6.4	-0.9	-0.7	-1.1	-0.9	-0.7	-1.3	8.4	-7.2
Italy	2.6	0.1	7.7	0.9	0.4	0.5	0.5	1.1	1.3	11.2	-5.2
Netherlands	0.2	-3.4	7	-2.4	-3.4	-3.4	-2.5	-3.2	-3.4	7.3	-5.1
Austria	1.8	-2	6.4	-1.5	-2.3	-1.8	-1.3	-2	-1.3	6.4	-4.3
Portugal	-1.7	-2.1	8.5	-1.3	-0.7	-0.6	-2.1	-1.5	-1.4	8.3	-4.5
Finland	1.2	-4.2	10.3	-1.9	-2.3	-2.3	-2.2	-1.9	-1.3	5.9	-4.6

Source: EC Ameco database and authors' calculations. BVAR full sample statistics based on EC spring 2020 vintage.

Empirical analysis: panel BVAR forecast 2020-24

Paper Table 9: Median forecast for i-g with the three EC vintages

Country	EC Autumn 2018 vintage				EC Autumn 2019 vintage					EC Spring 2020 vintage				
	2022 (T+5)			2018-2022	2022			2023 (T+5)	2018-2022	2022			2024 (T+5)	2018-2022
	Variant 1	Variant 2	Average models	Average models	Variant 1	Variant 2	Average models	Average models	Average models	Variant 1	Variant 2	Average models	Average models	Average models
Belgium	-0.5	-0.7	-0.6	-1.1	-1.5	-1.5	-1.5	-1.5	-1.1	-3.2	-2.6	-2.9	-2.4	-0.6
Germany	-1.2	-0.9	-1.1	-1.8	-1.8	-1.6	-1.7	-1.7	-1.5	-3.7	-3.4	-3.5	-2.8	-1.1
Greece	1.0	0.1	0.5	0.0	0.5	-1.6	-0.5	-0.3	-0.8	-1.3	-3.0	-2.2	-1.4	-0.4
Spain	-0.1	-0.8	-0.5	-1.3	-0.5	-1.3	-0.9	-0.8	-0.9	-2.7	-2.6	-2.6	-1.9	-0.4
France	-0.2	-0.6	-0.4	-1.0	-0.6	-1.2	-0.9	-0.8	-0.8	-2.5	-2.6	-2.5	-1.7	-0.6
Italy	1.1	0.8	0.9	0.4	0.8	0.4	0.6	0.6	0.9	-1.0	-1.1	-1.0	-0.4	1.4
Netherlands	-0.8	-0.9	-0.8	-1.3	-1.6	-1.9	-1.7	-1.7	-2.0	-3.5	-3.8	-3.6	-3.0	-2.2
Austria	-0.7	-1.0	-0.9	-1.7	-1.8	-2.0	-1.9	-1.8	-2.1	-3.8	-4.0	-3.9	-2.9	-1.9
Portugal	0.7	0.1	0.4	-0.5	-0.1	-1.3	-0.7	-0.4	-1.0	-2.3	-3.4	-2.9	-1.8	-1.0
Finland	-0.4	-0.6	-0.5	-1.3	-1.1	-1.2	-1.1	-1.1	-1.3	-3.6	-2.7	-3.1	-2.4	-0.3

Source: Author's calculations based on real time AMECO data and forecasts (EC autumn 2018, autumn 2019 and spring 2020 forecasts). Notes: Variants 1 and 2 are panel Bayesian VARs with the short term interest rates and a fiscal variable (debt ratio in Variant 1 and primary balance ratio in Variant 2) as endogenous variables and TFP growth and dependency ratio variation as exogenous variables.

Empirical analysis: panel BVAR forecast 2020-24

Paper Table 10: Model average of the probability of positive i-g across forecast vintages

Country	Probability above 0 (forecast period)		
	EC Autumn 2018	EC Autumn 2019	EC Spring 2020
Belgium	0.18	0.17	0.23
Germany	0.20	0.23	0.25
Greece	0.50	0.45	0.44
Spain	0.33	0.38	0.35
France	0.20	0.26	0.24
Italy	0.60	0.68	0.45
Netherlands	0.15	0.11	0.21
Austria	0.20	0.14	0.21
Portugal	0.42	0.38	0.33
Finland	0.27	0.32	0.28

Source: Authors' calculations based on real time AMECO data and forecasts (EC autumn 2018, autumn 2019 and spring 2020 forecasts). Notes: Probability of positive i-g calculated as the share of paths that deliver a positive value for the BVAR forecast period.

References

Underlying sources for the presentation:

- Checherita-Westphal, C. and J. Domingues Semeano (2020), "Interest rate-growth differentials on government debt: an empirical investigation for the euro area", ECB Working paper No 2486.
- Checherita-Westphal, C (2019), "Interest rate – growth differential and government debt dynamics", ECB Economic Bulletin Issue 2, Box 5

Other references:

- Blanchard, O. (2019), "Public Debt and Low Interest Rates," American Economic Review, vol 109(4), pages 1197-1229.
- Blanchard, O., Chouraqui, J.-C., Hagemann, R.P. and Sartor, N. (1991), "The Sustainability of Fiscal Policy: New Answers to an Old Question", Economic Studies, No 15, OECD, Paris
- Escolano, J., Shabunina, A. and Woo, J. (2017) "The Puzzle of Persistently Negative Interest-Rate–Growth Differentials: Financial Repression or Income Catch-Up?", IMF Fiscal Studies, vol. 38(2), pp. 179–217
- Goodhart, C A E and M Pradhan (2020), The Great Demographic Reversal. Aging Societies, Waning Inequalities, and an Inflation Revival, Palgrave Macmillan.
- Lian, W., A.F. Presbitero and U. Wiriadinata (2020), "Public debt and r-g at Risk", IMF Working paper, WP 20/137
- Mauro, P. and J. Zhou (2020), "r-g<0: Can We Sleep More Soundly?", IMF Working paper, WP/20/52, Washington DC.
- Martin A. and J. Ventura (2017), "The Macroeconomics of Rational Bubbles: a User's Guide", Annual Review of Economics
- Piketty, T. (2014)."Capital in the twenty-first century." Cambridge Massachusetts: The Belknap Press of Harvard University Press
- Rogoff, K S (2020), "Falling real interest rates, rising debt: A free lunch?", Journal of Policy Modelling 42(4): 778-790.
- Turner, D., Spinelli, F, (2011) "Explaining the interest-rate-growth differential underlying government debt dynamics", OECD Economics Department Working Papers, No. 919, OECD
- Wyplosz, C (2019), "Olivier in Wonderland", VoxEU.org, 17 June.