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Debt and growth: historical evidence

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Abstract

In this present paper, we examine the relationship between public debt and economic growth in a large historical panel dataset of 17 OECD economics over the period from 1870 to 2016. In contrast, the relevant literature focuses on the post-WW-II period. Several empirical studies provide evidence in support of the 'conventional view' that public debt is adversely associated with economic growth. We show that the relationship between government debt and per-capita GDP growth is neither statistically significant and robust nor unambiguous regarding the sign. While our baseline regressions support the 'conventional view', particularly in the aftermath of World War II, these results are not robust to alternative specifications. This holds for a linear as well as a non-linear relationship between public debt and economic growth. Thus, politicians should exercise great caution in using empirical studies on the debt-growth nexus as a guidance for fiscal policy.

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1 Introduction

Several recently published empirical studies support the 'conventional view' of public debt (Elmendorf and Mankiw 1999) and find a negative relationship between government debt and economic growth in advanced economies (Chudik et al. 2015; Eberhardt and Presbitero 2015; Woo and Kumar 2015). Reinhart and Rogoff (2010) share this view and, in particular, find that the relationship between economic growth and public debt becomes negative at a threshold of 90% of GDP. This view has sparked an intensive discussion in the empirical literature. Although the findings by Reinhart and Rogoff (2010) have been questioned on methodological grounds (Herndon et al. 2013), many econometric studies have followed the narrative by Reinhart and Rogoff (2010) to pinpoint the nature of the relationship between public debt and economic growth. So far, the outcome of this literature has been inconclusive (Panizza and Presbitero 2013 and 2014, Eberhardt and Presbitero 2015, Guex and Guex 2018).

Several studies corroborate the findings by Reinhart and Rogoff (2010) and provide evidence for a negative relation between government debt and economic growth at a certain threshold level (Baum et al., 2013; Dreger and Reimers 2013; Égert 2015; Salotti and Trecroci 2016; Lee et al. 2017). Égert (2015) reaches the conclusion that the evidence for a non-linear correlation is not robust and the results strongly depend on specific characteristics of the sample. Panizza and Presbitero (2014) do not find any evidence for a causal relationship in instrumental-variable regressions and Checherita-Westphal and Rother (2012) even find a positive impact of government debt on economic growth. Some studies provide evidence for a reversed-causality effect (Lof and Malinen 2014; Panizza and Presbitero 2014; Bell et al. 2015; Puente-Ajovín and Senso-Navarro 2015; Kempa and Khan 2016).

In this paper, we analyze the debt-growth nexus in a fixed-effects panel-growth regression framework, which is a standard workhorse of the relevant literature (Checherita-Westphal and Rother 2012; Salotti and Trecroci 2016). We contribute to the literature by applying a comprehensive dataset over the period from 1870 to 2016 (Jordà et al. 2017). Empirical studies on the relationship between government debt and economic growth focus their attention on post World War II (WWII) evidence. Though Reinhart et al. (2012) examine historical data since 1800, econometric studies usually rely on post-WW II samples and a relatively low number of observations. We extend the sample and additionally take into account the pre-World War II period. On the one hand, this might reduce the likelihood of potential reverse-causality, since counter-cyclical policies that increase debt in periods of economic slack became more popular after World War II. On the other hand, a large time dimension reduces the bias discussed in Nikkell (1981).

We do not find robust evidence for a systematic relationship between public debt and economic growth. This result suggests that public debt does not appear to be harmful to growth on average. While in our baseline specification we find some evidence for the 'conventional view', i.e. a potentially negative correlation between debt and growth, our sensitivity analysis shows that the baseline findings are highly sensitive to the inclusion of time fixed effects, country-specific trends and variations of the sample. We also do not find systematic evidence for an inverse U-shape relationship after allowing for a non-linear relation between public debt and economic growth. In the next section we present the dataset and the empirical strategy. Section three presents the empirical results and section four concludes.

2 Data and Empirical Strategy

For our panel regressions, with use the historical dataset of 17 OECD countries over the period from 1870 to 2016 by Jordà et al. (2017)[1] and apply the following fixed-effects panel regression approach:[2]

$$\Delta y_{i,t,t+j} = \alpha y_{i,t-1} + \beta b_{i,t-1} + \mu_i tr + \mu_i + \pi_t + e_{i,t} \quad (1)$$

where $\Delta y_{i,t,t+j}$ denotes five- and ten-year moving averages respectively of the first differences of real GDP per capita (in natural logs) between t and t+j (with j = 5, 10), $y_{i,t-1}$ is real GDP per capita (in country i and year t-1) (in natural logs). Coefficient α identifies the effect of economic convergence. The influence of public debt (b) in country *i* and year *t-1* on subsequent growth is captured by coefficient β. The variables $\mu_i tr$, μ_i and π_t respectively denote country-specific trends, country- and time fixed effects. Fixed effects capture unobserved heterogeneity across countries and over time. We include country-specific trends to account for unobserved cross-country time-varying heterogeneity, for example, growth rates of a country that tend to be high in the early stage of industrialization and fall over time. While time fixed effects capture shocks that are common across countries and hit them symmetrically such as global financial crises, oil price shocks or pandemics (e.g. COVID-19), country-specific trends take into account time-varying heterogeneity that affects countries asymmetrically.

We estimate a *baseline model* that includes the public-debt-to-GDP ratio and the level of the real GDP-per-capita. We include country fixed effects and estimate two variations of the regressions, firstly, with five-year, and secondly, with ten-year moving averages of the dependent variable. To deal with reversed causality, we follow Woo and Kumar (2015) and include all exogenous variables at the right-hand side of equation (1) with a lag of one year. We also examine a possible non-linear relationship between public debt and economic growth by including a quadratic term of the public-debt-to-GDP ratio. To make our results comparable to the literature that focuses on the post-WW II period, we run further regressions for the sub-sample periods from 1870 to 1939 (pre-WW II) and from 1946 to 2016 (post-WW II). Moreover, we carry out further robustness tests with additional controls and sample adjustments as shown in the Appendix.

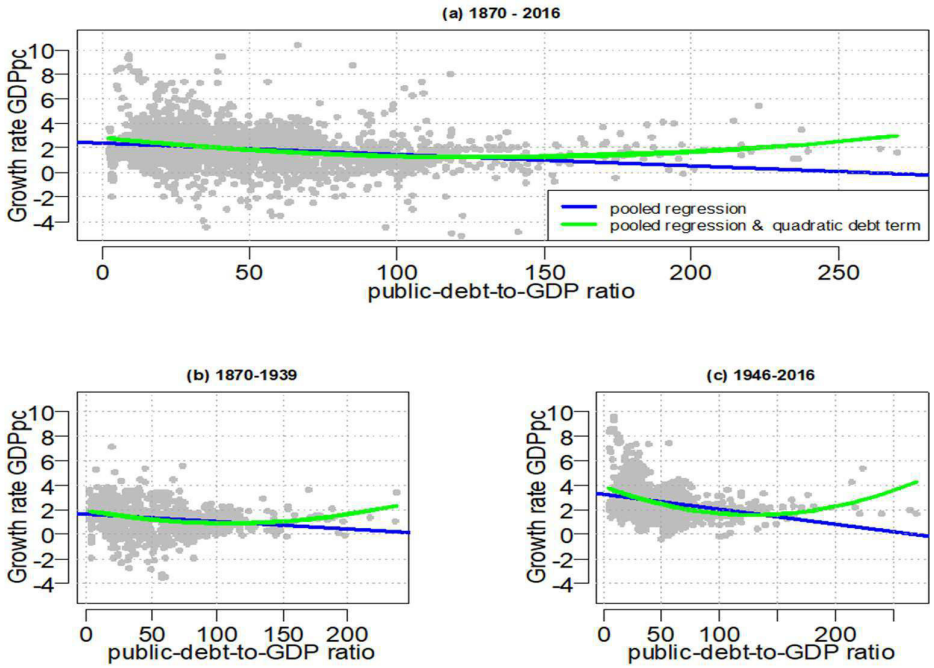
3 Results

A simple correlation analysis of the data seems to confirm the 'conventional view' and suggests that the correlation between economic growth and the public-debt-to-GDP ratio is negative (see Figure 1).

[1] The following countries are included in the sample: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

[2] For the summary statistics see Appendix, Table A.I.

Figure 1: Debt and growth - historical evidence



Notes: Scatter plots of the public-debt-to-GDP ratio lagged by 10 years and the growth rate of real GDP per capita as 10-year moving averages for different samples (as %); pooled linear regression (blue line) and pooled linear regression with quadratic term of the public-debt-to-GDP ratio (green line).
Source: Jordà et al. (2017), authors' calculations

The inclusion of country-fixed effects in our baseline model provides further support for the 'conventional view'. This bird's eyes view suggests a negative linear relationship between government debt and economic growth for the full sample with five-year growth averages and 10-year growth averages (see Table I, column (1) and (2)). However, the split into pre- and post-WW II samples reveals contradicting findings and shows that the results are sensitive to sample variations. While the coefficient of the public-debt-to-GDP ratio remains negative and statistically significant for the post-WW II sample, the coefficient turns out to be positive and statistically significant for the period before WW II. The quantitative interpretation of the coefficients suggests that an increase of the debt ratio by 10 percentage points of GDP would result in a reduction of 0.08 percentage points of per-capita GDP growth after WW II or an increase of 0.05 to 0.18 percentage points before WW II (see Table I, column (3), (4), (5) and (6)).

Table I: Debt and growth – baseline regressions

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	0.002	0.003*	-0.019**	-0.015***	-0.020***	-0.019***
	(0.002)	(0.001)	(0.008)	(0.003)	(0.003)	(0.003)
DEBT AS A RATIO TO GDP	-0.014**	-0.011***	0.018***	0.005**	-0.008**	-0.008***
	(0.007)	(0.004)	(0.005)	(0.002)	(0.003)	(0.003)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	No	No	No	No	No	No
COUNTRY SPECIFIC TRENDS	No	No	No	No	No	No
NO. OF OBSERVATIONS	2,186	2,101	980	895	1,051	966
NO. OF COUNTRIES	17	17	17	17	17	17
R^2 WITHIN	0.0306	0.0526	0.0608	0.0761	0.469	0.624

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA AND DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

To test the robustness of our baseline estimations, we include time-fixed effects (Table II).

Table II: Debt and growth – baseline regressions with time fixed effects

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.028***	-0.025***	-0.068***	-0.054***	-0.043***	-0.041***
	(0.007)	(0.006)	(0.016)	(0.009)	(0.004)	(0.004)
DEBT AS A RATIO TO GDP	-0.010**	-0.007***	-0.002	-0.003	-0.001	-0.000
	(0.005)	(0.003)	(0.005)	(0.002)	(0.002)	(0.002)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY SPECIFIC TRENDS	No	No	No	No	No	No
NO. OF OBSERVATIONS	2,186	2,101	980	895	1,051	966
NO. OF COUNTRIES	17	17	17	17	17	17
R^2 WITHIN	0.348	0.445	0.337	0.335	0.717	0.813

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA AND DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

After this change, our results differ substantially compared to the baseline specification. While the regression for the whole sample still provides evidence for a systematically negative correlation between public debt and economic growth, the evidence vanishes for the pre- and post-WW II samples. The coefficient of the public-debt-to-GDP ratio decreases substantially and loses statistical significance for both of the sub-samples. Thus, the negative or positive correlation of public debt with economic growth might reflect common shocks that influence all countries at the same time, however, in an asymmetric way. Examples are oil price shocks, exchange rate shocks, financial or international political crises. To better capture cross-country heterogeneity, we add country-specific trends (see Table III).

Table III: Debt and growth – baseline regressions with time fixed effects and country-specific trends

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.080***	-0.067***	-0.146***	-0.104***	-0.048***	-0.047***
	(0.011)	(0.010)	(0.017)	(0.009)	(0.008)	(0.007)
DEBT AS A RATIO TO GDP	-0.007	-0.003	-0.003	-0.002	0.011***	0.011***
	(0.005)	(0.003)	(0.005)	(0.001)	(0.003)	(0.002)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY SPECIFIC TRENDS	Yes	Yes	Yes	Yes	Yes	Yes
NO. OF OBSERVATIONS	2,186	2,101	980	895	1,051	966
NO. OF COUNTRIES	17	17	17	17	17	17
R^2 WITHIN	0.426	0.565	0.479	0.529	0.758	0.866

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA AND DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

Again, the results change substantially. The relationship between public debt and growth turns out to be statistically insignificant in the regressions for the full sample and remains insignificant for pre-WW II. In contrast, the regressions for the post-WW II sample indicate even a systematic positive relationship between public debt and growth. These results suggest that the relationship between public debt and economic growth appears to be neither sample-robust nor robust against standard controls.

Table IV: Debt and growth – nonlinear specification with time fixed effects

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.028***	-0.024***	-0.069***	-0.055***	-0.042***	-0.040***
	(0.012)	(0.010)	(0.016)	(0.008)	(0.008)	(0.007)
DEBT AS A RATIO TO GDP	-0.022***	-0.020***	-0.014	-0.012*	-0.008	-0.008*
	(0.006)	(0.005)	(0.015)	(0.007)	(0.006)	(0.004)
DEBT * DEBT	0.007**	0.007***	0.006	0.005*	0.003	0.004**
	(0.003)	(0.002)	(0.005)	(0.003)	(0.002)	(0.001)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY SPECIFIC TRENDS	No	No	No	No	No	No
NO. OF OBSERVATIONS	2,186	2,101	980	895	1,051	966
NO. OF COUNTRIES	17	17	17	17	17	17
R^2 WITHIN	0.351	0.453	0.339	0.338	0.719	0.817

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA, DEBT AS A RATIO TO GDP, AS WELL AS DEBT AS A RATIO TO GDP* DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

Table V: Debt and growth – nonlinear specification with time fixed effects and country specific trends

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.079***	-0.066***	-0.149***	-0.106***	-0.048***	-0.048***
	(0.012)	(0.010)	(0.016)	(0.008)	(0.008)	(0.007)
DEBT AS A RATIO TO GDP	-0.014	-0.011*	-0.030*	-0.020***	0.011*	0.007
	(0.009)	(0.006)	(0.016)	(0.005)	(0.006)	(0.005)
DEBT * DEBT	0.003	0.004*	0.013**	0.009***	0.000	0.002
	(0.003)	(0.002)	(0.006)	(0.002)	(0.002)	(0.002)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY SPECIFIC TRENDS	Yes	Yes	Yes	Yes	Yes	Yes
NO. OF OBSERVATIONS	2,186	2,101	980	895	1,051	966
NO. OF COUNTRIES	17	17	17	17	17	17
R^2 WITHIN	0.427	0.567	0.485	0.538	0.758	0.867

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA, DEBT AS A RATIO TO GDP, AS WELL AS DEBT AS A RATIO TO GDP* DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

Table IV and V take into account a non-linear relationship between debt and growth. With or without controlling for country-specific trends, these findings do not suggest a systematic non-linear relationship. The quadratic term turns out to be statistically significant and positive for the full sample with 10-year moving averages as well as the pre-WW II sample. However, this indicates a U-shaped relationship, which is contrary to the hypotheses in the literature that predicts an inverse U-shaped relationship (e.g. Lee et al., 2017). For the post-WW II period, we do not find a statistically significant non-linear relationship. These results suggest that the non-linear relationship is relatively loose.

Overall, our analysis provides no evidence for a systematic negative or non-linear relationship between public debt and economic growth. These findings hold if further controls are included and after sample adjustments as excluding the Great Financial Crisis (after 2007) or the period of large war-related debt-build-ups between 1914-1950 (see Appendix). Further robustness tests with non-overlapping windows corroborate the results (available upon request).

4 Conclusion

Our results do not provide support for a systematic statistically significant and robust relationship between government debt and growth in the long run (five or 10-year windows). While our baseline regressions do support the 'conventional view' that government debt might be negatively associated with economic growth, this relationship loses statistical significance and even turns into the opposite if tests for robustness are carried out, such as including time-fixed effects and country-specific trends.

We additionally analyze a potentially non-linear relationship between public debt and growth and include a quadratic term of the public-debt-to GDP ratio. These results do not provide evidence for a systematic and robust inverse U-shape relationship. We thus recommend that policymakers treat the literature on the systematic debt-growth nexus with great caution.

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APPENDIX

Table A.I: Descriptive Statistics

Variable	(1) Observations	(2) Mean	(3) Std. Dev.	(4) Min	(5) Max	(6) 25 Pctl	(7) 75pctl
Av. GDP growth 5 years	2,363	0.018	0.028	-0.244	0.161	0.007	0.030
Av. GDP growth 10 years	2,278	0.018	0.019	-0.061	0.103	0.009	0.028
Government debt as a ratio to GDP	2,271	0.528	0.387	0.019	2.698	0,238	0.688
Log GDP per capita	2,448	3.226	0.888	1.183	4.730	2.538	4.078
Investment ratio	2,228	0.185	0.064	0.017	0.389	0.137	0.226
Real interest rate	2,397	5.562	3.018	-5.996	23.729	3.661	6.373
Openness	2,358	0.424	0.329	0.013	2.974	0.247	0.505
Population growth	2,431	0.008	0.010	-0.252	0.265	0.005	0.012

Results with additional control variables

Table A.II: Debt and growth – baseline regressions

predictors	(1) full sample 5 years	(2) full sample 10 years	(3) pre-1939 5 years	(4) pre-1939 10 years	(5) post-1946 5 years	(6) post-1946 10 years
Log GDP per capita	-0.002	-0.001	-0.017	-0.015***	-0.022***	-0.022***
	(0.002)	(0.002)	(0.010)	(0.004)	(0.003)	(0.002)
Investment ratio	0.053	0.041	-0.081	-0.006	-0.052	-0.034
	(0.038)	(0.037)	(0.051)	(0.024)	(0.032)	(0.021)
Real interest rate	0.001	0.000	0.001	-0.000	0.000	0.000
	(0.001)	(0.000)	(0.002)	(0.001)	(0.000)	(0.000)
Openness	-0.011*	-0.007	-0.011*	-0.001	0.002	0.008*
	(0.006)	(0.005)	(0.006)	(0.002)	(0.007)	(0.004)
Population growth	-0.110	-0.164	-0.001	-0.338***	-0.087*	-0.045
	(0.076)	(0.109)	(0.145)	(0.083)	(0.047)	(0.039)
Debt as a ratio to GDP	-0.007	-0.009***	0.017***	0.007***	-0.010***	-0.009***
	(0.004)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	No	No
Country specific trends	No	No	No	No	No	No
No. of observations	1,981	1,896	825	750	1,035	950
No. of countries	17	17	16	16	17	17
R^2 within	0.0464	0.0663	0.101	0.127	0.508	0.667

Notes: dependent variable: real GDP per capita growth rate (over 5 or 10 years). Explanatory variables are (log) GDP per capita, investment as a ratio to GDP, real interest rate, degree of openness, population growth (percentage points), and debt as a ratio to GDP. Driscoll and Kraay (1998) Standard errors in parentheses.*, **, and ***indicate significance at the 10, 5, and 1% level.

Table A.III: Debt and growth – baseline regressions with time fixed effects

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.025***	-0.025***	-0.061***	-0.047***	-0.040***	-0.040***
	(0.005)	(0.005)	(0.016)	(0.009)	(0.004)	(0.004)
INVESTMENT RATIO	-0.063**	-0.059*	-0.075**	-0.011	-0.040*	-0.025*
	(0.026)	(0.034)	(0.035)	(0.030)	(0.022)	(0.013)
REAL INTEREST RATE	-0.000	-0.000	0.001	0.000	0.000*	0.001***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
OPENNESS	0.004	0.006*	-0.008*	-0.002	0.008	0.008***
	(0.005)	(0.003)	(0.004)	(0.002)	(0.005)	(0.003)
POPULATION GROWTH	-0.148*	-0.191*	0.068	-0.187**	-0.063	-0.047*
	(0.089)	(0.112)	(0.202)	(0.089)	(0.038)	(0.026)
DEBT AS A RATIO TO GDP	-0.008**	-0.008***	-0.000	-0.000	-0.005*	-0.003*
	(0.004)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY SPECIFIC TRENDS	No	No	No	No	No	No
NO. OF OBSERVATIONS	1,981	1,896	825	750	1,035	950
NO. OF COUNTRIES	17	17	16	16	17	17
R^2 WITHIN	0.385	0.483	0.365	0.310	0.741	0.842

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA, INVESTMENT AS A RATIO TO GDP, REAL INTEREST RATE, DEGREE OF OPENNESS, POPULATION GROWTH (PERCENTAGE POINTS), AND DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

Table A.IV: Debt and growth – baseline regressions with time fixed effects and country-specific trends

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.068***	-0.064***	-0.154***	-0.104***	-0.048***	-0.052***
	(0.009)	(0.009)	(0.021)	(0.011)	(0.008)	(0.008)
INVESTMENT RATIO	-0.060*	-0.062*	-0.022	-0.002	-0.007	0.025*
	(0.031)	(0.037)	(0.042)	(0.021)	(0.024)	(0.014)
REAL INTEREST RATE	0.000	0.000	0.001	0.001	0.000	0.000***
	(0.000)	(0.000)	(0.002)	(0.001)	(0.000)	(0.000)
OPENNESS	-0.003	0.002	-0.018***	-0.008***	0.027***	0.028***
	(0.007)	(0.004)	(0.005)	(0.002)	(0.008)	(0.004)
POPULATION GROWTH	-0.107	-0.142	0.204	-0.071	-0.050	-0.041
	(0.083)	(0.102)	(0.155)	(0.072)	(0.037)	(0.025)
DEBT AS A RATIO TO GDP	-0.006	-0.004*	-0.000	-0.001	0.008**	0.010***
	(0.004)	(0.003)	(0.005)	(0.001)	(0.004)	(0.002)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY SPECIFIC TRENDS	Yes	Yes	Yes	Yes	Yes	Yes
NO. OF OBSERVATIONS	1,981	1,896	825	750	1,035	950
NO. OF COUNTRIES	17	17	16	16	17	17
R^2 WITHIN	0.454	0.594	0.514	0.541	0.772	0.884

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA, INVESTMENT AS A RATIO TO GDP, REAL INTEREST RATE, DEGREE OF OPENNESS, POPULATION GROWTH (PERCENTAGE POINTS), AND DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

Table A.V: Debt and growth – Nonlinear specification with time fixed effects

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.024***	-0.02463***	-0.060***	-0.047***	-0.039***	-0.039***
	(0.005)	(0.005)	(0.016)	(0.009)	(0.005)	(0.004)
INVESTMENT RATIO	-0.071***	-0.067*	-0.080**	-0.014	-0.041*	0.025*
	(0.027)	(0.035)	(0.033)	(0.029)	(0.022)	(0.013)
REAL INTEREST RATE	-0.000	-0.000	0.001	0.000	0.000*	0.001***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
OPENNESS	0.004	0.006*	-0.008*	-0.002	0.008*	0.008***
	(0.005)	(0.003)	(0.004)	(0.003)	(0.005)	(0.003)
POPULATION GROWTH	-0.152*	-0.197*	0.053	-0.199*	-0.062*	-0.046*
	(0.090)	(0.116)	(0.194)	(0.076)	(0.037)	(0.026)
DEBT AS A RATIO TO GDP	-0.024***	-0.024***	-0.010	-0.009	-0.012**	-0.010***
	(0.006)	(0.005)	(0.010)	(0.007)	(0.005)	(0.004)
DEBT * DEBT	0.009***	0.009***	0.005	0.004	0.004*	0.004***
	(0.003)	(0.003)	(0.004)	(0.003)	(0.002)	(0.001)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY SPECIFIC TRENDS	No	No	No	No	No	No
NO. OF OBSERVATIONS	1,981	1,896	825	750	1,035	950
NO. OF COUNTRIES	17	17	16	16	17	17
R^2 WITHIN	0.391	0.494	0.366	0.313	0.743	0.845

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA, INVESTMENT AS A RATIO TO GDP, REAL INTEREST RATE, DEGREE OF OPENNESS, POPULATION GROWTH (PERCENTAGE POINTS), DEBT AS A RATIO TO GDP, AS WELL AS DEBT AS A RATIO TO GDP* DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

Table A.VI: Debt and growth – Nonlinear specification with time fixed effects and country specific trends

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.068***	-0.063***	-0.156***	-0.105***	-0.048***	-0.054***
	(0.009)	(0.008)	(0.021)	(0.011)	(0.008)	(0.008)
INVESTMENT RATIO	-0.064**	-0.067*	-0.030	-0.013	-0.007	0.026*
	(0.031)	(0.038)	(0.041)	(0.021)	(0.024)	(0.014)
REAL INTEREST RATE	0.000	0.000	0.001	0.000	0.000	0.000***
	(0.000)	(0.000)	(0.002)	(0.001)	(0.000)	(0.000)
OPENNESS	-0.003	0.002	-0.019***	-0.009***	0.027***	0.030***
	(0.007)	(0.004)	(0.005)	(0.003)	(0.008)	(0.004)
POPULATION GROWTH	-0.111	-0.146	0.154	-0.111*	-0.050	-0.041
	(0.083)	(0.104)	(0.139)	(0.058)	(0.037)	(0.025)
DEBT AS A RATIO TO GDP	-0.017*	-0.017***	-0.028	-0.028***	0.007	0.003
	(0.009)	(0.006)	(0.019)	(0.006)	(0.007)	(0.005)
DEBT * DEBT	0.005*	0.006**	0.014*	0.013***	0.001	0.003*
	(0.003)	(0.003)	(0.007)	(0.002)	(0.002)	(0.002)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY SPECIFIC TRENDS	Yes	Yes	Yes	Yes	Yes	Yes
NO. OF OBSERVATIONS	1,981	1,896	825	750	1,035	950
NO. OF COUNTRIES	17	17	16	16	17	17
R^2 WITHIN	0.456	0.598	0.520	0.561	0.772	0.886

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA, INVESTMENT AS A RATIO TO GDP, REAL INTEREST RATE, DEGREE OF OPENNESS, POPULATION GROWTH (PERCENTAGE POINTS), DEBT AS A RATIO TO GDP, AS WELL AS DEBT AS A RATIO TO GDP* DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

Table AVII: Further controls – time fixed effects and country-specific trends, excluding the GFC (table 3)

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.082***	-0.069***	-0.146***	-0.104***	-0.080***	-0.067***
	(0.012)	(0.011)	(0.017)	(0.009)	(0.011)	(0.010)
DEBT AS A RATIO TO GDP	-0.006	-0.002	-0.003	-0.002	-0.007	-0.003
	(0.006)	(0.003)	(0.005)	(0.001)	(0.005)	(0.003)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY SPECIFIC TRENDS	Yes	Yes	Yes	Yes	Yes	Yes
NO. OF OBSERVATIONS	2,186	2,101	980	895	1,051	966
NO. OF COUNTRIES	17	17	17	17	17	17
R^2 WITHIN	0.417	0.561	0.479	0.529	0.426	0.565

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA AND DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

Results without war period 1914-1950

Table B. I: Debt and growth – baseline regressions

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.002	0.002*	-0.003	-0.007	-0.023***	-0.023***
	(0.002)	(0.002)	(0.010)	(0.004)	(0.003)	(0.002)
DEBT AS A RATIO TO GDP	-0.019***	-0.018***	0.007	0.010**	-0.007	-0.005
	(0.004)	(0.003)	(0.006)	(0.005)	(0.005)	(0.004)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	No	No	No	No	No	No
COUNTRY SPECIFIC TRENDS	No	No	No	No	No	No
NO. OF OBSERVATIONS	1,546	1,381	568	488	978	893
NO. OF COUNTRIES	17	17	16	16	17	17
R^2 WITHIN	0.098	0.133	0.005	0.027	0.481	0.674

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA, INVESTMENT AS A RATIO TO GDP, REAL INTEREST RATE, DEGREE OF OPENNESS, POPULATION GROWTH (PERCENTAGE POINTS), AND DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

Table B.II: Debt and growth – baseline regressions with time fixed effects

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.011***	-0.012***	-0.063***	-0.057***	-0.047***	-0.047***
	(0.003)	(0.003)	(0.016)	(0.013)	(0.006)	(0.004)
DEBT AS A RATIO TO GDP	-0.013**	-0.012***	-0.009	-0.004	-0.004	-0.003
	(0.002)	(0.002)	(0.006)	(0.003)	(0.003)	(0.002)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY SPECIFIC TRENDS	No	No	No	No	No	No
NO. OF OBSERVATIONS	1,546	1,381	568	488	978	893
NO. OF COUNTRIES	17	17	16	16	17	17
R^2 WITHIN	0.554	0.661	0.230	0.320	0.733	0.844

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA, INVESTMENT AS A RATIO TO GDP, REAL INTEREST RATE, DEGREE OF OPENNESS, POPULATION GROWTH (PERCENTAGE POINTS), AND DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

Table B.III: Debt and growth – baseline regressions with time fixed effects and country-specific trends

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.060***	-0.058***	-0.184***	-0.126***	-0.058***	-0.058***
	(0.006)	(0.004)	(0.016)	(0.008)	(0.011)	(0.007)
DEBT AS A RATIO TO GDP	-0.011***	-0.009***	-0.014**	-0.003	0.008**	0.009***
	(0.003)	(0.002)	(0.006)	(0.003)	(0.004)	(0.002)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY SPECIFIC TRENDS	Yes	Yes	Yes	Yes	Yes	Yes
NO. OF OBSERVATIONS	1,546	1,381	568	488	978	893
NO. OF COUNTRIES	17	17	16	16	17	17
R^2 WITHIN	0.666	0.817	0.565	0.722	0.771	0.892

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA, INVESTMENT AS A RATIO TO GDP, REAL INTEREST RATE, DEGREE OF OPENNESS, POPULATION GROWTH (PERCENTAGE POINTS), AND DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

Table B.IV: Debt and growth – Nonlinear specification with time fixed effects

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.011***	-0.012***	-0.064***	-0.058***	-0.047***	-0.047***
	(0.003)	(0.003)	(0.017)	(0.014)	(0.007)	(0.004)
DEBT AS A RATIO TO GDP	-0.027***	-0.025***	-0.019	-0.007	-0.006**	-0.004***
	(0.005)	(0.005)	(0.019)	(0.011)	(0.008)	(0.005)
DEBT * DEBT	0.010***	0.009***	0.007	0.002	0.001*	0.000
	(0.003)	(0.002)	(0.011)	(0.006)	(0.004)	(0.002)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY SPECIFIC TRENDS	No	No	No	No	No	No
NO. OF OBSERVATIONS	1,546	1,381	568	488	978	893
NO. OF COUNTRIES	17	17	16	16	17	17
R^2 WITHIN	0.561	0.667	0.232	0.321	0.733	0.844

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA, INVESTMENT AS A RATIO TO GDP, REAL INTEREST RATE, DEGREE OF OPENNESS, POPULATION GROWTH (PERCENTAGE POINTS), DEBT AS A RATIO TO GDP, AS WELL AS DEBT AS A RATIO TO GDP* DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

Table B.V: Debt and growth – Nonlinear specification with time fixed effects and country specific trends

PREDICTORS	(1) FULL SAMPLE 5 YEARS	(2) FULL SAMPLE 10 YEARS	(3) PRE-1939 5 YEARS	(4) PRE-1939 10 YEARS	(5) POST-1946 5 YEARS	(6) POST-1946 10 YEARS
LOG GDP PER CAPITA	-0.060***	-0.058***	-0.191***	-0.129***	-0.059***	-0.058***
	(0.007)	(0.005)	(0.016)	(0.008)	(0.011)	(0.007)
DEBT AS A RATIO TO GDP	-0.014**	-0.010**	-0.050***	-0.018	0.016*	0.015**
	(0.007)	(0.004)	(0.017)	(0.016)	(0.009)	(0.007)
DEBT * DEBT	0.002	0.001	0.021**	0.008	-0.004	-0.004
	(0.003)	(0.002)	(0.009)	(0.007)	(0.004)	(0.003)
COUNTRY FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
TIME FIXED EFFECTS	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY SPECIFIC TRENDS	Yes	Yes	Yes	Yes	Yes	Yes
NO. OF OBSERVATIONS	1,546	1,381	568	488	978	893
NO. OF COUNTRIES	17	17	16	16	17	17
R^2 WITHIN	0.666	0.817	0.571	0.723	0.772	0.893

NOTES: DEPENDENT VARIABLE: REAL GDP PER CAPITA GROWTH RATE (OVER 5 OR 10 YEARS). EXPLANATORY VARIABLES ARE (LOG) GDP PER CAPITA, INVESTMENT AS A RATIO TO GDP, REAL INTEREST RATE, DEGREE OF OPENNESS, POPULATION GROWTH (PERCENTAGE POINTS), DEBT AS A RATIO TO GDP, AS WELL AS DEBT AS A RATIO TO GDP* DEBT AS A RATIO TO GDP. DRISCOLL AND KRAAY (1998) STANDARD ERRORS IN PARENTHESES.*, **, AND ***INDICATE SIGNIFICANCE AT THE 10, 5, AND 1% LEVEL.

Table C.I: Descriptive Statistics Pre-1939

Variable	(1) Observations	(2) Mean	(3) Std. Dev.	(4) Min	(5) Max	(6) 25 Pctl	(7) 75 pctl
Av. GDP growth 5 years	1,173	0.012	0.026	-0.130	0.160	0.002	0.024
Av. GDP growth 10 years	1,173	0.012	0.018	-0.061	0.103	0.005	0.020
Government debt as a ratio to GDP	1,045	0.519	0.396	0.019	2.370	0,206	0. 732
Log GDP per capita	1,173	2.492	0.446	1.183	3.511	2.180	2.832
Investment ratio	1,006	0.140	0.047	0.017	0.358	0.107	0.169
Real interest rate	1,136	4.678	2.084	1.945	23.729	3.573	5.056
Openness	1,118	0.411	0.386	0.050	2.974	0.230	0. 475
Population growth	1,156	0.010	0.008	-0.059	0.050	0.006	0.013

Table C.II: Descriptive Statistics Post-1945

Variable	(1) Observations	(2) Mean	(3) Std. Dev.	(4) Min	(5) Max	(6) 25 Pctl	(7) 75pctl
Av. GDP growth 5 years	1,054	0.025	0.018	-0.020	0.161	0.014	0.034
Av. GDP growth 10 years	969	0.026	0.014	-0.008	0.103	0.017	0.032
Government debt as a ratio to GDP	1,122	0.514	0.357	0.043	2.698	0,277	0.655
Log GDP per capita	1,139	4.014	0.534	1.952	4.730	3.603	4.467
Investment ratio	1,128	0.229	0.044	0.091	0.389	0.199	0.253
Real interest rate	1,137	6.666	3.495	0.567	21.215	4.169	8.539
Openness	1,135	0.457	0.267	0.022	1.836	0.287	0.543
Population growth	1,139	0.008	0.010	-0.017	0.265	0.003	0.010