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DEBT AND GROWTH:

HISTORICAL EVIDENCE

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Abstract (81 words)

In this paper we examine the relationship between public debt and economic growth in a large historical panel dataset of 17 OECD economics over the period 1870 - 2016.

We do not provide evidence for a statistically significant and robust relationship between government debt and growth. While our baseline regressions support the 'conventional view' that government debt is negatively associated with economic growth, particularly in the aftermath of World War II, these results appear to be not robust to alternative specifications.

Keywords: Government Debt, Economic Growth, Robustness

JEL Classification: E62, H56, H63

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Highlights

- We study the debt-growth nexus in a large historical panel dataset over the period 1870 to 2016.
- We show that government debt is not negatively associated with growth.
- Our results do not provide any robust evidence for a relationship between public debt and growth.

1 Introduction

Several recent empirical studies support the 'conventional view' of public debt (Elmendorff and Mankiw, 1999) and find a negative relationship between government debt and economic growth (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 of Reinhart and Rogoff 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 support 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. A few studies provide evidence for a reversed-causality effect (Lof and Malinen, 2014; Panizza and Presbitero, 2014; Bell et al., 2015).

In this paper, we analyze the debt-growth nexus in a fixed-effects panel growth regression framework and in a historical perspective. 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 do not find robust evidence for a systematic relationship between public debt and economic growth. This result suggests that public debt is not harmful for 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 the panel regressions with the historical dataset of 17 OECD countries over the period 1870 - 2016 by Jordà, Schularick, and Taylor (2017) we use the following fixed-effects approach:

$$\Delta y_{it,t+j} = \alpha y_{it} + \beta b_{it} + tr_i + \mu_i + \pi_t + e_{it}$$

where $\Delta y_{it,t+j}$ denotes annual averages of the first differences of real GDP per capita (in natural logs) between t and t+j (with j = 5, 10), y_{it} is real GDP per capita (in country i and year t) (in natural logs). Coefficient α captures the convergence effect. The influence of

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public debt (b) in country i and year t on subsequent growth is captured by coefficient β. The variables tr_i, 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. As a test for robustness we include country-specific trends that adds to taking account of unobserved heterogeneity.

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. The controls are lagged by one year before the estimation window begins. To control for the robustness of our results, we add time-fixed effects and country-specific trends. We also examine a possible non-linear relationship between public debt and economic growth and include 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 1946 to 2016 (post-WW II). Moreover, we carry out further robustness tests with additional controls and non-overlapping windows as shown in the Appendices I – III.

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).

*** Include Figure 1 about here ***

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 0.05-0.18 percentage points before WW II (see Table I, column (3), (4),(5) and (6)).

*** Include Table I about here ***

To test the robustness of our baseline estimations, we include time-fixed effects (Table II). After this change, our results differ substantially compared to the baseline specification.

*** Insert Table II about here ***

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, indicating that the negative or positive correlation of public debt with economic growth might reflect common shocks that influence all countries at the same time. Examples can be oil price, financial or international political crises that affect the countries of our sample asymmetrically. To control for unobserved cross country heterogeneity, we add country-specific trends (see Table III).

*** Insert Table III about here ***

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.

*** Insert Table IV about here ***

Table IV shows the results after a non-linear relationship between debt and growth is taken into account. 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 as well as the pre-WW II sample, which indicates a U-shaped relationship. This is contrary to the hypotheses in the literature (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 might be relatively loose.

Overall, our analysis provides no evidence for a systematic negative or non-linear relationship between public debt and economic growth. We carry out further robustness tests by including additional controls and non-overlapping windows. These regression results confirm our findings (see Appendix I-III).

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 debt and growth and include a quadratic term of the 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 caution.

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TABLES

TABLE I
DEBT AND GROWTH – BASELINE WITHOUT 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	0.002	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
R² 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.

TABLE II
DEBT AND GROWTH – BASELINE WITH TIME FIXED EFFECTS AND WITHOUT 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	-0.028***	-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
R² 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.

TABLE III
DEBT AND GROWTH – BASELINE 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
R² 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.

TABLE IV
DEBT AND GROWTH – NONLINEAR 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
R² 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.

FIGURES

(a) 1870 - 2016

(b) 1870-1939

(c) 1946-2016

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

APPENDIX I: RESULTS WITH CONTROLS

TABLE I
DEBT AND GROWTH – BASELINE CONCLUDING CONTROLS WITHOUT 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	-0.002	-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
R² 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.
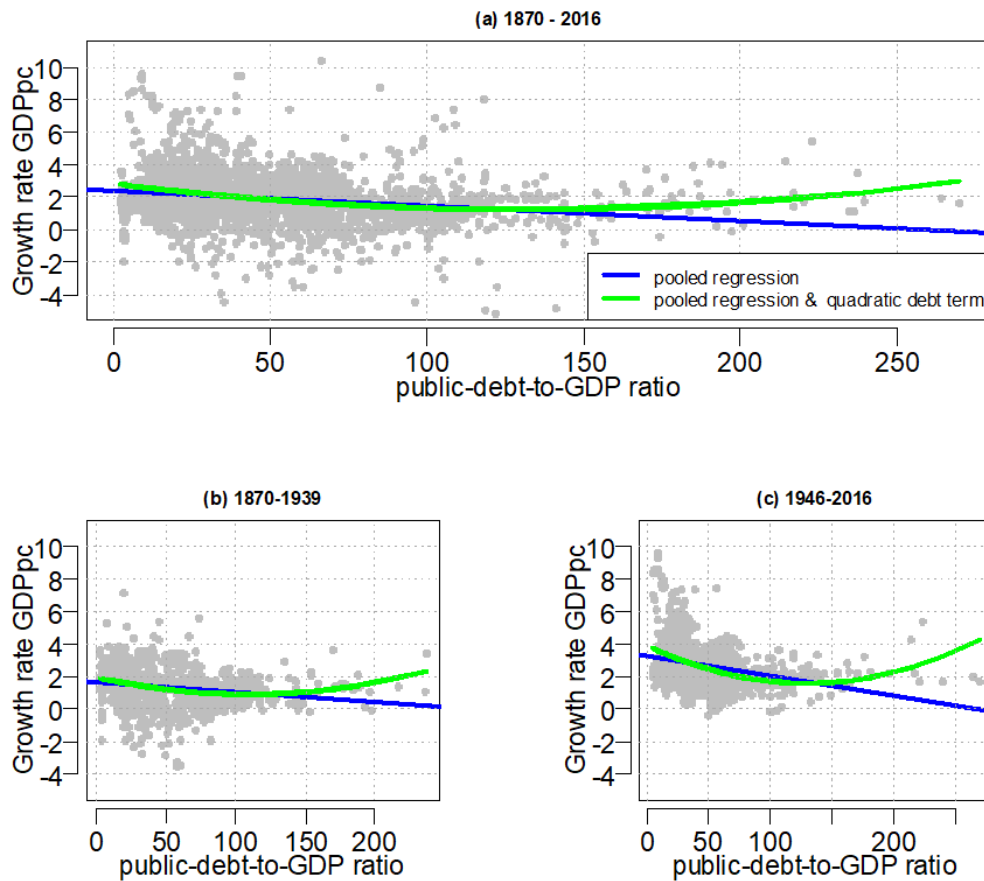
TABLE II
DEBT AND GROWTH – BASELINE WITH TIME FIXED EFFECTS AND WITHOUT COUNTRY SPECIFIC TRENDS

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	-0.025***	-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
R² 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.

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
R² 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.

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
R² 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.

APPENDIX II: NON-OVERLAPPING WITHOUT CONTROLS

TABLE I
DEBT AND GROWTH – BASELINE WITHOUT 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	0.003	0.002	-0.014**	-0.005	-0.021***	-0.021***
	(0.002)	(0.003)	(0.006)	(0.008)	(0.003)	(0.003)
DEBT AS A RATIO TO GDP	-0.012*	-0.014**	0.014**	0.010	-0.008	-0.013***
	(0.007)	(0.006)	(0.006)	(0.005)	(0.005)	(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	438	219	195	89	202	100
NO. OF COUNTRIES	17	17	17	17	17	17
R² WITHIN	0.0317	0.0649	0.0485	0.0438	0.497	0.702

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.

TABLE II
D DEBT AND GROWTH – BASELINE WITH TIME FIXED EFFECTS AND WITHOUT 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	-0.025*	-0.023*	-0.047***	-0.045***	-0.043***	-0.042***
	(0.012)	(0.012)	(0.011)	(0.007)	(0.007)	(0.004)
DEBT AS A RATIO TO GDP	-0.008	-0.009*	0.001	-0.001	-0.002	-0.002
	(0.005)	(0.004)	(0.003)	(0.003)	(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	No	No	No	No	No	No
NO. OF OBSERVATIONS	438	219	195	89	202	100
NO. OF COUNTRIES	17	17	17	17	17	17
R² WITHIN	0.343	0.498	0.278	0.413	0.710	0.831

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.

TABLE III
DEBT AND GROWTH – BASELINE 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	-0.075***	-0.065***	-0.113***	-0.110***	-0.055***	-0.053***
	(0.015)	(0.013)	(0.022)	(0.006)	(0.010)	(0.010)
DEBT AS A RATIO TO GDP	-0.004	-0.004	0.006	0.003	0.010**	0.008**
	(0.004)	(0.003)	(0.006)	(0.002)	(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	438	219	195	89	202	100
NO. OF COUNTRIES	17	17	17	17	17	17
R² WITHIN	0.430	0.625	0.420	0.744	0.763	0.883

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.

TABLE IV
DEBT AND GROWTH – NONLINEAR 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	-0.075***	-0.064***	-0.121***	-0.117***	-0.055***	-0.055***
	(0.015)	(0.013)	(0.019)	(0.009)	(0.010)	(0.012)
DEBT AS A RATIO TO GDP	-0.012	-0.022**	-0.029	-0.010	0.013	-0.003
	(0.010)	(0.008)	(0.016)	(0.010)	(0.013)	(0.019)
DEBT * DEBT	0.004	0.010**	0.019**	0.007	-0.001	0.005
	(0.004)	(0.004)	(0.007)	(0.006)	(0.006)	(0.007)
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	438	219	195	89	202	100
NO. OF COUNTRIES	17	17	17	17	17	17
R² WITHIN	0.431	0.634	0.431	0.747	0.763	0.885

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.

APPENDIX III: NON-OVERLAPPING WITH CONTROLS

TABLE I
DEBT AND GROWTH – BASELINE CONCLUDING CONTROLS WITHOUT 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	-0.002	-0.003	-0.015*	-0.010	-0.026***	-0.027***
	(0.003)	(0.003)	(0.008)	(0.010)	(0.003)	(0.002)
INVESTMENT RATIO	0.056	0.057	-0.009	0.053*	-0.054	-0.026
	(0.045)	(0.051)	(0.042)	(0.022)	(0.054)	(0.022)
REAL INTEREST RATE	0.001	0.001	0.000	-0.001*	0.000	0.000
	(0.001)	(0.001)	(0.002)	(0.001)	(0.000)	(0.000)
OPENNESS	-0.010	-0.010	0.000	0.002	0.012**	0.011*
	(0.007)	(0.007)	(0.005)	(0.002)	(0.005)	(0.005)
POPULATION GROWTH	-0.062	-0.099	-0.114	-0.600**	-0.367***	-0.391***
	(0.184)	(0.345)	(0.234)	(0.191)	(0.087)	(0.085)
DEBT AS A RATIO TO GDP	-0.007	-0.009*	0.018**	0.016***	-0.010**	-0.012***
	(0.006)	(0.005)	(0.006)	(0.003)	(0.004)	(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	391	191	158	68	201	99
NO. OF COUNTRIES	17	17	16	16	17	17
R² WITHIN	0.0521	0.100	0.0830	0.205	0.539	0.759

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 II
DEBT AND GROWTH – BASELINE WITH TIME FIXED EFFECTS AND WITHOUT 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	-0.024***	-0.022**	-0.052***	-0.039**	-0.040***	-0.041***
	(0.008)	(0.009)	(0.014)	(0.011)	(0.008)	(0.004)
INVESTMENT RATIO	-0.039	-0.046	-0.026	0.043	-0.038	-0.028
	(0.032)	(0.035)	(0.039)	(0.023)	(0.036)	(0.021)
REAL INTEREST RATE	0.000	0.000	0.000	-0.001	0.000	0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
OPENNESS	0.005	0.004**	-0.003	0.000	0.013**	0.010***
	(0.003)	(0.002)	(0.004)	(0.001)	(0.005)	(0.002)
POPULATION GROWTH	-0.278	-0.566**	0.094	-0.359	-0.251**	-0.197**
	(0.191)	(0.206)	(0.329)	(0.186)	(0.107)	(0.075)
DEBT AS A RATIO TO GDP	-0.008	-0.011*	0.007	0.006	-0.006	-0.005
	(0.006)	(0.005)	(0.004)	(0.003)	(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	No	No	No	No	No	No
NO. OF OBSERVATIONS	391	191	158	68	201	99
NO. OF COUNTRIES	17	17	16	16	17	17
R² WITHIN	0.370	0.564	0.279	0.447	0.733	0.857

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 III
DEBT AND GROWTH – BASELINE 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	-0.071***	-0.064***	-0.124***	-0.108***	-0.059***	-0.065**
	(0.011)	(0.015)	(0.034)	(0.010)	(0.012)	(0.017)
INVESTMENT RATIO	-0.037	-0.036	-0.037	0.072***	0.013	0.052
	(0.041)	(0.038)	(0.054)	(0.010)	(0.043)	(0.050)
REAL INTEREST RATE	0.000	0.001	0.002*	0.000	-0.000	0.000
	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
OPENNESS	-0.003	0.001	-0.014**	0.006	0.036***	0.038**
	(0.005)	(0.003)	(0.005)	(0.006)	(0.006)	(0.013)
POPULATION GROWTH	-0.229	-0.509**	0.336	-0.558*	-0.152	-0.148*
	(0.209)	(0.215)	(0.368)	(0.225)	(0.109)	(0.059)
DEBT AS A RATIO TO GDP	-0.005	-0.006	0.010	0.007	0.008**	0.008***
	(0.006)	(0.005)	(0.007)	(0.006)	(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	391	191	158	68	201	99
NO. OF COUNTRIES	17	17	16	16	17	17
R² WITHIN	0.458	0.683	0.450	0.770	0.776	0.903

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 IV
DEBT AND GROWTH – NONLINEAR 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	-0.070***	-0.063***	-0.130***	-0.119***	-0.059***	-0.067**
	(0.011)	(0.015)	(0.036)	(0.017)	(0.013)	(0.020)
INVESTMENT RATIO	-0.039	-0.039	-0.046	0.070***	0.012	0.054
	(0.041)	(0.039)	(0.054)	(0.008)	(0.045)	(0.051)
REAL INTEREST RATE	0.000	0.001	0.001	-0.000	-0.000	0.000
	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
OPENNESS	-0.003	0.001	-0.015**	0.002	0.036***	0.040**
	(0.005)	(0.003)	(0.005)	(0.008)	(0.006)	(0.013)
POPULATION GROWTH	-0.228	-0.481*	0.335	-0.572**	-0.155	-0.121
	(0.207)	(0.228)	(0.360)	(0.206)	(0.104)	(0.085)
DEBT AS A RATIO TO GDP	-0.009	-0.020**	-0.019	-0.012	0.011	-0.003
	(0.011)	(0.009)	(0.021)	(0.008)	(0.010)	(0.016)
DEBT * DEBT	0.002	0.007*	0.015	0.010	-0.001	0.005
	(0.004)	(0.004)	(0.010)	(0.006)	(0.005)	(0.006)
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	391	191	158	68	201	99
NO. OF COUNTRIES	17	17	16	16	17	17
R² WITHIN	0.459	0.688	0.457	0.776	0.776	0.906

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.

APPENDIX 4: SUMMARY STATISTICS

TABLE V
DESCRIPTIVE STATISTICS

VARIABLE	(1) OBSERVATIONS	(2) MEAN	(3) STD. DEV.	(4) MIN	(5) MAX
AV. GDP GROWTH 5 YEARS	2363	0.018	0.028	-0.244	0.161
AV. GDP GROWTH 10 YEARS	2278	0.018	0.019	-0.061	0.103
GOVERNMENT DEBT AS A RATIO TO GDP	2271	0.528	0.387	0.019	2.698
LOG GDP PER CAPITA	2448	3.226	0.888	1.183	4.730
INVESTMENT RATIO	2228	0.185	0.064	0.017	0.389
REAL INTEREST RATE	2397	5.562	3.018	-5.996	23.729
OPENNESS	2358	0.424	0.329	0.013	2.974
POPULATION GROWTH	2431	0.008	0.010	-0.252	0.265