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Growth and Productivity: the role of Government Debt

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Growth and Productivity: the role of Government Debt*

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Abstract

We use a panel of 155 countries to assess the links between growth, productivity and government debt. Via growth equations we assess simultaneity, endogeneity, cross-section dependence, nonlinearities, and threshold effects. We find a negative effect of the debt ratio. For the OECD, the higher the debt maturity the higher economic growth; financial crisis are detrimental for growth; fiscal consolidation promotes growth; and higher debt ratios are beneficial to TFP growth. The growth impact of a 10% increase in the debt ratio is -0.2% (0.1%) respectively for countries with debt ratios above (below) 90% (30%), and an endogenous debt ratio threshold of 59% can be derived.

JEL: C23, E62, H50.
Keywords: government debt, crises, panel analysis.

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1. Introduction

The relevance of government debt for economic growth has become crucial, particularly in a context where policy makers have to face increasing fiscal imbalances. In terms of economic theory, at moderate levels of government debt, fiscal policy may induce growth, with a typical Keynesian behaviour. However, at high debt levels, the expected future tax increases will reduce the possible positive effects of government debt, decreasing investment and consumption resulting in less employment and lower output growth. Unfortunately, the empirical evidence that is currently available to shed light on the importance of government debt (and related aspects) for growth of productivity is not very conclusive. This paper attempts to fill some gaps and intends to provide some additional empirical evidence of the effects of government debt (and its maturity structure) on output growth and productivity for advanced countries (OECD) as well as emerging and developing countries.

We have recently observed a revival in this theme fuelled by the substantial worsening of public finances in many advanced (and other) economies as a result of the 2008/09 financial and economic crisis. In response, governments around the world implemented important fiscal stimulus. More than ever it is important to understand the effects of government debt on growth, capital accumulation and productivity, particularly when associated with financial crisis.

The linkages between fiscal policy and growth have been the object of several analyses For instance, Gemmell (2004) has summarised many existing empirical work dividing it into three generation studies depending on the econometric methods used. Even though our main purpose is empirical in nature, it is worth referring to some initial theoretical contributions which serve as the underlying basis for our analysis. In particular, Modigliani (1961) and Diamond (1965) first, and later Saint-Paul (1992), take a theoretical approach based on a neoclassical growth model and suggest that an increase in public debt will always decrease the growth rate of the economy. Regarding the developments of government debt, Corsetti et al. (2010) discuss the importance of the reversal of significant fiscal imbalances, to ensure the curbing of government debt, notably in a context where monetary policy is limited by a zero lower bound regarding policy interest rates.

With respect to the empirical evidence, most papers have focussed on advanced countries. Authors looking at mixed samples such as Schlarek (2004) focusing on a panel of 59 developing and 24 advanced countries for the period 1970-2002 concludes that, for developing countries, there is always a negative and significant relation between debt and growth. For advanced countries, he does not find any robust evidence, suggesting that higher public debt levels are not necessarily associated with lower GDP growth rates. Checherita and Rother (2010) look at the Euro-area from 1970 to 2010 and find a nonlinear impact of debt on growth with a turning point at about 90-100% of GDP. On the same line, Kumar and Woo (2010) used 38 advanced and emerging countries from 1970 to 2007 and also find an inverse relationship between initial debt and subsequent growth, controlling for other determinants of growth.

On the other hand, de la Fuente (1997) using OECD countries between 1965 and 1995 report evidence of a sizeable negative externality effect of government on the level of productivity. In addition, Dar and Amirkhalkhali (2002) for a sample of 19 OECD countries find that Total Factor Productivity (TFP) growth and productivity of capital are weaker in countries with larger government (which can be proxied by the debt-to-GDP ratio).

In this study we use cross-sectional/time series data for a panel of 155 developed and developing countries for the period 1970-2008. We do not present or test a comprehensive theory of economic growth. Rather, we are investigating the stability of coefficients over time and across countries (and groups of homogeneous economies). In the empirical estimation, the paper makes use of growth equations and growth accounting techniques (to explore different channels of impact) and focus on a number of econometric issues that can have an important bearing on the results. In particular, we assess such issues as simultaneity, endogeneity, the relevance of nonlinearities, and the importance of outliers.

Therefore, this paper contributes to the literature by assessing the debt-growth nexus with a diversified variety of methods, providing sensitivity and robustness, and, in more specific terms, by addressing the following issues: i) The impact of government debt, and its maturity, on growth, the existence of nonlinearities, and the relevance of debt thresholds. ii) The relevance of financial development (e.g., banking sector development, stock market development, for which we build several financial development proxies) and the impact of financial crises (debt, currency and banking) on the debt-growth relationship. iii) On a growth accounting perspective, the impact on TFP growth (for that purpose we build a measure of TFP), capital stock accumulation, private and public investment. iv) Differences between country groups (OECD vs. Emerging and Developing).

Our main results can be summarised as follows:

i) there is a negative effect of the government debt ratio for the full sample; ii) a quadratic debt term is not statistically significant; iii) for the OECD, the longer the average debt maturity the higher economic growth; iv) financial crisis are detrimental for growth, notably with high debt ratios; v) fiscal consolidation promotes growth in a non-Keynesian fashion; vi) for countries with debt ratios above (below) 90% (30%) the growth impact of a 10% increase in the debt ratio is -0.2.% (0.1%); vii) an endogenous debt ratio threshold of 59% can be derived for the full sample; viii) financial development, stock market development, financial efficiency and bond market development positively affect growth in the OECD; ix) higher debt ratios are beneficial to TFP growth, the growth of capital stock per worker, and detrimental to the levels of private and public investment; x) the higher the household's debt burden coupled with higher government debt, the lower output growth; xi) most results are confirmed even after we address cross-sectional dependence.

The paper is organised as follows. Section two describes the analytical and econometric methodology. Section three presents the data, in particular the construction of the TFP and financial development measures. Section four discusses our main results. Section five concludes.

2. Methodology

2.1 Analytical framework

A neoclassical growth model provides the analytical framework for our analysis, and the underlying basic aggregate production function can be written as $Y=F(L,K)$, with Y being the real aggregated output; L, labour force or population; K, capital (physical and human). This model suggests that poor countries should have a high return to capital and a fast growth in transition to the steady-state. However, there are several factors that could interfere with this result. Therefore, the standard growth model is based on a conditional convergence equation that relates real growth of per capita GDP to the initial level of income per capita,[1] investment-to-GDP ratio (a proxy for physical capital in a standard neoclassical production function), a measure of human capital or educational attainment, and the population growth rate, which is augmented to include the level of government debt (as a share of GDP) – and some variants based on government debt maturity.[2] This is complemented with some controls, one of which is a measure of trade openness,[3] as

[1] The initial level of income per capita is not only a robust and significant variable for growth (in terms of conditional or beta convergence), but output is generally correlated with fiscal variables, in particular, tax revenues and government expenditures.

[2] The underlying model has its theoretical underpinnings from Landau's (1983), Kormendi and Meguire's (1985) or Ram's (1986) formulations.

[3] If open economies are especially exposed to shocks, it may be especially important for the government to facilitate private consumption smoothing via countercyclical policies (Rodrick, 1998). On the other hand,

commonly found in the growth literature to expand the model beyond a closed-economy form.

Ultimately, our aggregate production function is *Y=F(L,K,D)* with *D* being a debt-related variable of interest. Specifically, *D* alternatively consists of the total government debt ratio; short-term government debt ratio; long-term government debt ratio; short-term government debt as a share of total government debt. The baseline specification assumes a linear relationship between *D* and growth:

$$y_{it} - y_{it-1} = \alpha_{it} + \beta_0 y_{io} + \beta_1 x^j{}_{it} + \gamma D_{it} + \eta_t + \nu_i + \varepsilon_{it} \quad (1)$$

where $y_{it} - y_{it-1}$ represents the growth rate of real GDP per capita; y_{i0} is the initial value of the real GDP per capita;[4] $x^j{}_{it}$, *j*=1,2 is a vector of control variables; D_{it} is a debt-related variable; η_t and ν_i correspond to the country-specific fixed effect and time-fixed effect, respectively, and ε_{it} is some unobserved zero mean white noise-type column vector satisfying the standard assumptions. α, β_0, β_1 and γ are unknown parameters to be estimated.

The vector $x^1{}_{it}$ (benchmark) comprises population growth, trade openness, gross fixed capital formation (% GDP) and an education proxy for human capital corresponding to Barro and Lee's (2010) secondary school attainment (in Tables 1 to 4.b). $x^1{}_{it}$ is enlarged with the debt maturity variable as well as an interaction term (in Table 4.c). Table 5 includes as controls $x^1{}_{it}$ and four interaction terms with financial crises-related dummies. Table 6 uses alternatively $x^2{}_{it}$ composed of the initial values of the variables included in $x^1{}_{it}$ (apart from population growth) together with the initial values (at the beginning of each 5-year period) for inflation (CPI-based), initial government size (see Appendix 2), initial financial depth (or liquid liabilities over GDP), banking crisis dummy and government balance ratio. Table 7 includes $x^2{}_{it}$ together with a number of interaction terms with debt threshold levels and geographical dummies. Tables 11.a-b use $x^2{}_{it}$ and Table 12 $x^1{}_{it}$.

To capture a possible non-linear relationship, we also consider a quadratic term in (1). Such specification would support, in this context, a so-called Laffer hypothesis if the coefficient on debt is positive and the coefficient on debt squared is negative. Furthermore,

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integrated international financial markets may offer more scope to absorb shocks through risk sharing, suggesting there is less need for governments to step in. For instance, Afonso and Furceri (2008) find that such risk sharing is lower among the EU countries than in the US states.

[4] For regressions using annual data, the lagged value of GDP(y_{it-1}) is used instead.

we access the existence of other non-linear and threshold effects by making use of several dummy (binary-type) variables and interaction terms in our regressions, as it will be explained in the next section.

Finally, taking a growth accounting approach, we compute a measure of TFP and we examine the influence of fiscal variables in affecting its growth rate, as well as the growth rate of per worker capital stock, and private and public investment levels.

2.2. Econometric approaches

2.2.1. Panel techniques

The argument for cross-section studies over long time spans has been that less interesting short- to medium-term effects, such as business cycle effects, are thereby eliminated. However, a number of problems with cross-section studies using long time spans need to be addressed. The most important of these may be a potentially severe simultaneity problem. The cross-country regressions are usually based on average values over long time periods. In such cases, e.g., the level of government spending is likely to be influenced by demographics, in particular an increasing share of elderly. At the same time the share of elderly is correlated with GDP. Thus, errors in the growth variable will affect GDP, demographics and fiscal variables as a share of GDP, which are then correlated with the error term in the growth regression.

A second problem is that cross-section studies using long observation periods give rise to an endogenous selection of government spending (tax) policy. For example, countries that raise taxes and experience lower growth during the observation period are more likely to change the policy stance afterwards and, for instance, reduce taxes, such as Ireland did during the 1980s.

A third related problem is that cross-section analysis may be inefficient since it discards information on within-country variation. While both the simultaneity effect and the use of within-country variation are arguments in favour of panel regressions with shorter time spans, there are also risks. When the period of observation is short, it is less likely that the error in the growth regression will affect government debt and other regressors in the same period.

Cross-section methods are simple and easy to interpret but relationships may be artificially created or obscured by unobserved heterogeneity and outliers. The use of panel data can overcome (some of) these problems, and has other advantages. As a compromise we focus mainly on combined cross-section time-series regressions using cumulative 5 year non-overlapping averages to smooth the effects of short-run fluctuations, even though growth regressions will be first estimated with annual data, therefore making use of the full informational advantage of our (unbalanced) dataset. We run (pooled) Ordinary Least Squares to serve as a benchmark model – as common practice in the literature – despite being aware of all the econometric problems associated with this method, as previously discussed. We also run a within estimator, fixed effects, with the inclusion of time dummies that allow for common long-run growth in per capita GDP, which is consistent with common technical progress.

2.2.2. Dealing with outliers

A closer inspection of the data - next section - suggests that influential outliers could play an important role in cross-section analysis. The sample sensitivity of some cross-country empirical studies is well known. Therefore, one advance in this paper over earlier work is the use of two robust estimators, the MM and the Least Absolute Deviation (LAD). The former fits the efficient high breakdown estimator proposed by Yokai (1987) which on the first stage takes the S estimator applied to the residual scale and derives starting values for the coefficient vectors, and on the second stage applies the Huber-type bisquare M-estimator using iteratively re-weighted least squares (IRWLS) to obtain the final coefficient estimates.

As for the LAD, it minimises the sum of squares over half the observations. One way of thinking about this informally is that the estimator seeks out part of the data for which the model has greatest explanatory power (as measured by the coefficient of determination) and then bases the parameter estimates on just that portion of the data. We then exclude any observations for which the LAD residual is more than two standard deviations from the mean residual, before re-estimating the model by OLS or FE. When the two sets of estimates are very different, then it may be that the observations are drawn from several different regimes, and/or the OLS (FE) estimates are driven by a few outliers. These procedures are not perfect, but should help to exclude the worst outliers, including some that would not be identified by more conventional OLS (FE) diagnostics.

2.2.3. Endogeneity

One should address possible endogeneity issues of right-hand side regressors. While country-specific fixed effects might capture some of the omitted variables (if we miss out an important variable it not only means our model is poorly specified it also implies that any estimated parameters are likely to be biased)[5], it does not solve the potential problem and one may end up estimating biased coefficient. Moreover, panel data estimations may yield biased coefficient estimates when lagged dependent variables are included. In our case, initial income (or lagged income when using annual observations) is a regressor also present in the dependent variable, the rate of growth per capita GDP. Moreover, on the right-hand side of most estimated equations there is the debt-to-GDP ratio, which is itself a function of real output. It is quite possible that countries with higher growth potential can support a higher level of government debt. Furthermore, investment is also likely to be endogenous because the expectation of high growth usually induces higher investment levels. Therefore, we have re-estimated our regressions using the bias-corrected least-squares dummy variable (LSDV-C) estimator by Bruno (2005).[6]

Therefore, we complement our fixed-effects approach by estimating the main equations using Generalised Methods of Moments (GMM), and to further inspect endogeneity issues we use a panel Instrumental Variable-Generalised Least Squares (IV-GLS) approach.[7]

We estimate the growth equations by system-GMM (SYS-GMM) which jointly estimates the equations in first differences, using as instruments lagged levels of the dependent and independent variables, and in levels, using as instruments the first differences of the regressors. As far as information on the choice of lagged levels (differences) used as instruments in the difference (level) equation, as work by Bowsher (2002) and, more recently, Roodman (2009) has indicated, when it comes to moment conditions (as thus to instruments) more is not always better. The GMM estimators are likely to suffer from "overfitting bias" once the number of instruments approaches (or exceeds) the number of groups/countries (as a simple rule of thumb). In the present case, the choice of lags was directed by checking the validity of different sets of instruments and we rely on comparisons of first stage R-squares. Intuitively, the system GMM estimator does not rely exclusively on the first-differenced equations, but exploits also information contained in the original equations in levels.

[5] If our variables are uncorrelated with the omitted variables, then results may be unbiased. Thus, if we do not use any predictors that might be correlated with what we imagine to be an important omitted variable, we may be able to reduce the bias. That is why we do not wish to have too many variables in our model. If we use a predictor that is correlated with an omitted variable, we generate endogeneity bias. On the other hand, the more variables we consider the less likely it is that we are omitting something.

[6] Kiviet (1995) uses asymptotic expansion techniques to approximate the small sample bias of the standard LSDV estimator for samples where N is small or only moderately large. Bruno (2005) extends the bias approximation formulas to accommodate unbalanced panels with a strictly exogenous selection rule.

[7] Where endogenous variables are instrumented by appropriate lagged levels and tested by looking at first-stage regression estimates, as common practice in the literature.

2.2.4. Cross-sectional dependence

We are aware of the potential issue (in particular, bias in coefficient estimates) that can arise from a significant cross-sectional dependence (within similar groups of countries in our sample) in the error term of the model. As put forward by Eberhardt et al. (2010), the so-called unobserved common factor technique relies on both latent factors in the error term and regressors to take into account the existence of cross-sectional dependence. Developed with the panel-date/time-series econometric literature over the course of the past few years, this method has been largely employed in macroeconomic panel data exercises (see, e.g., Pesaran (2004, 2006), Coakley et al. (2006), Pesaran and Tosetti (2007), Bai (2009), Kapetanios et al. (2009) and Eberhardt and Teal (2011 and references therein)). This common factor methodology takes cross-sectional dependence as the outcome of unobserved time-varying omitted common variables or shocks which influence each cross-sectional element in a different way. Cross-sectional dependence in the error term of the estimated model results then in inconsistent coefficient estimates if independent variables are correlated with the unspecified common variables or shocks.[8]

With this in mind, we test for the presence of cross-sectional dependence Pesaran's (2004) CD test statistic based on a standard normal distribution. We then run some of the most important regression equations with Driscoll-Kraay (1998) robust standard errors. This non-parametric technique assumes the error structure to be heteroskedastic, autocorrelated up to some lag and possibly correlated between the groups. Given the particular nature of the dependent variable and the possibility of error dependence another estimation approach would be worthwhile. We rely on the Pesaran (2006) common correlated effects pooled (CCEP) estimator, a generalization of the fixed effects estimator that allows for the possibility of cross section correlation. Including the (weighted) cross sectional averages of the dependent variable and individual specific regressors is suggested by Pesaran (2006, 2007, 2009) as an effective way to filter out the impacts of common factors, which could be common technological shocks or macroeconomic shocks, causing between group error dependence.

[8] There are different ways to account for such error cross-sectional dependences (see, e.g., Sarafidis and Wansbeek (2010) for an overview).

3. Building the dataset

We investigate the relationship between government debt and real per capita GDP growth and TFP growth in a sample of 155 countries over the period 1970-2008. The dataset excludes countries with poor data collection, as measurement error is likely to be large. All variables are in logs with the exception of shares and growth rates.

The dataset was collected from several sources.[9] Real GDP per capita was retrieved from the World Bank's Word Development Indicators (WDI); gross fixed capital formation (as share of GDP) was retrieved from the same source; public investment (as a share of GDP) was also taken from the same source together with AMECO for advanced countries; we constructed TFP based on data from the latest version 6.3 of the Penn World Table (PWT) of Heston et al. (2009) – see section below. The debt-to-GDP ratio comes from IMF's debt historical database due to Abbas et al. (2010).

With respect to human capital proxies we mainly rely on the average years of schooling of the population over 25 years old from the international data on educational attainment by Barro and Lee (2010), but we also take the literacy rate (% of people ages 15 to 24), primary school enrolment (% gross), primary school duration (years) secondary school enrolment (% gross), secondary school duration (years), tertiary school enrolment (% gross) and tertiary school duration (years) from the WDI, for robustness purposes.

As for other controls and variables most come from either the WDI or the IMF's IFS, as follows: land area (in square kilometres), population, real interest rate (%), interest rate spread (lending rate minus deposit rate), imports and exports of good and services (BoP, current USD), labour participation rate (% of total), labour force, unemployment, total (% of total labour force), fertility rate (births per woman), age dependency ratio (% of working age population), urban population (% of total), short-term debt (% of exports of goods and services), terms of trade adjustment (constant LCU), real effective exchange rate index (2000=100), come from WDI.

3.1. Growth accounting - Total Factor Productivity

In order to assess how fiscal developments may impinge on TFP we construct a new dataset for this variable, for a large number of developed and developing countries, in the periods 1960-2007 and 1970-2007, depending on the availability of investment data for the period 1950-1960 and 1960-1970, respectively. Naturally, the TFP construction based on the latter period encompasses a larger number of countries. National income and product

[9] A summary table with definitions, acronyms and sources is presented in Appendix 2.

account data and labour force data are obtained from the latest version 6.3 of the Penn World Table (PWT) of Heston et al. (2009). We gathered the following variables: "*rgdpwok*" (real GDP per worker) and "*Ky*" (physical capital to output ratio). To construct the labour quality index of human capital (H), we take average years of schooling in the population over 25 years old from the international data on educational attainment (*E*) by Barro and Lee (2010). Annual data on years of schooling from 1960 up to 2000 were retrieved from Klenow and Rodriguez-Clare (2005) dataset and then complemented with information up to 2007 using the Barro and Lee (2010) dataset together with linear interpolation methods. Appendix 1.a details the construction of the TFP variable.

3.2. Financial development proxies

We also chose to take a further step into combining different proxies of financial development, which will then be interacted with the debt variable in our regressions, by using Principal Components Analysis (PCA). The conventional measures of financial development are based on Ross Levine's database,[10] on which the principal component analysis is applied (following Huang's (2010) approach). See Appendix 1.b for a detailed description on how we constructed the different financial development proxies: overall financial development, financial intermediary development, stock market development, financial efficiency, financial size development and bond market development.

4. Empirical Analysis

4.1. Descriptive statistics and graphical analysis

Since we are largely interested in the relationship between growth (and TFP) and debt, it is instructive to aggregate our data into one big cross-section spanning from 1970-2008 and analyse some scatter plots. Figure 1.a shows per capita real GDP growth against the ratio of government debt-to-GDP for the full sample. It seems that a negative relationship between the two variables can be extracted, attested by a linear fit. Figure 1.b looks at the OECD only but in this case, no clear relationship is found. Lastly, when taking the sub-sample consisting of emerging and developing countries – Figure 1.c - we also find some evidence of a negative relationship. If one takes a quadratic fit instead (not shown), to account for a possible non-linear behaviour between debt and growth, the 95% confidence interval includes slightly more countries.

[Figure 1]

[10] The description of these measures draws on Demirgüç-Kunt and Levine (1996, 1999).

We find roughly a similar picture (not shown) when plotting the growth rate of TFP against the ratio of government debt-to-GDP for the full sample and emerging and developing sub-sample, that is, a negative relation. However, our graphical representation suggests a positive relationship between TFP growth and the debt-to-GDP ratio for the OECD sub-sample (Figure 1.d). In addition, from the Kernel density estimates (Figure 2) we see that government debt has increased throughout time, which implies an increase of the size of the government notably when trying to provide the additional services related to the welfare state.

[Figure 2]

4.2. Results: government debt

4.2.1. Debt-growth relationship

We begin our analysis by estimating a growth regression using annual data, for the period 1970-2008, using as regressors the initial level of GDP, population growth, trade openness, private investment (gross fixed capital formation), education and government debt (our variable of interest). Results (not shown for reasons of parsimony) are in line with the growth literature, as we find significantly negative coefficients for the initial level of per capita GDP (conditional convergence hypothesis, confirming the catching-up process underlying a longer distance to the steady-state) and population growth, and significantly positive coefficients for trade openness,[11] private investment and education levels. We will refrain from commenting on these results again for the remainder of the paper as they are generally consistent and robust throughout. As for the debt-to-GDP ratio evidence points to a statistically significant negative relationship with GDP per capita growth rates for the full sample (pooled OLS and outlier robust estimators).[12]

In is important to acknowledge that private credit may bear a complementary relationship with government debt, notably in the context of economic growth. Therefore, we have included an interaction term between a measure of credit issued to the private sector by banks and other financial intermediaries (divided by GDP), excluding credit given to the government, government agencies and public enterprises, and government debt-to-GDP ratio. In Table 1 we still get statistically significant negative estimates of the

[11] This translates the successive openness process to international trade flows (removal of trade barriers and other sort of protectionism duties) by many countries, which has been intensified over the last few decades.

[12] Estimations with outlier-robust techniques don't change qualitatively our main results. The observations excluded are: Angola, Argentina, Azerbaijan, Belize, Chad, Congo (Rep.), Gabon, Iran, Jordan, Kuwait, Lebanon, Malawi, Nicaragua, Nigeria, Oman, Paraguay, Qatar, Sierra Leone, St. Lucia, Swaziland, Syria, Togo, Trinidad and Tobago, UAE, Uruguay, Vanatu, Venezuela and Zimbabwe.

debt-to-GDP ratio on output growth and, additionally, a negative coefficient for the interaction term, meaning that the higher the household's debt burden coupled with higher government debt, the lower output growth will be. As a robustness exercise we have also estimated a model excluding the debt-to-GDP ratio, but explicitly including private credit and the interaction term between the two variables. Results (not shown) suggest that private credit by itself has a statistically positive effect on growth, however, the interaction term yields statistically negative coefficients for the all sample which are robust across econometric specifications (OLS, FE and SYS-GMM). The negative coefficient makes not only the effect of the debt-to-GDP ratio conditional on the level of private credit, but vice versa. In fact, it implies that private credit itself boosts growth given a low level of the debt-to-GDP ratio. However, the negative coefficient on the interaction term has the interesting implication that there exists a threshold level of the debt ratio above which private credit can actually dampen growth.

[Table 1]

For the remainder of the paper we focus on 5-year averages, as common practice in the literature. Regarding the full sample we find evidence that an increase in the debt-to-GDP ratio is detrimental to output growth and this is robust across econometric specifications, as reported in Table 2.

[Table 2]

Moreover, for the OECD sub-group, the same conclusion seems to apply when running pooled OLS (and the coefficient is now significant at 5% level). It is instructive to briefly discuss the size of the standardized coefficients – these indicate the relative importance of the variables included in the model: a big impact comes from the initial level of per capita GDP as well as from the population growth rate; private investment also accounts for a sizeable share; and the negative impact of the debt-to-GDP ratio is confirmed.

In order to explore nonlinearities we re-run the same model with a quadratic-debt-term included as an additional regressor. Results (not shown) do not provide evidence of any significant quadratic-debt-term. As a robustness exercise, we have included also credit to the private sector in our 5-year averages dataset and the same conclusions as for the use of annual data apply. We have redone these estimations taking potential GDP growth as an alternative dependent variable.[13] In particular, we took the smoothed or detrended GDP series extracted for each country making use of i) the Hodrick-Prescott, ii) the Baxter-King

[13] For reasons of parsimony results are not shown but they are available from the authors on request.

and iii) the Christiano-Fitzgerald random walk filters. Computing the growth rates of these new series and using them as alternative dependent variables, yields similar results.

An interesting issue to explore is debt maturity, which we did using information from the World Bank.[14] Table 3.a shows that when short-debt-to-GDP ratio is included in our growth specifications we still get a negative and statistically significant coefficient (for the full sample). The same applies when long-term debt is used instead.

[Table 3.a]

In addition, we also assessed the impact of short- and long-term debt, as shares of the total level of debt.[15] In this case we obtain a positive and statistically significant coefficient (at the 1% level) for the short-debt-to-total debt ratio across different econometric specifications (being the long-debt-to-total-debt the complement, it naturally yields a negative coefficient).

Due to limitations in data retrieved from the WDI, we used the OECD’s own measure of average debt to maturity (in years) to construct additional dummy (binary type) variables. For the average maturity above 5 years we have classified it as long-term debt (*dumlong)* and attributed a value 1; the complement (short- and medium-term) takes the value zero. Table 3.b presents the results from these estimations. In only one case we find evidence supporting the claim that the higher debt maturity the higher the economic growth rate (specification 3). As for the interaction term it appears not to be significant.

[Table 3.b]

Financial crisis

We now turn to a different, but equally important topic. In line with research by Afonso, Gruner, Kolerus (2010) on fiscal developments and financial crisis, we take the Laeven and Valencia’s (2010) database on banking, debt and currency crisis and study the relevance of these phenomena, when interacted with the debt-to-GDP ratio, in explaining differences in output growth. According to Easterly (2001), econometric tests and fiscal solvency accounting carried out in his paper confirm the important role of debt crises. Table 4 presents the results from adding *govdebt_gdp* with an interaction term for each type of crisis introduced one at a time, plus a dummy variable (available in the same dataset) taking the value 1 when a debt restructuring occurred and zero otherwise. The first aspect to notice is that *govdebt_gdp* retains its negative and statistically significant. We do find some evidence supporting the detrimental effect of financial crisis when associated with higher

[14] Given data availability a number of observations were lost due to data transformations.

[15] Results available upon request.

government debt-to-GDP levels on output growth, in particular those related to debt and currency crisis (robust across econometric methodologies).

For the OECD sub-group (not shown) we loose statistical significance of the debt-to-GDP variable entirely, but we retain statistically negative coefficients for most interaction terms with different types of crisis (in pooled OLS and FE cases; not in the SYS-GMM though). Moreover, we now have evidence of negative effects of both banking crisis and debt restructuring operations on per capita GDP growth. This seems to be in line with Reinhart and Rogoff's (2009) finding that banking crises are typically accompanied by large increases in government debts.

[Table 4]

According to Gupta's et al. (2005) study of 39 low income countries (during the 1990s) initial conditions also have a bearing on the nexus between fiscal variables and growth, an avenue is also explored by Kumar and Woo (2010). Therefore, we similarly include the initial government size (from Gwartney and Lawsson, 2006), in light of the robust results obtained by Sala-i-Martin et al. (2004).[16] In addition, we include initial trade openness, initial financial depth (*llgdp*) and initial inflation (all averaged over each time period). A measure of banking crisis incidence is also considered as we have shown it is important determinant. The fiscal deficit is included to take into account the finding that fiscal deficits are negatively associated with longer-run growth (see, Fisher (1993) and Baldacci et al. (2004)).

From Table 5 it stands out that banking crisis have indeed a negative impact on output growth which is robust across econometric specifications (as attested before). The budget balance is positive and statistically significant in four specifications for the OECD sample, which would imply that a fiscal consolidation promotes growth in a non-Keynesian fashion in those cases.[17] As before, the debt-to-GDP ratio appears with negative and a significant coefficient for the whole sample and mostly insignificant for the OECD sub-group. As a robustness exercise we have repeated the analysis without initial conditions of the regressors previously included (apart from *inigdppc*) – hence, replaced with variables averaged over each 5-year period –, and results didn't change.

[Table 5]

Another exercise worth while conducting is an assessment of the sensitivity degree of the different explanatory variables included in our regressions. We have re-run the

[16] Fiscal sustainability can also be a motivation, in line with Woo (2003) and Huang and Xie (2008).
[17] Afonso (2010) reports related evidence for the EU.

estimations without the budget balance (due to possible collinearity with either government debt or government size) and inflation (which proved not to be significant in the regression with initial conditions; but statistically negative in the first robustness exercise). Such additional findings confirm the negative effect to debt-to-GDP ratio for the full sample and for the OECD (the latter when running SYS-GMM).

4.2.2. Debt thresholds

High levels of government debt may affect the allocation of resources, hence growth and productivity. In this sub-section we study the effect of different debt-to-GDP ratio thresholds on growth. We followed Table's 5 setting in terms of initial conditions of the regressors. In addition to *govdebt_gdp* included in each specification, we interact this variable with a dummy variable (*dum30*) taking the value 1 if the debt-to-GDP ratio was below 30 at a certain point in time, between 60 and 90 (*dum3060*) or above 90 (*dum90*), respectively. We find that the 30% debt threshold is positive and statistically significant at 1 percent level in one pooled OLS, one FE, and SYS-GMM estimation for both the whole sample, and for the OECD sub-group. For the full sample having a debt-to-GDP ratio above 90 affects negatively growth.[18]

In order to have a visual image, we plot the cross-sectional average of per capita GDP growth rates for these levels of debt-to-GDP ratios for the entire sample as well as the OECD and emerging economies sub-groups in Figure 3. Low debt is defined as having *govdebt_gdp* below 30% and high debt as a level above 90%. A consistent pattern is present, namely countries with low debt ratios grow faster (which is also true for the emerging sub-group). No significant difference is found with respect to OECD economies.

[Figure 3]

We also computed the impact on growth of a given proportional increase in the debt-to-GDP ratio. This was undertaken to allow an appropriate comparison of the impact of government debt on growth at different levels of debt and reflects the fact that an increase in the ratio from 10 to 20 percent constitutes a doubling, while an increase from 100 to 110 percent raises it only by one-tenth. Table 6 summarizes the results for debt ratios in three groupings: <30%, 30-60% and > 90%. For each of these grouping we obtained the sample average debt ratio (row 1), and then multiplied a given increase (10%) in this ratio, by the estimated coefficient of the interaction term (row 2, based on the different estimation

[18] Results available upon request.

techniques). The results (row 3) indicate that the higher the level of the debt ratio, the higher the negative impact on output growth. For instance, a 10 percent increase in the debt ratio in countries with debt ratio above 90 percent is associated with a decline in growth of 0.27 percent, while an identical increase in the debt ratio in the 30-60 percent group is associate with a decline is growth around 0.08 percent.

[Table 6]

In Table 7 we run additional regressions with the debt ratio interacted with dummy variables taking the value 1 if the average debt ratio of a particular country over that country's time span is above 60 (*dumav60*), above 65 (*dumav65*) until we reach the level of 100 (*dumav100*). For reasons of parsimony we only report the coefficients of interest and not the full set of estimates. The results show that for the whole sample, irrespective of the threshold level included in the regression, we always find the debt-to-GDP ratio having a negative and statistically significant effect on growth for the pooled OLS and SYS-GMM specifications. Similarly, for emerging countries we have the same result. Nothing can be said with respect to the OECD sub-group.[19] The interaction terms in specification 1 (for the full sample) suggest that having average debt ratios above 60 further increases the adverse impact of debt on output growth. Indeed, we find interaction terms with statistically significant negative coefficients in 8 out of 9 regressions for the full sample.

[Table 7]

Endogenous debt threshold

In the context of defining a plausible debt threshold level, other than specifying it in a purely ad-hoc way, we now explore the endogenous determination of the debt-to-GDP threshold ratio which is the threshold value in the empirical model that provides the best fit by maximizing its likelihood. Based on a reduced form growth equation allowing for the presence of multiple equilibrium (like in Strubhaar et al., 2002), we can employ Hansen's (1996, 2000) techniques to a (generalized) threshold regression of the form:

$$y_{it} - y_{it-1} = \begin{array}{l} \gamma_{01} + \gamma_{11} y_{i0} + \gamma_{21} X_{it} \rightarrow if\ \ G > \gamma \\ \gamma_{02} + \gamma_{12} y_{i0} + \gamma_{22} X_{it} \rightarrow if\ \ G < \gamma \end{array} \quad (2)$$

where $\gamma_{ij}, i, j = 0,1,2$ are regression coefficients and γ is a threshold value that splits the sample in two halves. X_{it} is a vector of control variables consisting of population growth,

[19] If we re-run the estimations without initial conditions (not shown) little changes occur apart from the fact that i) we loose some significant coefficients for specification 1 (full sample) but ii) we gain some significantly negative coefficients with fixed-effects estimation in specification 4, and, more importantly, the OECD sub-group has a significantly negative coefficient in the debt-to-GDP ratio when *govdebt*dumav95* is included as an additional regressor.

openness, education and investment. The main innovation of the empirical part is to estimate γ endogenously and then split the entire sample accordingly (by examining whether a country performed better (over-performer) or worse (under-performer) than its country-specific growth projection). The threshold variable, *G*, will be the government debt ratio.

Equation (2) has an econometric correspondence: a threshold regression model. This model estimation procedure involves three steps: i) estimating the sample split threshold value; ii) testing whether the endogenously determined sample split value is significant; and iii) performing conventional hypothesis tests.

The endogenously determined sample split is estimated by minimizing mean square errors,

$$\gamma = \arg\min_{q_i \in Q} e(q_i)'e(q_i) \qquad (3)$$

where q_i is the value of the threshold variable (government debt) of region *i*, Q is the set of all different values of q_i in the sample, γ is the estimated threshold value of q_i, and $e(q_i)$ is the vector of OLS residuals of the regression (2) if the sample is split in observations larger or smaller than q_i, and each sample half is estimated separately.

The significance of the sample split could be obtained from a conventional structural break test (Chow test). However, Davies (1977) argued that this test is invalid in the present context, because it assumes that the sample split γ is known with certainty, while we estimate it endogenously. A Chow test would not take into account the estimation error of γ and the uncertainty whether the threshold exists under the null hypothesis. Hansen (1996) suggests a Supremum F-, LM- or Wald-test, which has a non-standard distribution dependent on the sample of observations. The critical values can be obtained by a bootstrap.

Estimating (2) with cross-sectional 5-year averages and with the annual samples (correcting for heteroskedasticity)[20] yields an estimated threshold value γ=59.305 and a corresponding Supremum Wald-test of 27.89 whose p-value is 0.079, indicating a significant sample break for the full sample.[21]

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[20] We thank Dieter Urban for kindly making his original code available, which was adaptated to our particular needs.

[21] Using the 5-year averages sample instead, we obtained a statistically significant threshold for the debt-to-GDP ratio of 58.8% (significant Supremum Wald-test of 76.6 with p-value of 0.016). Spliting the sample into OECD countries does not yield a significant debt threshold, but taking the narrower Euro-area sub-sample we

If we take the roughly 60% debt threshold just computed and attempt to summarize GDP growth based on this information we have in Figure 4 a visual representation that allows us to draw some meaningful conclusions. In particular, either picking the 60% debt threshold or the 3% budget deficit level, splitting the sample results in having countries with higher debt ratios, and higher budget deficits, associated with lower growth rates. On the other hand, countries with lower debt ratios and lower fiscal imbalances have higher growth rates.

[Figure 4]

Financial development

One additional issue to keep in mind when investigating the relationship between government debt and growth is the level of financial development. The negative impact of government debt on growth could conceivably be stronger in countries with more developed financial systems, translating, for example, a higher private debt stock and associated burdens (as already partly explored before with the inclusion of private credit).

Therefore, we proxy financial development with different measures computed using PCA (see Appendix 1.b for the computation of these variables). As a first exercise, we run a regression including the previous set of initial regressors plus our overall measure of financial development (*fd*) and the latter interacted with the previously constructed dummies for the debt ratio threshold. In a second exercise, similarly to Table 7, we run independent regressions one at a time with a proxy for financial development and its interaction with the above 60% debt threshold, which we have computed as the approximate threshold level.[22]

The evidence in Table 8 (panel a) suggests that those proxies and the interaction terms are statistically stronger in emerging countries. Results from the first exercise suggest that overall financial development has a positive effect on growth, but not when interacted with debt ratios, and the same is true for the OECD sub-group (according to the fixed-effects estimation). From the second exercise (Table 8, panel b), financial development, stock market development, financial size, financial efficiency, and bond market development essentially affect positively growth in the OECD sub-group. For emerging countries if the debt-to-GDP ratio is above 60% both the banking sector development and financial efficiency have a detrimental impact on output growth.

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find a debt threshold of 58.14% highly significant (at 1% level). Finally, for the emerging countries sub-group a threshold of 79.11% was found for the debt-to-GDP ratio (significant at 1% level).

[22] Estimating this set of regressions with the outlier-robust MCD version of the newly computed financial development proxies didn't qualitatively change our main results.

[Table 8]

4.3. Debt-TFP relationship: a growth accounting approach

A detailed growth accounting exercise was also undertaken – based on the measures of TFP and capital stock per worker (see Appendix 1.a) – through which government debt influences growth. Table 9 presents panel regression estimates on the growth rate of TFP and capital stock per worker. Similarly to per capita GDP growth we find that the level of financial development affects positively both TFP and capital stock growth rates. While banking crises have a positive effect on TFP growth, they have a detrimental effect to the capital stock growth rate. Moreover, the budget balance appears with a negative coefficient for the OECD sample when explaining TFP growth but positive ones when explaining capital stock growth rates. Furthermore, the debt-to-GDP ratio has positive effects when considering both samples for TFP growth rates.

[Table 9]

Regarding the impact of debt ratios on private and public investment (not shown), our results suggest that banking crises and debt ratios have statistically significant negative effects in both cases. However, the impact of the budget balance is distinct: for private investment a higher debt ratio has a positive effect, whereas a higher debt ratio is associated with lower levels of government fixed capital formation.

4.4. Cross-sectional dependence

As discussed before, it is natural to suspect of the existence of cross-sectional dependence across homogeneous groups of economies. Therefore, we use Pesaran's CD test (standard growth equation, with a basic set of controls, the debt ratio, and fixed effects) for the OECD and Euro-area sub-samples. We find statistics of 15.26 and 10.26; respectively corresponding to p-values of zero in both cases, rejecting the null hypothesis of cross-sectional independence.

In Table 10 we run benchmark type growth regressions for the two sub-samples using either a Driscoll Kraay robust estimation approach or Pesaran's Common Correlated Effects Pooled Estimator (CCEP). We examine three main variables of interest: debt ratio, the change of the debt ratio, and average debt maturity (using the OECD measure). Similarly to our earlier results, we find that government debt has a negative effect on growth for the OECD sub-group using Driscoll-Kraay robust estimation, but not under the CCEP approach. For both econometric methodologies we find negative effects on growth associated with higher debt ratios. When running the CCEP estimator the debt maturity yields statistically significant positive coefficients, reinforcing our results in Table 3.b, which appeared to be weak.

[Table 10]

4.5. "Above" and "below" average performers vis-à-vis fiscal thresholds

To gain additional insight on the relationship between fiscal developments and economic performance, we briefly review some country-specific details related to the regression results reported above (in particular the regression equation corresponding to specification 1 in Table 2). The main purpose of this exercise is to see if any definite trend can be observed with respect to government debt and budget deficits and the level of economic performance of the so-called "above-average performers" and "below-average performers" (countries), vis-à-vis the fiscal thresholds.

For the full sample we identified above-average and below-average performing countries on the basis of the difference between their actual and predicted values of per capita GDP growth rates. In line with Nelson and Singh (1994) countries whose actual growth rates exceeded their predicted growth rates by 1% or more were classified as "above-average" performers, and countries that fell short of the predicted growth by a similar percentage (or more) were categorized as "below-average" performers. The list of countries in both categories is reported in Table 11. In both cases we run the regression using government debt-to-GDP ratios as the included fiscal variable of interest. The table shows the residual of the per capita GDP growth rate, the government debt ratio, and the budget balance ratio for these groupings of countries.

[Table 11]

From examination of the results in Table 11 there is no clear-cut or direct connection between these aggregates. In particular, we cannot conclude that the "above-average" performers (higher residuals in this case) have had necessarily lower debt ratios or budget deficits and that the "below-average" performers generally experienced larger debts and deficits. For example, we have "below-average" cases (negative residuals) with low levels of government debt and even budget balance surpluses. Conversely in the "above-average" category we find countries such as Israel with both a high debt ratio and a substantial budget deficit. If one isolates the group of OECD countries (not shown) we also have a mixed picture with, for instance, Greece being in the "above-average" category but with a debt ratio of 62.5% and a budget deficit of 8.1% of GDP. On the other hand, Finland is in the "below-average" category although it has relatively small debt ratio (35.1%) and a budget deficit of 1.1% GDP. Still for OECD countries, the higher the computed residuals in absolute terms, the lower the debt-to-GDP ratio. The same is true for the budget balance in the "above–average" Performers: the higher the computed residuals, the higher the budget balance (or the lower is the deficit).

Finally, and in order to summarise the overall effect of government debt on economic growth it is possible to build a density chart of all the statistically significant estimated coefficients, as depicted in Figure 5, where the left skewed plot confirms the global negative effect of government debt on economic growth.

[Figure 5]

5. Conclusion

We have used cross-sectional/time series data for a panel of 155 developed and developing countries for the period 1970-2008, in order to assess the potential linkage between fiscal policy developments and economic growth. More specifically, we used growth equations and growth accounting techniques and focussed also on a number of econometric issues that can have an important bearing on the results, notably, simultaneity, endogeneity, the relevance of nonlinearities, and threshold effects.

Our empirical results confirm the negative effect of the government debt ratio for the full sample in our dataset. This result is robust across econometric methodologies and the inclusion of different sets of regressors. We don't find evidence supporting a Laffer-type relationship, as a quadratic debt term was found to be statistically insignificant. Moreover, when taking debt maturity into account it differs whether one has short or long-term debt as percentage of GDP or as percentage of the total debt level. In the first case, we get statistically negative coefficients for both the short- and long-term debt across different econometric specifications for the full sample. Using the second definition, we find that short-term debt positively affects growth. For the OECD sub-group only, we have the result that the longer the average maturity of government debt the higher growth will be.

Using the IMF's database on financial crisis we confirm their detrimental effect of growth, but that is further worsened if interacted with high debt-to-GDP ratios. When the budget balance is included in the equation to be estimated we consistently get positive coefficients, which implies that, in those cases, a fiscal consolidation promotes growth in a non-Keynesian fashion. In addition, the higher the household's debt burden coupled with higher government debt, the lower output growth.

With respect to the analysis of different government debt thresholds, countries with debt ratios above 90% of GDP are associated with lower economic growth rates when compared with countries that maintained an average debt ratio below 30% of GDP over the period under scrutiny. In particular, for the latter group, the growth impact of a 10% increase in the debt ratio is 0.1% whereas for the former group of countries that effect amounts to -0.2%. Using Hansen's endogenous determination of the threshold debt ratio we find that, for the full sample we get a value of 59% of GDP, more specifically 58% of GDP for the Euro area, and for emerging countries a slightly bigger value of 79% of GDP.

Regarding the level of financial development when interacted with government debt-to-GDP, our results show that it positively affects growth in the OECD sub-group, and the same is valid for stock market development, financial efficiency and bond market development (after controlling for the debt-to-GDP ratio set at 60%).

On a growth accounting perspective, higher debt ratios are beneficial to TFP growth, and for the growth of capital stock per worker, whereas they are detrimental to the levels of private and public investment. The budget balance appears with positive contributions for the TFP growth, capital stock growth and private investment. Finally, most results are confirmed even after we account for cross-section dependence.

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Appendix 1.a Growth Accounting - TFP

For human capital (*H*), we follow Hall and Jones (1999) and Klenow and Rodriguez-Clare (2005) in giving a larger weight to more educated workers:

$$H = \exp(\phi(E)) \tag{A1}$$

where *E* is the average years of schooling; and the function $\phi(E)$ is piece linear with slope of 0.134 for $E \leq 4$, 0.101 for $4 < E \leq 8$ and 0.068 for $8 < E$. The wage of a worker with *E* years of education is proportional to her human capital. Since the wage-schooling relationship is widely believed to be log-linear, this would imply that *H* and *E* would have a log-linear relation as well, such as $H = \exp(\phi * E)$. International data on education-wage profiles (Psacharopoulos, 1994) suggests that in Sub-Saharan Africa the return to one extra year of education is about 13.4%, the world average is 10.1% and the OECD average is 6.8%. We estimate the capital stock, *Ky,* using the perpetual inventory method:

$$Ky_t = I_t + (1-\delta)Ky_{t-1} \tag{A2}$$

where I_t is the investment and δ is the depreciation rate. Data on I_t are from PWT 6.3 as real aggregate investment in PPP. We estimate the initial value of the capital stock (Ky_0), in year 1950 as $I_{1950}/(g+\delta)$ where *g* is the average compound growth rate between 1950 and 1960, and δ is the depreciation rate (set to 7% for all countries and years).

We construct two different measures of TFP: one for a smaller sample of countries, which have investment data from 1950 onwards and TFP figures go from 1960 till 2007, and another, larger sample, for countries which have investment data from 1960 onwards and TFP figures go from 1970 till 2007. TFP was then based on a Cobb-Douglas aggregate production function of the type $Y = AK^{\alpha}(HL)^{1-\alpha}$, following the neoclassical tradition, where α =capital-income share, *K*=physical capital, *H*=human capital, *L*=labour input and

A=TFP. After some mathematical manipulations (dividing both sides by L, taking logs and time derivatives and rearranging) TFP is computed according to the equation below (with a capital-income share $\alpha = 1/3$)[23]:

$$TFP_{it} = rgdpwok_{it} / [(Ky_{it} * rgdpwok_{it})^{\alpha} . \exp(\varphi * H_{it})^{(1-\alpha)}]. \qquad (A3)$$

Appendix 1.b Financial Development Proxies

The first measure, Liquid Liabilities (*llgdp*), is calculated as the liquid liabilities of banks and non-bank financial intermediaries (currency plus demand and interest-bearing liabilities) over GDP. The second indicator, Private Credit (*pcrdbofgdp*), measures general financial intermediary activities provided to the private sector. The third one, Commercial-Central Bank (*dbacba*), proxies the advantage of financial intermediaries in channelling savings to investment, monitoring firms, influencing corporate governance and undertaking risk management relative to the central bank.

Efficiency measures for the banking sector: Overhead Costs (*overhead*), the ratio of overhead costs to total bank assets; and the Net Interest Margin (*netintmargin*), the difference between bank interest income and interest expenses, divided by total assets.[24]

Indices for stock market development: Stock Market Capitalization (*stmktcap*), the size index, is the ratio of the value of listed domestic shares to GDP. Total Value Traded (*stvaltraded*), the ratio of the value of domestic shares traded on domestic exchanges to GDP, can be used to gauge market liquidity on an economy-wide basis. Turnover Ratio (*stturnover*) is the ratio of the value of domestic share transactions on domestic exchanges to total value of listed domestic shares.[25] Finally, we consider two bond market capitalization measures as ratios to GDP, private (*prbond*) and public (*pubond*).

Following Huang (2010), we combine the above financial measures as follows: 1) Overall financial development, 1st principal component of *pcrdbofgdp, llgdp, dbacba, overhead, netintmargin, stmktcap, stvaltraded* and *stturnover*; 2) Financial intermediary development, 1st principal component of *pcrdbofgdp*, *llgdp* and *dbacba*; 3) Stock market development, 1st principal component of *stmktcap stvaltraded* and *stturnover*; 4) Financial

[23] Since consistent data of factor income shares are difficult to obtain for individual countries, most empirical papers assume that income shares are identical across time and space. Gollin (2002) provides strong evidence supporting this assumption, which is also consistent with the Cobb-Douglas function approach. Moreover, Bernanke and Gürkaynak (2001) find no systematic tendency for labour shares to vary with real GDP per capita or the capital-labour ratio nor a systematic tendency to rise or fall over time, and most estimated labour income shares lie between 0.6 and 0.8. For our own purposes we take it to be equal to 2/3.

[24] Lower overhead costs and net interest margins frequently indicate greater competition and efficiency.

[25] A high value of the turnover ratio indicates a more liquid (and potentially more efficient) equity market.

efficiency development, 1st principal component of overhead, *netintmargin*, *stvaltraded* and *stturnover*; 5) Financial size development, 1st principal component of *llgdp* and *stmktcap*; 6) Bond market development, 1st principal component of *prbond* and *pubond*.

The 1st principal component is normalized in such a way that high values indicate higher financial development. The first standardized index, overall Financial Development, can be written as:[26]

$$fd = 0.67 * pcrdbofgdp + 0.45 * llgdp + 0.28 * dbacba - 0.16 * overhead - 0.25 * netintmargin + \\ + 0.81 * stmktcap + 0.84 * stvaltraded + 0.33 * stturnover$$

In addition, the 1st principal component explains 79% of the total variance in the standardized data. Nevertheless, given our outlier discussion and the fact that PCA is based on the classical covariance matrix, which is sensitive to outliers, we take one further step. This drawback is easily solved by basing the PCA on a robust estimation of the covariance (correlation) matrix. A well suited method is the Minimum Covariance Determinant (MCD) that considers all subsets containing h% of the observations (generally 50%) and estimates $\sum$ (the variance) and μ (the mean) on the data of the subset associated with the smallest covariance matrix determinant. We implement Rousseeuw and Van Driessen's (1999) algorithm to estimate new measures for the previously created aggregated proxies. After re-computing the same measures with the MCD version we obtain similar results. Moreover, the pair wise correlation coefficients between the 12 different proxies range from 77 to 93 percent (statistically significant at 1%).

[26] A likelihood ratio test was used to examine the "sphericity"case, allowing for sampling variability in the correlations. This test comfortably rejects sphericity at the 1% level with a Kaiser-Meyer-Olkin measure of sampling adequacy equal to 0.753.

Appendix 2 – Variables and sources

Variable	Definition/Description	Acronym	2/
real GDP per capita		*Gdppc*	1/
gross fixed capital formation (% GDP)		*Gfcf_gdp*	2/
public investment (% GDP)		*Pubinv_gdp*	2/ 3/
Total Factor Productivity	Variable constructed using growth accounting techniques	*Tfp*	4/
Government budget surplus or deficit (% of GDP)	The government budget surplus or deficit as a percentage of GDP.	*Govbal_gdp*	5/
Central Government Debt (% GDP)		*Govdebt_gdp*	6/
School attainment	average years of schooling in the population over 25 years old from the international data on educational attainment	*Edu*	7/
literacy rate (% of people ages 15 to 24)		*Literates*	2/
primary school enrolment (% gross)		*Primary_enrol*	2/
primary school duration (years)		*Primary_dur*	2/
secondary school enrolment (% gross)		*Secondaru_enrol*	2/
secondary school duration (years)		*Secondary_dur*	2/
tertiary school enrolment (% gross)		*Tertiary_enrol*	2/
tertiary school duration (years)		*Tertiary_dur*	2/
land area (in square kilometres)		*Land_area*	2/
population		*Pop*	2/
imports and exports of good and services (BoP, current USD)		*Imp, exp*	2/
labor participation rate (% of total)		*Lfp*	2/
labor force		*Laborf*	2/
unemployment, total (% of total labor force)		*Unemp*	2/
fertility rate (births per woman)		*Fertility*	2/
age dependency ratio (% of working age population)		*Depratio_wa*	2/
urban population (% of total)		*Urban_pop*	2/
Short-term debt (% of exports of goods and services)		*Short_debt_gdp*	2/
terms of trade adjustment (constant LCU)		*Terms_trade*	2/
real effective exchange rate index (2000=100)		*Reer*	2/
Liquid Liabilities	One of the major indicators to measure the size, relative to the economy, of financial intermediaries, including three types of financial institutions: the central bank, deposit money banks and other financial institutions. It is calculated as the liquid liabilities of banks and non-bank financial intermediaries (currency plus demand and interest-bearing liabilities) over GDP.	*llgdp*	8/
Private Credit	is defined as the credit issued to the private sector by banks and other financial intermediaries divided by GDP excluding credit issued to government, government agencies and public enterprises, as well as the credit issued by the monetary authority and development banks. It measures general financial intermediary activities provided to the private sector.	*pcrdbofgdp*	8/
Commercial-Central Bank	is the ratio of commercial bank assets to the sum of commercial bank and central bank assets. It proxies the advantage of financial intermediaries in channelling savings to investment, monitoring firms, influencing corporate governance and undertaking risk management relative to the central bank.	*dbacba*	8/
Overhead Costs	is the ratio of overhead costs to total bank assets.	*overhead*	8/
Net Interest Margin	equals the difference between bank interest income and interest expenses, divided by total assets. A lower value of overhead costs and net interest margin is frequently interpreted as indicating greater competition and efficiency.	*netintmargin*	8/
Stock Market Capitalization	the size index, is the ratio of the value of listed domestic shares to GDP.	*stmktcap*	8/
Total Value Traded	as an indicator to measure market activity, is the ratio of the value of domestic shares traded on domestic exchanges to GDP, and can be used to gauge market liquidity on an economy-wide basis.	*stvaltraded*	8/
Turnover Ratio	is the ratio of the value of domestic share transactions on domestic exchanges to total value of listed domestic shares. A high value of the turnover ratio will indicate a more liquid (and potentially more efficient) equity market.	*stturnover*	8/
Private bond market capitalization		*prbond*	8/
Public bond market capitalization		*pubond*	8/
Banking crisis	Dummy variable taking the value 1 if a banking crisis occurred and zero otherwise	*Bankcrisis*	9/
Debt crisis	Dummy variable taking the value 1 if a debt crisis occurred and zero otherwise	*Debtcrisis*	9/
Currency crisis	Dummy variable taking the value 1 if a currency crisis occurred and zero otherwise	*Currencycrisis*	9/
Debt restructuring	Dummy variable taking the value 1 if a debt restructuring took place and zero otherwise	*debtrestru*	9/

1/ World Bank's Word Development Indicators (WDI). 2/ WDI, 3/ AMECO. 4/ version 6.3 of the Penn World Table PWT) of Heston et al. (2009). 5/ WDI, IMF IFS, Easterly (2001). 6/ IMF (Abas et al., 2010). 7/ Barro and Lee (2010). 8/ Ross Levine's publicly available database. 9/ Laeven and Valencia (2008).

Table 1: Growth equations, annual data – different estimation methods and samples

Dependent Variable: Real GDPpc growth	**OLS (pooled)**				**OLS-LAD**	**MM**	**FE-within**		**DIFF-GMM**		**SYS-GMM**	
Sample	**1970-1990**	**1990-2008**	**All**	**OECD**	**All**	**All**	**All**	**OECD**	**All**	**OECD**	**All**	**OECD**
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
gdppc(-1)	-1.31**	-0.59***	-0.71***	-0.71**	-0.75***	-0.56***	-3.54***	-1.64**	-8.98**	-3.35	-1.00***	0.05
	(0.549)	(0.130)	(0.122)	(0.286)	(0.131)	(0.095)	(0.898)	(0.797)	(3.659)	(3.277)	(0.308)	(2.817)
popgr	-1.41**	-0.65***	-0.74***	-0.56*	-0.86***	-0.89***	-1.01***	-1.40***	-1.10*	-2.21	-0.77***	-2.07
	(0.569)	(0.134)	(0.134)	(0.322)	(0.117)	(0.088)	(0.320)	(0.476)	(0.607)	(1.918)	(0.256)	(3.074)
openness	-0.01	0.00	0.01**	0.01***	0.00	0.01**	0.05***	0.06***	0.15***	0.09***	0.02*	0.02
	(0.011)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.009)	(0.014)	(0.049)	(0.028)	(0.010)	(0.010)
gfcf_gdp	0.24***	0.10***	0.12***	0.10***	0.14***	0.10***	0.18***	0.12**	-0.00	0.32**	0.15***	0.01
	(0.072)	(0.017)	(0.017)	(0.036)	(0.019)	(0.017)	(0.029)	(0.047)	(0.107)	(0.160)	(0.036)	(0.163)
education	0.02	0.02***	0.02***	0.02**	0.02***	0.01***	0.05***	0.02	0.18***	-0.04	0.04**	-0.02
	(0.027)	(0.006)	(0.006)	(0.008)	(0.006)	(0.004)	(0.014)	(0.015)	(0.061)	(0.041)	(0.017)	(0.058)
govdebt_gdp	0.00	-0.01***	-0.01***	-0.01	-0.02***	-0.01***	-0.02***	-0.01	-0.04**	0.01	-0.03***	-0.02
	(0.018)	(0.004)	(0.004)	(0.007)	(0.004)	(0.003)	(0.006)	(0.012)	(0.016)	(0.045)	(0.010)	(0.039)
credit*debt	-0.03	-0.01***	-0.01***	0.00	-0.01	-0.01***	-0.00	-0.00	-0.03	-0.01	-0.03	-0.01
	(0.042)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.010)	(0.007)	(0.032)	(0.021)	(0.025)	(0.023)
Standardized Coeff.												
inigdppc	*-0.36*	*-0.25*	*-0.26*	*-0.18*	*-0.34*							
popgr	*-0.31*	*-0.21*	*-0.22*	*-0.13*	*-0.28*							
openness	*-0.04*	*0.03*	*0.05*	*0.18*	*0.03*							
gfcf_gdp	*0.31*	*0.19*	*0.20*	*0.14*	*0.26*							
education	*0.11*	*0.16*	*0.18*	*0.12*	*0.15*							
govdebt_gdp	*0.02*	*-0.14*	*-0.10*	*-0.10*	*-0.21*							
*credit*debt*	*-0.08*	*-0.10*	*-0.08*	*0.01*	*-0.06*							
Obs.	236	1,141	1,598	429	896	1,598	1,598	429	920	249	1,598	429
F-test (p-value)	0.00	0.00	0.00	0.00	0.00							
R-squared	0.14	0.16	0.15	0.13	0.26		0.14	0.18				
Hansen (p-value)									0.31	1.00	1.00	1.00
AB AR(1) (p-value)									0.00	0.03	0.00	0.02
AB AR(2) (p-value)									0.05	0.43	0.04	0.61

Note: The models are estimated by OLS (OLS-pooled), OLS with Least Absolute Deviation robust version (OLS-LAD), MM estimator a la Yohai (1987) which efficiently makes uses of both the S and Huber-type M estimators using iteratively reweighted least squares (IRWLS), Bias-Corrected Least Squares Dummy Variable (LSDV-C), Within Fixed Effects (FE-within), Two-Step robust Difference GMM (DIFF-GMM) and Two-Step robust System GMM (SYS-GMM). For the latter two methods lagged regressors are used as suitable instruments. The dependent variable is real GDPpc growth, as identified in the first row. Robust heteroskedastic-consistent standard errors are reported in parenthesis below each coefficient estimate. The standardised coefficients show the change of a standard deviation of GDPpc growth due to a one standard deviation change in a variable of interest. The F-test p-value reports the test on the joint significance of the regressors. The Hansen test evaluates the validity of the instrument set, i.e., tests for over-identifying restrictions. AR(1) and AR(2) are the Arellano-Bond autocorrelation tests of first and second order (the null is no autocorrelation), respectively. A constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels.

Table 2: Growth equations, 5-year averages data – different estimation methods and samples

Dependent Variable: Real GDPpc growth	**OLS**			**OLS-LAD**	**MM**	**LSDV-C**	**FE-within**		**IV-GLS**		**SYS-GMM**	
Sample	**All**	**OECD**	**Emerg**	**All**	**All**	**All**	**All**	**OECD**	**All**	**OECD**	**All**	**OECD**
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
inigdppc	-0.55***	-0.60***	-0.97***	-0.52***	-0.82***	-5.05***	-5.22***	-2.90***	-4.17***	-2.66***	-0.30	-2.72
	(0.125)	(0.227)	(0.258)	(0.118)	(0.095)	(0.510)	(0.619)	(0.467)	(0.541)	(0.422)	(0.308)	(2.927)
popgr	-0.36***	-0.02	-0.37**	-0.41***	-0.68***	-0.37**	-0.37	-0.59	-0.37*	-0.54*	-0.31*	1.03
	(0.111)	(0.191)	(0.165)	(0.111)	(0.217)	(0.174)	(0.226)	(0.390)	(0.220)	(0.308)	(0.181)	(0.750)
openness	0.00	0.01***	0.01	0.00	0.00*	0.04***	0.04***	0.05***	0.04***	0.04***	0.01	0.02
	(0.002)	(0.003)	(0.005)	(0.002)	(0.002)	(0.008)	(0.009)	(0.015)	(0.007)	(0.010)	(0.010)	(0.024)
gfcf_gdp	0.16***	0.11***	0.22***	0.15***	0.14***	0.16***	0.18***	0.13**	0.16***	0.13***	0.21***	-0.00
	(0.021)	(0.028)	(0.040)	(0.019)	(0.022)	(0.024)	(0.042)	(0.049)	(0.031)	(0.039)	(0.042)	(0.230)
education	0.02**	0.01	0.01	0.02***	0.02***	0.05***	0.05***	0.01	0.04***	0.01	0.01	-0.00
	(0.007)	(0.006)	(0.011)	(0.006)	(0.007)	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)	(0.020)	(0.032)
govdebt_gdp	-0.02***	-0.01**	-0.02**	-0.02***	-0.02***	-0.01***	-0.02***	-0.00	-0.02***	-0.00	-0.01***	-0.01
	(0.002)	(0.004)	(0.008)	(0.002)	(0.006)	(0.003)	(0.003)	(0.005)	(0.003)	(0.005)	(0.004)	(0.042)
Standardized Coeff.												
inigdppc	*-0.25*	*-0.25*	*-0.32*	*-0.25*								
popgr	*-0.14*	*-0.006*	*-0.18*	*-0.17*								
openness	*0.03*	*0.19*	*0.08*	*0.027*								
gfcf_gdp	*0.33*	*0.25*	*0.36*	*0.32*								
education	*0.15*	*0.06*	*0.07*	*0.16*								
govdebt_gdp	*-0.23*	*-0.13*	*-0.15*	*-0.24*								
Obs.	982	217	204	967	982	964	982	217	918	210	982	217
F-test (p-value)	0.00	0.00	0.00	0.00								
R-squared	0.21	0.20	0.31	0.22			0.28	0.27	0.26	0.25		
Hansen (p-value)											0.20	1.00
AB AR(1) (p-value)											0.00	0.06
AB AR(2) (p-value)											0.86	0.53

Note: The models are estimated by OLS (OLS-pooled), OLS with Least Absolute Deviation robust version (OLS-LAD), MM estimator a la Yohai (1987) which efficiently makes uses of both the S and Huber-type M estimators using iteratively reweighted least squares (IRWLS), Bias-Corrected Least Squares Dummy Variable (LSDV-C), Within Fixed Effects (FE-within), Panel IV-GLS estimation and Two-Step robust System GMM (SYS-GMM). For the latter two methods lagged regressors are used as suitable instruments. The dependent variable is real GDPpc growth, as identified in the first row. Robust heteroskedastic-consistent standard errors are reported in parenthesis below each coefficient estimate. The standardised coefficients show the change of a standard deviation of GDPpc growth due to a one standard deviation change in a variable of interest. The F-test p-value reports the test on the joint significance of the regressors. The Hansen test evaluates the validity of the instrument set, i.e., tests for over-identifying restrictions. AR(1) and AR(2) are the Arellano-Bond autocorrelation tests of first and second order (the null is no autocorrelation), respectively. Time fixed effects were included, but are not reported. Also a constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels.

Table 3.a: Growth equations with short-debt-to-GDP and long-debt-to-GDP ratios, 5-year averages data – different estimation methods

Dependent Variable: Real GDPpc growth	**OLS**		**OLS-LAD**		**MM**		**LSDV-C**		**FE-within**		**IV-GLS**		**SYS-GMM**	
Sample	**All**													
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
inigdppc	-0.55***	-0.85***	-0.49***	-0.79***	-0.81***	-1.05***	-6.92***	-6.94***	-6.40***	-6.68***	-4.22***	-4.86***	-0.68	-0.72*
	(0.184)	(0.188)	(0.178)	(0.181)	(0.147)	(0.148)	(0.770)	(0.657)	(0.778)	(0.806)	(0.740)	(0.765)	(0.477)	(0.412)
Popgr	-0.38**	-0.38**	-0.49***	-0.51***	-1.11***	-0.98***	-0.48**	-0.48**	-0.24	-0.37	-0.15	-0.19	-0.15	-0.35
	(0.169)	(0.159)	(0.168)	(0.160)	(0.169)	(0.259)	(0.190)	(0.214)	(0.245)	(0.270)	(0.168)	(0.179)	(0.174)	(0.243)
Openness	0.00	0.00	-0.00	-0.00	-0.00	-0.00	0.04***	0.05***	0.04***	0.05***	0.04***	0.04***	0.01	0.03**
	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.010)	(0.010)	(0.011)	(0.010)	(0.008)	(0.009)	(0.012)	(0.011)
gfcf_gdp	0.17***	0.17***	0.17***	0.16***	0.16***	0.17***	0.16***	0.16***	0.21***	0.19***	0.15***	0.14***	0.22***	0.20***
	(0.026)	(0.025)	(0.024)	(0.023)	(0.036)	(0.032)	(0.028)	(0.030)	(0.054)	(0.050)	(0.029)	(0.030)	(0.045)	(0.044)
education	0.02**	0.02**	0.02*	0.02**	0.02***	0.03***	0.08***	0.08***	0.07***	0.08***	0.06***	0.07***	0.03	-0.00
	(0.009)	(0.009)	(0.009)	(0.009)	(0.007)	(0.010)	(0.017)	(0.015)	(0.014)	(0.015)	(0.014)	(0.014)	(0.023)	(0.023)
shortgovdebt_gdp	-0.04***		-0.04**		-0.05**		-0.00		-0.00		-0.04***		-0.05***	
	(0.016)		(0.016)		(0.018)		(0.021)		(0.027)		(0.013)		(0.016)	
longgovdebt_gdp		-0.02***		-0.02***		-0.02***		-0.01***		-0.02***		-0.01***		-0.02***
		(0.003)		(0.003)		(0.003)		(0.004)		(0.006)		(0.004)		(0.007)
Standardized Coeff.														
inigdppc	*-0.15*	*-0.24*	*-0.14*	*-0.24*										
popgr	*-0.12*	*-0.12*	*-0.16*	*-0.17*										
openness	*0.004*	*0.03*	*-0.03*	*-0.0005*										
gfcf_gdp	*0.33*	*0.34*	*0.33*	*0.34*										
education	*0.15*	*0.17*	*0.14*	*0.16*										
shortgovdebt_gdp	*-0.10*		*-0.09*											
longgovdebt_gdp		*-0.24*		*-0.25*										
Obs.	629	594	620	585	629	594	616	585	629	594	529	493	629	594
F-test (p-value)	0.00	0.00	0.00	0.00										
R-squared	0.18	0.23	0.19	0.24					0.28	0.32	0.27	0.29		
Hansen (p-value)													0.91	0.89
AB AR(1) (p-value)													0.00	0.00
AB AR(2) (p-value)													0.29	0.57

Note: The models are estimated by OLS (OLS-pooled), OLS with Least Absolute Deviation robust version (OLS-LAD), MM estimator a la Yohai (1987) which efficiently makes uses of both the S and Huber-type M estimators using iteratively reweighted least squares (IRWLS), Bias-Corrected Least Squares Dummy Variable (LSDV-C), Within Fixed Effects (FE-within), Panel IV-GLS estimation and Two-Step robust System GMM (SYS-GMM). For the latter two methods lagged regressors are used as suitable instruments. The dependent variable is real GDPpc growth, as identified in the first row. Robust heteroskedastic-consistent standard errors are reported in parenthesis below each coefficient estimate. The standardised coefficients show the change of a standard deviation of GDPpc growth due to a one standard deviation change in a variable of interest. The F-test p-value reports the test on the joint significance of the regressors. The Hansen test evaluates the validity of the instrument set, i.e., tests for over-identifying restrictions. AR(1) and AR(2) are the Arellano-Bond autocorrelation tests of first and second order (the null is no autocorrelation), respectively. Time fixed effects were included, but are not reported. Also a constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels.

Table 3.b: Growth equations with debt average maturity plus dummy interactions, 5-year averages data – different estimation methods (OECD sample)

Dependent Variable: Real GDPpc growth	**OLS**		**FE-within**		**IV-GLS**		**SYS-GMM**	
Sample	**OECD**							
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
inigdppc	-0.81***	-0.72**	-6.05***	-5.93***	-4.48**	-4.97**	-0.63	-0.56
	(0.304)	(0.313)	(1.569)	(1.934)	(2.158)	(2.054)	(0.887)	(0.473)
popgr	-0.06	-0.16	-2.78***	-2.38***	-1.97***	-2.01***	0.41	0.52
	(0.258)	(0.279)	(0.718)	(0.527)	(0.745)	(0.692)	(0.756)	(1.731)
openness	0.01**	0.01**	0.09**	0.11**	0.08***	0.09***	0.00	0.01
	(0.003)	(0.003)	(0.042)	(0.049)	(0.029)	(0.030)	(0.006)	(0.008)
gfcf_gdp	0.06	0.06	0.34***	0.43***	0.21	0.35**	-0.03	0.01
	(0.047)	(0.045)	(0.080)	(0.071)	(0.146)	(0.167)	(0.133)	(0.131)
education	-0.00	-0.00	0.02	0.03*	0.02	0.01	-0.01	0.01
	(0.008)	(0.008)	(0.012)	(0.014)	(0.028)	(0.030)	(0.011)	(0.016)
debtavtermmat	0.01		0.33*		-0.02		-0.02	
	(0.057)		(0.184)		(0.148)		(0.164)	
govdebt_gdp		-0.00		0.02**		0.02***		-0.02
		(0.004)		(0.009)		(0.007)		(0.021)
govdebt_gdp*dumlong		-0.00		-0.00		-0.00		-0.00
		(0.003)		(0.004)		(0.003)		(0.004)
Standardized Coeff.								
inigdppc	*-0.35*	*-0.31*						
popgr	*-0.01*	*-0.04*						
openness	*0.19*	*0.17*						
gfcf_gdp	*0.15*	*0.14*						
education	*-0.04*	*-0.03*						
debtavtermmat	*0.01*							
govdebt_gdp		*-0.06*						
Obs.	93	93	93	93	66	66	93	93
F-test (p-value)	0.00	0.00						
R-squared	0.24	0.25	0.46	0.44	0.30	0.36		
Hansen (p-value)							1.00	1.00
AB AR(1) (p-value)							0.77	0.99
AB AR(2) (p-value)							0.72	0.92

Note: The models are estimated by OLS (OLS-pooled), Within Fixed Effects (FE-within), Panel IV-GLS estimation and Two-Step robust System GMM (SYS-GMM). For the latter method lagged regressors are used as suitable instruments. The dependent variable is real GDPpc growth, as identified in the first row. Robust heteroskedastic-consistent standard errors are reported in parenthesis below each coefficient estimate. The standardised coefficients show the change of a standard deviation of GDPpc growth due to a one standard deviation change in a variable of interest. The F-test p-value reports the test on the joint significance of the regressors. The Hansen test evaluates the validity of the instrument set, i.e., tests for over-identifying restrictions. AR(1) and AR(2) are the Arellano-Bond autocorrelation tests of first and second order (the null is no autocorrelation), respectively. Time fixed effects were included, but are not reported. Also a constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels.

Table 4: Growth equations with debt and financial crisis, 5-year averages data – different estimation methods

Dependent Variable: Real GDPpc growth	FE(within)					IV-GLS					SYS-GMM				
Sample	**All**														
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
inigdppc	-5.22***	-5.29***	-5.13***	-5.28***	-5.33***	-4.17***	-4.08***	-3.83***	-4.04***	-4.11***	-0.52	-0.41	-0.54	-0.37	-0.12
	(0.619)	(0.694)	(0.722)	(0.711)	(0.698)	(0.541)	(0.566)	(0.567)	(0.559)	(0.570)	(0.575)	(0.474)	(0.535)	(0.489)	(0.625)
popgr	-0.37	-0.56**	-0.57**	-0.57**	-0.57**	-0.37*	-0.54**	-0.54**	-0.56**	-0.56**	-0.18	-0.61	-0.69*	-0.68	-0.88
	(0.226)	(0.273)	(0.278)	(0.265)	(0.278)	(0.220)	(0.231)	(0.232)	(0.220)	(0.237)	(0.370)	(0.438)	(0.376)	(0.415)	(0.549)
openness	0.04***	0.04***	0.04***	0.04***	0.04***	0.04***	0.04***	0.03***	0.04***	0.04***	0.01	-0.01	0.00	-0.01	0.00
	(0.009)	(0.010)	(0.011)	(0.010)	(0.010)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.026)	(0.015)	(0.014)	(0.017)	(0.018)
gfcf_gdp	0.18***	0.18***	0.18***	0.18***	0.18***	0.16***	0.16***	0.16***	0.16***	0.16***	0.19***	0.25***	0.23***	0.22***	0.23***
	(0.042)	(0.044)	(0.044)	(0.044)	(0.045)	(0.031)	(0.032)	(0.032)	(0.032)	(0.032)	(0.060)	(0.049)	(0.049)	(0.050)	(0.055)
education	0.05***	0.05***	0.05***	0.04***	0.05***	0.04***	0.03***	0.03***	0.03***	0.03***	0.03	0.02	0.03	0.03	0.00
	(0.010)	(0.011)	(0.011)	(0.011)	(0.011)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.042)	(0.033)	(0.035)	(0.035)	(0.044)
govdebt_gdp	-0.02***	-0.01***	-0.02***	-0.01***	-0.02***	-0.02***	-0.01***	-0.01***	-0.01**	-0.02***	-0.01**	-0.00	-0.00	-0.00	-0.01***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.006)	(0.003)	(0.004)	(0.003)
govdebt_gdp*bankingcrisis		-0.01					-0.00					-0.00			
		(0.004)					(0.004)					(0.005)			
govdebt_gdp*debtcrisis			-0.02***					-0.02***					-0.02***		
			(0.005)					(0.005)					(0.006)		
govdebt_gdp*currencycrisis				-0.01***					-0.01***					-0.01***	
				(0.004)					(0.004)					(0.003)	
govdebt_gdp*debtrestruct					-0.00					0.00					0.01*
					(0.003)					(0.003)					(0.004)
Obs.	982	876	876	876	876	918	826	826	826	826	982	876	876	876	876
R-squared	0.28	0.29	0.29	0.30	0.28	0.26	0.26	0.28	0.28	0.26					
Hansen (p-value)											1.00	1.00	1.00	1.00	1.00
AB AR(1) (p-value)											0.00	0.00	0.00	0.00	0.00
AB AR(2) (p-value)											1.00	0.82	0.81	0.76	0.78

Note: The models are estimated by Within Fixed Effects (FE-within), Panel IV-GLS estimation and Two-Step robust System GMM (SYS-GMM). For the latter method lagged regressors are used as suitable instruments. The dependent variable is real GDPpc growth, as identified in the first row. Robust heteroskedastic-consistent standard errors are reported in parenthesis below each coefficient estimate. The Hansen test evaluates the validity of the instrument set, i.e., tests for over-identifying restrictions. AR(1) and AR(2) are the Arellano-Bond autocorrelation tests of first and second order (the null is no autocorrelation), respectively. Time fixed effects were included, but are not reported. Also a constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels.

Table 5: Growth equations with initial conditions, 5-year averages data – different estimation methods and samples

Dependent Variable: Real GDPpc growth	OLS		Fixed-Effects (within)		FE-LAD		IV-GLS		SYS-GMM	
Sample	**All**	**OECD**	**All**	**OECD**	**All**	**OECD**	**All**	**OECD**	**All**	**OECD**
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
inigdppc	-0.14	-0.98***	-4.18***	-3.15**	-3.95***	-3.15**	-4.23***	-3.16***	-0.45	-1.58*
	(0.095)	(0.311)	(0.959)	(1.465)	(0.931)	(1.465)	(0.801)	(1.201)	(0.458)	(0.930)
iniedu	0.68	-1.28	0.42	1.20	0.43	1.20	0.37	1.23	3.86*	4.55
	(0.767)	(2.096)	(0.684)	(1.575)	(0.674)	(1.575)	(0.689)	(1.951)	(2.106)	(3.902)
iniinf	0.002***	-0.00	0.001***	-0.00	0.003***	-0.00	0.002***	-0.00	0.01	-0.02
	(0.000)	(0.002)	(0.000)	(0.002)	(0.000)	(0.002)	(0.000)	(0.002)	(0.008)	(0.029)
inigovsize	0.04	0.09	0.26	0.31	0.27	0.31	0.34**	0.31	-0.32	-0.22
	(0.090)	(0.115)	(0.169)	(0.196)	(0.174)	(0.196)	(0.174)	(0.198)	(0.344)	(0.308)
inifindepth	0.35	-0.31	2.65**	0.24	2.71*	0.24	2.32**	0.23	-0.38	2.64
	(0.409)	(0.458)	(1.332)	(1.195)	(1.375)	(1.195)	(1.022)	(1.012)	(3.029)	(1.760)
initrade	0.01	0.01**	0.01	0.01	0.01	0.01	0.02**	0.01	-0.01	0.01
	(0.003)	(0.004)	(0.009)	(0.015)	(0.008)	(0.015)	(0.008)	(0.013)	(0.015)	(0.007)
bankcrisis	-1.24***	-1.45***	-1.30***	-1.12**	-1.32***	-1.12**	-1.39***	-1.12**	-2.70**	-2.21*
	(0.392)	(0.541)	(0.369)	(0.489)	(0.360)	(0.489)	(0.346)	(0.525)	(1.063)	(1.340)
govbal_gdp	-0.01	0.13***	0.05	0.10*	0.06	0.10*	0.04	0.10**	0.08	0.05
	(0.052)	(0.045)	(0.048)	(0.056)	(0.048)	(0.056)	(0.043)	(0.049)	(0.080)	(0.105)
govdebt_gdp	-0.02***	-0.01*	-0.01*	-0.01	-0.01*	-0.01	-0.01*	-0.01	-0.03**	-0.02
	(0.004)	(0.006)	(0.006)	(0.009)	(0.006)	(0.009)	(0.006)	(0.008)	(0.012)	(0.014)
inigfcf	0.04	0.02	-0.05*	-0.12	-0.05	-0.12	-0.05*	-0.12*	0.19**	0.11
	(0.030)	(0.035)	(0.032)	(0.069)	(0.032)	(0.069)	(0.032)	(0.062)	(0.084)	(0.130)
Obs.	370	129	370	129	362	129	355	127	370	129
R-squared	0.13	0.31	0.27	0.37	0.28	0.37	0.27	0.37		
Hansen (p-value)									0.20	1.00
AB AR(1) (p-value)									0.00	0.00
AB AR(2) (p-value)									0.07	0.42

Note: The models are estimated by pooled OLS, Within Fixed Effects (FE-within), Fixed Effects Least-Absolute Deviation method (FE-LAD) and Two-Step robust System GMM (SYS-GMM). For the latter method lagged regressors are used as suitable instruments. The dependent variable is real GDPpc growth, as identified in the first row. Robust heteroskedastic-consistent standard errors are reported in parenthesis below each coefficient estimate. The Hansen test evaluates the validity of the instrument set, i.e., tests for over-identifying restrictions. AR(1) and AR(2) are the Arellano-Bond autocorrelation tests of first and second order (the null is no autocorrelation), respectively. Time fixed effects were included, but are not reported. Also a constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels.

Table 6: Impact on real GDP growth per capita of a 10 % increase in the debt ratio

	Initial debt ratios (% GDP)		
	<30	30-60	>90
Sample average of govdebt	14.644	46.542	116.565
Regression coefficient, average(1)	0.067	-0.017	-0.023
Growth impact of 10% increase in govdebt from sample average(2)	0.098	-0.079	-0.268

Note: (1) average of the estimates (from OLS, FE, SYS-GMM) on the coefficients of interaction terms between initial debt-to-GDP and dummy variables for four categories of levels of initial debt-to-GDP (below 30%, between 30 and 60%, between 60 and 90% and above 90% of GDP) for the entire sample period. The results are based on coefficients statistically different from zero. However, the statistical significance of the coefficients varies across estimations. (2) this estimate of growth impact of 10% increase in debt ratio is obtained as a product of the regression coefficient (row 2) and 10% of the sample average debt ratios (row 1).

Table 7: Growth equation with different levels of Government Debt plus initial regressors, 5 year averages data – different estimation methods and samples

Dependent Variable: Real GDPpc growth	OLS (pooled)			Fixed-Effects (within)			SYS-GMM		
Sample	**All**	**OECD**	**Emerg**	**All**	**OECD**	**Emerg**	**All**	**OECD**	**Emerg**
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Included one at a time									
govdebt_gdp	-0.02***	-0.00	-0.02	-0.01	0.00	0.01	-0.02**	-0.02	-0.03*
	(0.005)	(0.006)	(0.015)	(0.012)	(0.010)	(0.036)	(0.009)	(0.020)	(0.014)
govdebt*dumav60	-0.01**	-0.01	-0.01	-0.01	-0.02	0.03	-0.02*	0.00	-0.03
	(0.004)	(0.005)	(0.010)	(0.014)	(0.014)	(0.056)	(0.012)	(0.014)	(0.023)
Obs.	288	129	73	288	129	73			
R-squared	0.20	0.32	0.53	0.26	0.38	0.38			
govdebt_gdp	-0.01***	-0.00	-0.03*	-0.00	0.00	0.01	-0.02**	-0.01	0.01
	(0.005)	(0.007)	(0.015)	(0.012)	(0.010)	(0.036)	(0.009)	(0.022)	(0.000)
govdebt*dumav65	-0.01**	-0.01	-0.01	-0.02	-0.02	0.03	-0.02	-0.00	-0.05
	(0.005)	(0.006)	(0.010)	(0.014)	(0.015)	(0.058)	(0.012)	(0.013)	(0.000)
Obs.	288	129	73	288	129	73			
R-squared	0.20	0.32	0.52	0.27	0.39	0.38			
govdebt_gdp	-0.02***	-0.01	-0.03*	-0.01	-0.01	0.01	-0.02*	-0.03	0.01
	(0.005)	(0.008)	(0.015)	(0.012)	(0.013)	(0.036)	(0.010)	(0.029)	(0.000)
govdebt*dumav70	-0.01**	0.00	-0.01	-0.01	-0.00	0.03	-0.02	0.02	-0.05
	(0.005)	(0.006)	(0.010)	(0.014)	(0.013)	(0.058)	(0.013)	(0.029)	(0.000)
Obs.	288	129	73	288	129	73			
R-squared	0.20	0.32	0.52	0.26	0.37	0.38			
govdebt_gdp	-0.02***	-0.01	-0.03*	-0.01	-0.01	0.01	-0.02*	-0.03	0.01
	(0.005)	(0.008)	(0.015)	(0.011)	(0.013)	(0.036)	(0.011)	(0.028)	(0.000)
govdebt*dumav75	-0.01**	0.00	-0.01	-0.01	-0.00	0.03	-0.02	0.02	-0.05
	(0.005)	(0.006)	(0.010)	(0.015)	(0.013)	(0.058)	(0.014)	(0.024)	(0.000)
Obs.	288	129	73	288	129	73			
R-squared	0.20	0.32	0.52	0.26	0.37	0.38			
govdebt_gdp	-0.02***	-0.01	-0.03*	-0.01	-0.01	0.01	-0.02	-0.03	0.03
	(0.005)	(0.008)	(0.015)	(0.011)	(0.013)	(0.036)	(0.012)	(0.028)	(0.020)
govdebt*dumav80	-0.01**	0.00	-0.01	-0.01	-0.00	0.02	-0.02	0.02	-0.07***
	(0.005)	(0.006)	(0.012)	(0.015)	(0.013)	(0.066)	(0.013)	(0.024)	(0.025)
Obs.	288	129	73	288	129	73			
R-squared	0.20	0.32	0.52	0.26	0.37	0.37			
govdebt_gdp	-0.02***	-0.01	-0.03*	-0.01	-0.01	0.01	-0.02**	-0.03	0.03
	(0.005)	(0.008)	(0.015)	(0.010)	(0.013)	(0.036)	(0.011)	(0.028)	(0.020)
govdebt*dumav85	-0.01*	0.00	-0.01	-0.01	-0.00	0.02	-0.01	0.02	-0.07***
	(0.005)	(0.006)	(0.012)	(0.015)	(0.013)	(0.066)	(0.013)	(0.024)	(0.025)
Obs.	288	129	73	288	129	73			
R-squared	0.20	0.32	0.52	0.26	0.37	0.37			
govdebt_gdp	-0.02***	-0.01	-0.03*	-0.01	-0.01	0.01	-0.02**	-0.03	0.03
	(0.005)	(0.008)	(0.015)	(0.010)	(0.013)	(0.036)	(0.011)	(0.028)	(0.020)
govdebt*dumav90	-0.01*	0.00	-0.01	-0.01	-0.00	0.02	-0.01	0.02	-0.07***
	(0.005)	(0.006)	(0.012)	(0.015)	(0.013)	(0.066)	(0.013)	(0.024)	(0.025)
Obs.	288	129	73	288	129	73			
R-squared	0.20	0.32	0.52	0.26	0.37	0.37			
govdebt_gdp	-0.02***	-0.01	-0.03*	-0.01	-0.01	0.01	-0.02**	-0.03	0.03
	(0.005)	(0.008)	(0.015)	(0.010)	(0.013)	(0.036)	(0.011)	(0.028)	(0.020)
govdebt*dumav95	-0.01*	0.00	-0.01	-0.01	-0.00	0.02	-0.01	0.02	-0.07***
	(0.005)	(0.006)	(0.012)	(0.015)	(0.013)	(0.066)	(0.013)	(0.024)	(0.025)
Obs.	288	129	73	288	129	73			
R-squared	0.20	0.32	0.52	0.26	0.37	0.37			
govdebt_gdp	-0.01***	-0.01	-0.02*	-0.00	-0.01	0.04	-0.02*	-0.03	-0.03
	(0.005)	(0.008)	(0.013)	(0.011)	(0.013)	(0.038)	(0.012)	(0.028)	(0.031)
govdebt*dumav100	-0.01***	0.00	-0.02	-0.02	-0.00	-0.12***	-0.01	0.02	-0.04***
	(0.005)	(0.006)	(0.015)	(0.013)	(0.013)	(0.029)	(0.012)	(0.024)	(0.016)
Obs.	288	129	73	288	129	73			
R-squared	0.21	0.32	0.53	0.27	0.37	0.45			

Note: The models are estimated by OLS, Within Fixed Effects (FE-within) and Two-Step robust System GMM (SYS-GMM). For the latter method lagged regressors are used as suitable instruments. The dependent variable is real GDPpc growth, as identified in the first row. For the first panel dumav30, dumav3060 and dumav90, are binary dummy variables taking the value 1 if the average debt-to-GDP ratio of a particular country over the sample's time span is below 30%, between 30 and 60% or above 90%, respectively. For the second panel, we also take the average value of the debt-to-GDP ration for each country as the threshold level, but now dumav60 refers to having that average ratio above 60%. Mutatis mutandis for the remaining levels. Robust heteroskedastic-consistent standard errors are reported in parenthesis below each coefficient estimate. The Hansen test evaluates the validity of the instrument set, i.e., tests for over-identifying restrictions. AR(1) and AR(2) are the Arellano-Bond autocorrelation tests of first and second order (the null is no autocorrelation), respectively. Time fixed effects were included. *, **, *** denote significance at 10, 5 and 1% levels.

Table 8: Growth equation with different levels of government debt plus initial regressors and proxies for financial development, 5-year averages data – different estimation methods and samples

Dependent Variable: Real GDPpc growth	OLS (pooled)			Fixed-Effects (within)			SYS-GMM		
Sample	**All**	**OECD**	**Emerg**	**All**	**OECD**	**Emerg**	**All**	**OECD**	**Emerg**
(a)	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
fd	-0.01	0.14	3.29*	1.07	3.30***	-4.74**	1.40	-5.56	3.68
	(1.068)	(1.530)	(1.764)	(0.773)	(1.002)	(1.844)	(3.199)	(7.482)	(0.000)
fd*dumav30	-0.87	-0.46	-7.71***	-0.72	-2.97***	14.05	-1.34	4.97	6.13
	(1.124)	(1.633)	(1.971)	(0.720)	(0.963)	(12.937)	(3.320)	(8.699)	(0.000)
fd*dumav3060	0.03	-0.00	-5.00**	-0.26	-1.98*	2.86	-1.27	5.20	0.79
	(1.069)	(1.598)	(1.827)	(0.752)	(1.035)	(3.397)	(3.367)	(7.857)	(0.000)
fd*dumav90	-0.13	-1.77	-4.13**	-0.50	-1.25	2.56	-0.81	7.25	-3.87
	(1.387)	(2.038)	(1.985)	(2.049)	(2.383)	(35.745)	(3.205)	(9.593)	(0.000)
Obs.	127	80	36	127	80	36	127	80	36
R-squared	0.26	0.26	0.75	0.55	0.70	0.61			
Included one at a time (b)									
fd	-0.37	-0.07	-2.36***	0.67***	1.00***	-0.22	0.03	0.42	0.32
	(0.223)	(0.285)	(0.622)	(0.224)	(0.362)	(2.643)	(0.767)	(0.900)	(2.330)
fd*dumav60	0.26	-0.28	2.61**	0.14	1.48	-3.81	0.13	-1.21	0.09
	(0.782)	(1.311)	(1.038)	(0.840)	(1.143)	(2.564)	(1.300)	(1.799)	(2.739)
Obs.	127	80	36	127	80	36	127	80	36
R-squared	0.23	0.24	0.66	0.54	0.68	0.60			
fbank	-0.25	0.54	-0.66	0.52	0.35	4.60*	-0.67	-0.28	0.21
	(0.321)	(0.390)	(1.244)	(0.621)	(0.846)	(2.227)	(1.263)	(2.118)	(1.281)
fbank*dumav60	-0.10	-0.57	-0.05	-0.14	-0.09	-4.68**	-0.03	-0.15	-6.22
	(0.411)	(0.529)	(1.621)	(1.048)	(1.268)	(2.103)	(0.880)	(1.390)	(7.006)
Obs.	181	102	41	181	102	41	181	102	41
R-squared	0.23	0.33	0.63	0.38	0.48	0.77			
fstock	-0.17	0.08	-1.59**	0.67**	0.72**	1.47	-0.64	0.01	6.26
	(0.221)	(0.261)	(0.634)	(0.271)	(0.268)	(1.927)	(0.854)	(1.190)	(0.000)
fstock*dumav60	0.49	0.12	1.71	1.41	0.49	-2.67	0.40	0.40	-6.52
	(0.673)	(1.123)	(1.069)	(1.119)	(0.988)	(3.446)	(1.216)	(1.920)	(0.000)
Obs.	146	87	41	146	87	41	146	87	41
R-squared	0.24	0.32	0.66	0.47	0.53	0.68			
feff	-0.87**	-1.60***	-0.32	-0.28	1.19*	-0.81	-1.00	-0.81	-1.91
	(0.352)	(0.448)	(1.198)	(0.659)	(0.605)	(1.533)	(3.858)	(1.011)	(5.956)
feff*dumav60	0.34	1.04	-0.41	-0.59	-0.80	-8.92**	0.37	1.13	-1.24
	(0.626)	(0.821)	(3.345)	(1.818)	(2.058)	(3.904)	(1.863)	(1.604)	(5.431)
Obs.	133	81	36	133	81	36	133	81	36
R-squared	0.24	0.36	0.55	0.48	0.60	0.63			
fsize	-0.40	0.01	-2.17***	1.77**	1.72*	2.53	-0.30	1.30	-0.17
	(0.280)	(0.388)	(0.696)	(0.771)	(0.880)	(4.892)	(1.326)	(1.670)	(0.000)
fsize*dumav60	-0.17	-0.59	1.49	1.50	0.63	-4.13	0.91	-1.88	1.88
	(0.909)	(1.565)	(1.155)	(1.473)	(1.383)	(4.175)	(2.128)	(4.350)	(0.000)
Obs.	144	87	41	144	87	41	144	87	41
R-squared	0.25	0.32	0.69	0.48	0.54	0.69			
fbond	-0.56	0.22	-5.38***	2.17**	2.58***	-16.79***	-1.63	0.86	0.55
	(0.557)	(0.590)	(1.721)	(0.935)	(0.788)	(3.757)	(2.007)	(2.831)	(10.461)
fbond*dumav60	0.13	-0.36	8.82	-0.96	0.87	-10.74	-1.49	1.19	6.47
	(1.034)	(1.319)	(5.766)	(3.269)	(3.083)	(10.556)	(2.917)	(5.381)	(8.236)
Obs.	101	84	28	101	84	28	101	84	32
R-squared	0.25	0.29	0.62	0.58	0.62	0.78			

Note: The models are estimated by OLS, Within Fixed Effects (FE-within) and Two-Step robust System GMM (SYS-GMM). For the latter method lagged regressors are used as suitable instruments. The dependent variable is real GDPpc growth, as identified in the first row. For the first panel dumav30, dumav3060 and dumav90, are binary dummy variables taking the value 1 if the average debt-to-GDP ratio of a particular country over the sample's time span is below 30%, between 30 and 60% or above 90%, respectively. For the second panel, we also take the average value of the debt-to-GDP ration for each country as the threshold level, but now dumav60 refers to having that average ratio above 60%. *Fd, fbank, fstock, feff, fsize* and *fbond* correspond to the first principal component of different financial related variables based on Levine's publicly available database and they refer to Overal Financial development, Financial intermediary development, Stock market development, Financial efficiency development, Financial size development and Bond market development, respectively. For more detailed information do refer to the main text. Robust heteroskedastic-consistent standard errors are reported in parenthesis below each coefficient estimate. The Hansen test evaluates the validity of the instrument set, i.e., tests for over-identifying restrictions. AR(1) and AR(2) are the Arellano-Bond autocorrelation tests of first and second order (the null is no autocorrelation), respectively. Time fixed effects were included. *, **, *** denote significance at 10, 5 and 1% levels.

Table 9: Growth accounting with government debt plus initial regressors, 5-year averages data – different estimation methods and samples

Dependent Variable	Growth of TFP						Growth of capital stock per worker					
Estimation	**OLS (pooled)**	**FE (within)**	**SYS-GMM**	**OLS (pooled)**	**FE (within)**	**SYS-GMM**	**OLS (pooled)**	**FE (within)**	**SYS-GMM**	**OLS (pooled)**	**FE (within)**	**SYS-GMM**
Sample	**All**			**OECD**			**All**			**OECD**		
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
lagged dep. var.	-0.47***	- 5.89***	-0.71*	-3.31***	- 6.22***	-1.57	-0.27***	-1.88**	-0.15	-0.95***	- 1.17***	0.20
	(0.173)	(0.727)	(0.420)	(0.724)	(0.971)	(0.000)	(0.084)	(0.706)	(0.238)	(0.124)	(0.295)	(1.409)
iniedu	-0.01	-0.01	-1.27	1.52*	1.41**	-1.15	0.79***	0.17	0.94	-0.27	-0.09	-3.67
	(0.486)	(0.462)	(1.439)	(0.896)	(0.639)	(0.000)	(0.264)	(0.236)	(1.015)	(0.478)	(0.352)	(3.554)
iniinf	-0.00**	-0.00**	-0.00	-0.02*	0.00	0.01	0.00	-0.00	0.00	-0.01	-0.01	0.01
	(0.000)	(0.000)	(0.003)	(0.009)	(0.012)	(0.000)	(0.000)	(0.000)	(0.001)	(0.005)	(0.006)	(0.032)
inigovsize	-0.07	0.16	-0.18	-0.03	-0.01	0.10	-0.07*	0.13	0.01	0.03	0.14	0.07
	(0.045)	(0.106)	(0.162)	(0.054)	(0.151)	(0.000)	(0.039)	(0.092)	(0.097)	(0.041)	(0.083)	(0.094)
inifindepth	0.64***	2.62***	2.87***	0.53**	1.03	5.42	0.22*	-0.21	0.44	0.21*	0.06	0.43
	(0.219)	(0.703)	(1.080)	(0.218)	(0.615)	(0.000)	(0.131)	(0.453)	(0.680)	(0.115)	(0.358)	(0.971)
initrade	-0.00	0.00	-0.01*	0.00	-0.00	-0.00	-0.00	0.01	0.01	0.00	0.00	0.00
	(0.002)	(0.006)	(0.008)	(0.002)	(0.005)	(0.000)	(0.002)	(0.007)	(0.005)	(0.002)	(0.004)	(0.006)
bankcrisis	0.25	0.29	1.58**	-0.06	0.18	-1.47	-0.55***	-0.07	-0.20	-0.43**	-0.30**	-0.43
	(0.219)	(0.182)	(0.762)	(0.222)	(0.142)	(0.000)	(0.176)	(0.167)	(0.378)	(0.179)	(0.122)	(0.707)
govbal_gdp	-0.01	-0.03	0.07	-0.05**	-0.02	-0.08	-0.02	0.05	0.03	0.04***	0.06***	0.06
	(0.023)	(0.024)	(0.049)	(0.019)	(0.021)	(0.000)	(0.028)	(0.031)	(0.049)	(0.017)	(0.019)	(0.048)
govdebt_gdp	0.00	0.01**	0.01	-0.00	0.01*	-0.03	-0.01***	-0.00	-0.00	0.00	0.00	0.00
	(0.003)	(0.003)	(0.009)	(0.003)	(0.004)	(0.000)	(0.002)	(0.004)	(0.006)	(0.002)	(0.004)	(0.011)
inigfcf	0.03**	-0.03	0.06*	-0.05*	-0.11**	-0.29	0.04***	0.02	0.05	0.04***	0.03	0.06
	(0.014)	(0.020)	(0.035)	(0.027)	(0.042)	(0.000)	(0.015)	(0.023)	(0.033)	(0.011)	(0.023)	(0.036)
Obs.	290	290	290	110	110	110	186	186	186	105	105	105
R-squared	0.094	0.361		0.372	0.584		0.254	0.381		0.447	0.479	
Hansen (p-value)			0.709			1.000			0.972			1.000
AB AR(1) (p-value)			0.001			0.075			0.591			0.665
AB AR(2) (p-value)			0.157			0.590			0.163			0.960

Note: The models are estimated by OLS, Within Fixed Effects (FE-within) and Two-Step robust System GMM (SYS-GMM). For the latter method lagged regressors are used as suitable instruments. The dependent variable is either the growth rate of TFP or the growth rate of the capital stock per worker, as identified in the first row. Robust heteroskedastic-consistent standard errors are reported in parenthesis below each coefficient estimate. The Hansen test evaluates the validity of the instrument set, i.e., tests for over-identifying restrictions. AR(1) and AR(2) are the Arellano-Bond autocorrelation tests of first and second order (the null is no autocorrelation), respectively. Time fixed effects were included, but are not reported. Also a constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels.

Table 10: Growth equations with government debt– accounting for cross-sectional dependence, 5 year averages data – OECD and EURO area

Dependent Variable	gdppcgr											
Estimation	**Driscoll Kraay robust estimator**						**CCEP**					
Sample	**OECD**	**EURO**	**OECD**	**EURO**	**OECD**	**EURO**	**OECD**	**EURO**	**OECD**	**EURO**	**OECD**	**EURO**
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
inigdppc	-0.60**	-0.45	- 0.75***	- 1.28***	-0.81***	0.11	- 2.90***	-1.68	-2.63***	-2.42**	- 6.05***	-8.43**
	(0.241)	(0.582)	(0.174)	(0.319)	(0.267)	(1.103)	(0.543)	(1.236)	(0.505)	(1.069)	(1.506)	(3.513)
popgr	-0.02	-0.58	-0.10	-0.77**	-0.06	-1.47*	-0.59**	-1.91***	-0.60**	-1.78***	- 2.78***	-3.39**
	(0.198)	(0.372)	(0.188)	(0.265)	(0.114)	(0.715)	(0.280)	(0.552)	(0.255)	(0.460)	(0.730)	(1.243)
gfcf_gdp	0.01	-0.01	0.00	-0.01	-0.00	-0.01	0.01	-0.01	0.01	-0.01	0.02	0.02
	(0.004)	(0.011)	(0.003)	(0.010)	(0.005)	(0.004)	(0.010)	(0.019)	(0.010)	(0.015)	(0.021)	(0.043)
secondary_enrol	0.11***	0.18***	0.14***	0.13	0.06**	0.17	0.13***	0.29***	0.10***	0.15**	0.34***	0.40**
	(0.026)	(0.050)	(0.028)	(0.081)	(0.025)	(0.103)	(0.042)	(0.079)	(0.037)	(0.069)	(0.076)	(0.153)
openness	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.05***	0.04***	0.03***	0.04***	0.09***	0.12***
	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.002)	(0.008)	(0.012)	(0.008)	(0.011)	(0.019)	(0.035)
govdebt_gdp	- 0.01***	-0.00					-0.00	0.01				
	(0.002)	(0.005)					(0.006)	(0.011)				
d.govdebt_gdp			- 0.02***	- 0.04***					-0.02***	-0.04***		
			(0.006)	(0.010)					(0.008)	(0.012)		
debtavtermmat					0.01	0.15					0.33**	0.46*
					(0.094)	(0.128)					(0.150)	(0.258)
Obs.	217	109	210	105	93	45	217	109	210	105	93	45
R-squared	0.20	0.23	0.29	0.41	0.24	0.21	0.27	0.40	0.28	0.48	0.46	0.49

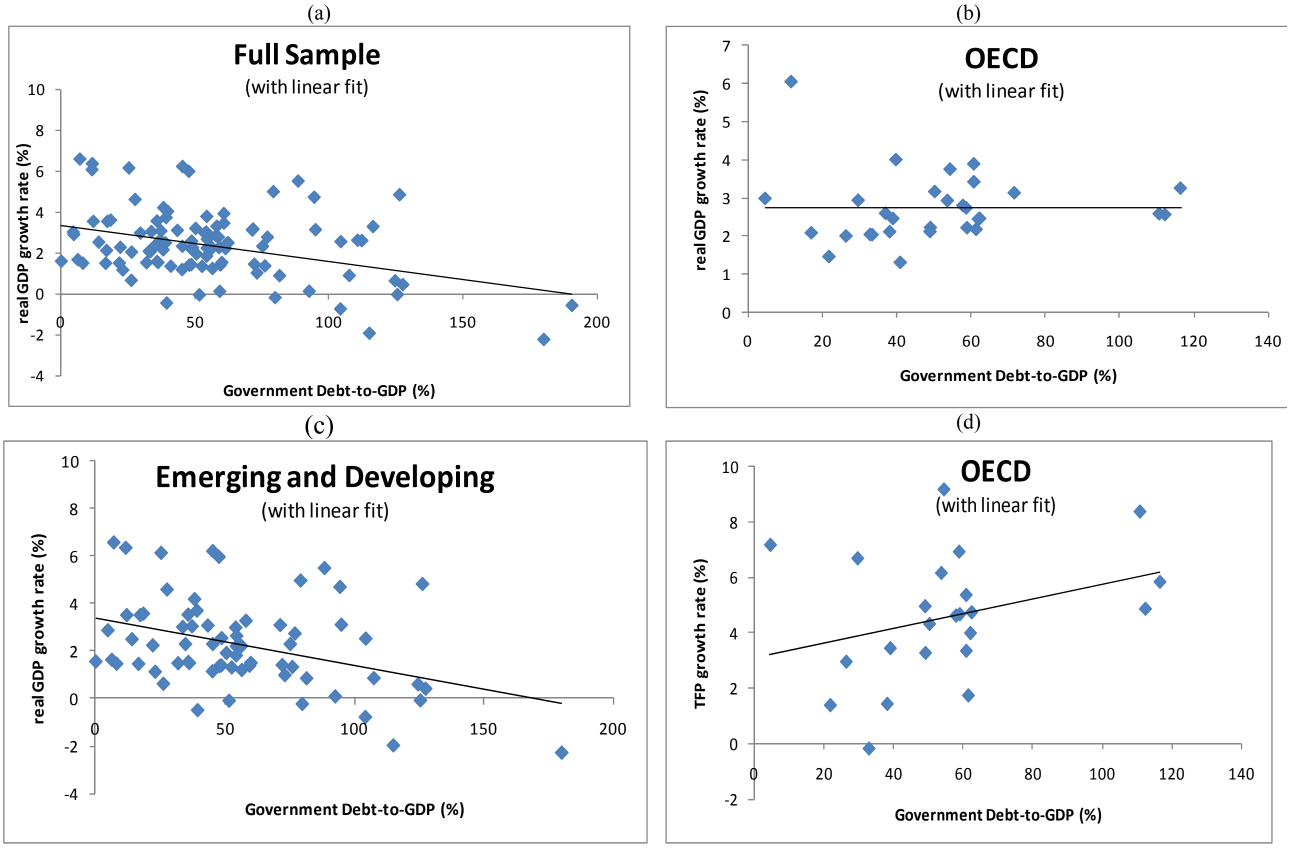
Note: The models are estimated with either Driscoll Kraay robust estimator or the Pesaran's Common Correlated Effects Pooled estimator (CCPE) to correct for the existence of cross-sectional dependence in the OECD an Euro-area groups of countries. The dependent variable is real GDPpc growth, as identified in the first row. Standard errors are reported in parenthesis below each coefficient estimate. A constant term has been estimated but it is not reported for reasons of parsimony. *, **, *** denote significance at 10, 5 and 1% levels.

Table 11: “Above” and “below” average growth performers, government debt and budget deficits: All sample (debt-based equation)

	“Residual” GDP growth rate	Government Debt (%GDP)	Budget deficit (-) or Surplus (+) (%GDP)
Bottom Performers:			
Kiribati	-5.1	16.1	
Guyana	-2.9	58.2	-23.9
Kuwait	-2.6	72.0	0.4
Congo, Dem. Rep.	-2.3	138.6	-5.9
Haiti	-2.2	56.9	-2.9
Suriname	-2.0	20.9	-8.3
Jamaica	-1.6	70.8	-10.0
Zambia	-1.6	60.6	-8.8
Georgia	-1.6	38.2	-0.8
Guinea-Bissau	-1.6	216.0	-0.3
Nicaragua	-1.4	48.7	-6.8
Niger	-1.3	65.5	2.7
Madagascar	-1.3	87.9	-3.3
Brunei Darussalam	-1.3	94.3	
Senegal	-1.3	25.0	-2.5
Australia	-1.2	24.2	-0.8
Bolivia	-1.2	34.5	-1.7
Ghana	-1.1	55.5	-4.6
Top Performers:			
Oman	5.1	65.0	-6.1
Botswana	4.0	56.5	12.0
Korea, Rep.	2.9	35.4	-0.2
China	2.8	27.4	-2.0
Dominican Republic	1.9	51.3	-0.7
Thailand	1.8	37.6	-1.4
Malaysia	1.8	59.9	-4.3
Malta	1.7	63.1	-2.4
Pakistan	1.6	58.7	-6.4
Cyprus	1.6	24.3	-5.4
Israel	1.2	72.8	-8.1
Saudi Arabia	1.2	52.8	
Indonesia	1.1	31.2	-1.3
Ireland	1.1	43.5	-4.9
Costa Rica	1.0	76.8	-2.2
Guatemala	1.0	103.2	-1.7
Belize	1.0	49.5	-3.6
Swaziland	1.0	53.8	-2.8
Japan	1.0	88.5	-4.0

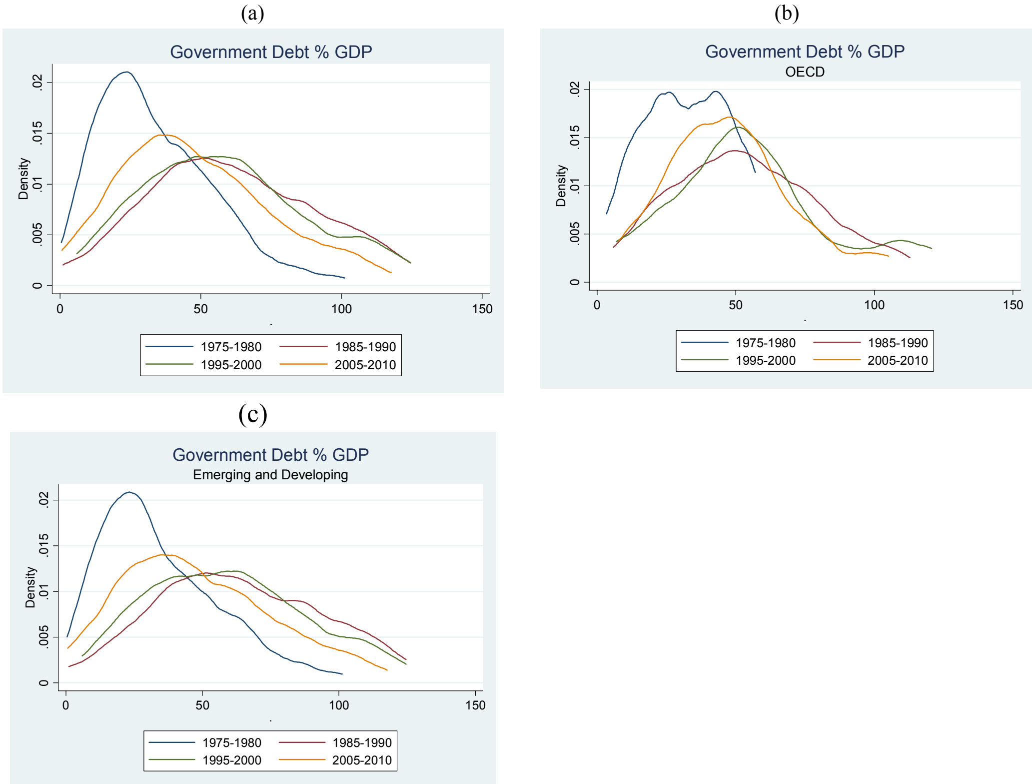
Note: see text for definition of “Bottom Performers” and “Top Performers”. Countries that do not fall in either of the two groups are excluded. Gross domestic product residuals are based on an OLS regression of GDPpc growth rate on initial GDPpc, population growth, secondary school enrolment, private investment, openness and government debt (%GDP). The residual is computed as actual minus predicted. A complete list of all countries in the dataset with residuals and deficits is available upon request.

Figure 1: Scatter plots of real GDPpc growth, and TFP, against the ratio of Government Debt (% of GDP) in different Samples



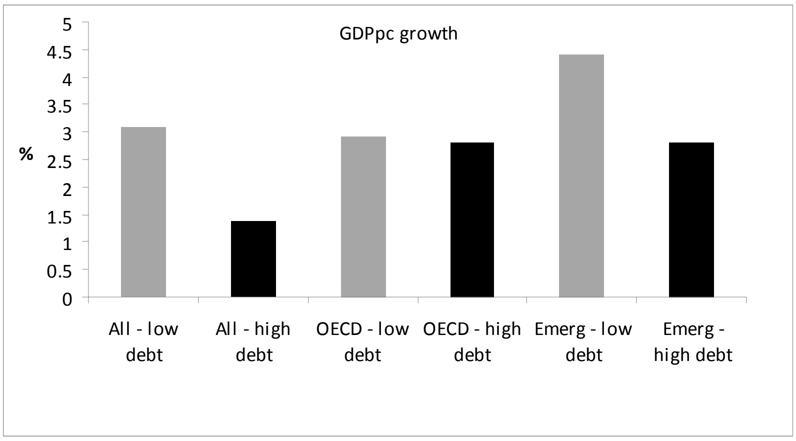
Source: Authors' estimates.

Figure 2: Kernel Density estimates of Government Debt (% GDP) for different samples and time periods



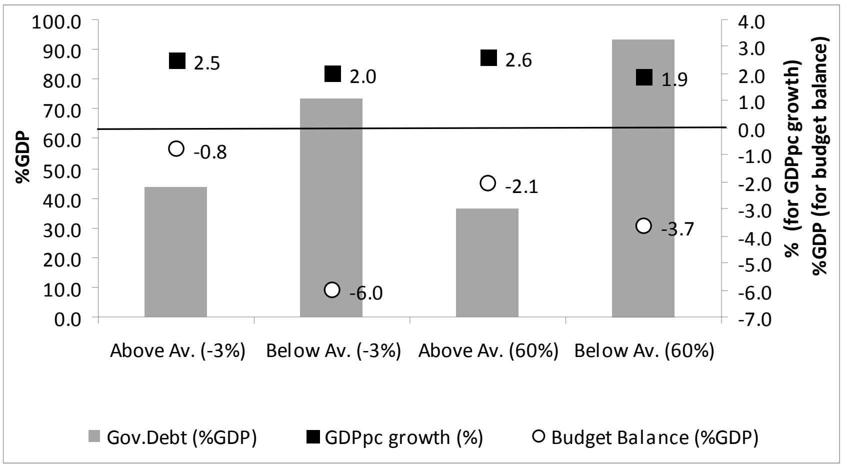
Source: Authors' estimates.

Figure 3: GDPpc growth rates for low (<30% GDP) and high (>90% GDP) debt ratios



Source: Authors' estimates.

Figure 4: "Above" and below" average performers (in terms of individual country-specific growth projections) – GDPpc growth, budget balance and debt ratios



Source: Authors' estimates.

Figure 5: Statistically significant debt coefficients in the growth regressions