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THE IMPACT OF DEMOCRACY AND CORRUPTION ON THE DEBT-GROWTH RELATIONSHIP IN DEVELOPING COUNTRIES

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The quality of governance, and in particular of the control of corruption and the level of democracy, is tested as a factor influencing the relationship between external debt (borrowing opportunities/constraints) and economic growth in a panel of 72 developing countries over the 1970-2005 period. Countries with lower corruption seem to be able to use and manage their debt better. Moreover, in countries with lower levels of corruption both the positive and negative effects of debt on growth, modelled with non-linear specifications, are significant. Furthermore, evidence cannot support a clear Debt-Laffer curve in our sample. The level of debt at which the effect of debt on growth becomes negative is also higher in countries with lower corruption levels. Finally, panel Granger-causality tests only weakly support the claim that causality runs from debt/institutional quality to growth. Despite our somewhat ambiguous results we conjecture some policy implications within the HIPC initiative and donor's approach to governance issues.

Keywords: Fixed-Effects, System-GMM, Granger-Causality, Political Rights, Governance
JEL classification: E02, E60, F30, F43, H63, O11

1. INTRODUCTION

During the World Bank's Annual Meeting back in 1996, corruption was identified as one of the crucial factors affecting growth in developing countries and the awareness of the costs of poor management and corruption have been increasing for the past decade. In this sense, recent discussions on sources of growth have brought to the forefront the role of governance, which is a key variable in explaining the cross-country differences that appear as exogenous in the basic Solow model. According to a definition by Kaufmann *et al*. (1999a, b), governance is defined as traditions and institutions by which

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authority in a country is exercised.[1]

A number of channels of influence of governance on growth have already been established. Pointing directly at the heart of the concerns raised in Durlauf *et al*. (2005)[2] this paper looks at the possibility of another channel through which governance may affect economic growth. Similarly to other literature on empirical growth (e.g., Burnside and Dollar, 2000; Roodman, 2007), a standard neoclassical growth model is augmented as to include the debt variable which will then be interacted with governance-type proxies. The issue addressed is whether the quality of governance influences the relationship between external debt and economic growth. Our main innovation is the introduction of institutional factors into the equation. In other words, can countries with better governance incur higher foreign debt to support their growth, as opposed to incurring debt that adversely affects growth performance? Do high foreign debt levels have a positive/negative effect on growth in the presence of good/bad institutions and economic policies?

The effects of foreign indebtedness on the world's poorest countries over the last decades has attracted considerable interest of policy makers and academics, who saw high indebtedness of developing countries as one of the key factors limiting their growth. The allocation of a big share of scarce resources to a limited number of countries lacking basic institutions and governance practices makes it urgent to investigate the debt-growth nexus in developing countries in order to draw sensible policy recommendations. In this context, the G-7, the World Bank and the IMF have introduced the High Indebted Poor Countries Initiative (HIPC), which aims at reducing the debt levels and debt service difficulties of the most indebted developing countries.[3]

In fact, there are a number of ways in which the quality of governance may affect the relationship between debt and growth. For example, corrupt governments are likely to borrow more than governments characterized by lower levels of corruption because they have a higher discount of the future than the latter.[4] Second, corruption affects the borrower's decision of how to spend the borrowed funds: high levels of corruption, for example, tend to shift loan resources away from highest value projects such as health

[1] This includes (i) the process by which governments are selected, monitored and replaced, (ii) the capacity of the government to effectively formulate and implement sound policies and (iii) the respect of citizens and the state for the institutions that govern economic and social interactions among them.

[2] Uncertainty over model specification (linear or quadratic), heterogeneity uncertainty (pooled or country regressions), theory uncertainty (which of the 145 pre-tested "determinants of growth" listed in the authors' appendix should be added to ad-hoc econometric specifications). These are all important issues, which will be only partly covered and discussed.

[3] Despite some successes, the HIPC Initiative has been insufficient in alleviating some countries from their debt pressures.

[4] They are therefore very likely to trade-off consumption today for consumption tomorrow and borrow well above the threshold level at which the effect of debt on growth becomes negative.

and education into potentially useless projects such as defence and infrastructure, as the latter offer better opportunities for corruption (Shleifer and Vishny, 1993).[5] Third, the quality of governance may increase the probability of default in a country (see, e.g., Ciocchini *et al*., 2003). In any case, the relationship between a democratic government and the decision to borrow is not clear. One may expect that a democratic government would be more concerned about the long run fiscal sustainability.[6] However, they also face uncertainty of tenure and, as some critics argue, they might not be capable of achieving the degree of restraint in consumption that is necessary for growth. The combination of these factors may result in democratic governments borrowing more to increase consumption at the demand of their constituents.[7]

This paper evaluates whether two crucial components of governance, the control of corruption (which proxies for institutional quality in general and captures the second and the third aspect of the governance definition mentioned above)[8] and the level of democracy (capturing the first aspect) have an impact on the debt-growth relationship. A crude graphical representation (scatter -plot type- not shown) can give us a rough idea of the direction of the sign between the variables under scrutiny and provide us some additional motivation.[9] However, there are many concerns about simultaneity and direction of causation as well as endogeneity problems which are not taken into account in such simplistic approach. Our results suggest that countries with lower corruption seem to be able to use and manage their debt better. Moreover, in countries with lower levels of corruption both the positive and negative effects of debt on growth, modelled with a non-linear specification, are significant. On the other hand, in countries with higher levels of corruption, only the negative effect of debt on growth is significant, meaning that poor institutional quality implies that a country is not capable of taking advantage of its borrowing opportunities. Furthermore, the level of debt at which the effect of debt on growth becomes negative is higher in countries with lower corruption.

[5] Lambsdorff (2003) finds that in general an increase in corruption by one point on a ten point scale, with 10 representing a highly clean society, lowers productivity by 2 percent.

[6] In Nieberding (2004) the author models the relationship between democracy and the optimal financing level of governments in developing countries.

[7] The effect of democracy on the efficiency with which borrowed funds are used is also not clear (e.g., King, 1981; and Scully, 1988).

[8] It has been shown that corruption indices are negatively associated with total government revenue, hence there may exist an increased need to go into debt and find external ways of financing the state's regular activities (Hwang, 2002).

[9] Moreover, the correlation matrix supports the graphical evidence (not shown): (i) growth is negatively correlated with the net present value of debt to GDP ratio and with debt service, while it is positively correlated with the control of corruption indicator; (ii) it is slightly negatively correlated with political rights (and civil liberties) indicating a most likely insignificant positive relationship between democracy and growth.

Once endogeneity is taken into account and interaction terms between governance proxies and debt allowed to enter the econometric specification, we don't find strong evidence supporting a Debt-Laffer curve.

The remainder of the paper is organized as follows. The next section presents some literature review on corruption, democracy and economic growth and its relationship with indebtedness levels. Section 3 discusses the dataset and econometric methodology. In Section 4 our main empirical results are presented and discussed. Section 5 briefly exposes some of the problems, shortcomings and criticisms that currently surround empirical cross-country growth literature. Section 6 concludes and makes some policy considerations.

2. LITERATURE REVIEW

A large range of empirical literature has emerged over the last two decades showing that the quality of institutions, particularly the control of corruption, does matter for growth.[10] The work by North (1981, 1990), systematically linking country characteristics such as the security of property rights directly to the prosperity of nations, was particularly important in setting the stage for this new approach. Easterly and Levine (2003) and Olson (1996) showed that institutional quality is highly correlated with economic growth and that the sustainability and economic effects of good macroeconomic policies seem to depend on good institutions. Mauro (1995) and Wei (2000) point out that the magnitude of the effect of different aspects of governance on growth is striking and the former author also finds that corruption affects primarily the volume of investment rather than its efficiency.

More specifically, high levels of corruption affect the quantity of investment by increasing the uncertainty and instability in the economic environment. Poor control of corruption also affects the efficiency of investment by introducing criteria other than efficiency into government policies and the allocation of public goods. In our paper we will specifically address the issue of quantity versus quality of investment as well as its separation into public and private components.

With regard to the relationship between democracy (another way of proxying for institutional quality and governance) and growth, the empirical evidence is controversial. Among studies finding a positive effect of democracy on growth, Kormendi and Meguire (1985) have found evidence that countries with a high standard of civil liberties experience about 1 percent greater economic growth ceteris paribus. Scully (1988) finds that politically open societies grew at a compound real per capita rate of 2.5 percent per year compared to politically closed societies, which grew at 1.4 percent per year. A

[10] There is considerable support that causality runs from institutional quality to economic growth, e.g., Chong and Calderon (2000) and Kaufmann and Kraay (2002).

paper by Kaufmann *et al*. (1999) finds support for a positive relationship between voice and accountability and growth. More recently, Jalles (2010) presented some new panel data-based evidence supporting statistically positive effects of extreme-type democratic regimes on economic growth. After controlling for initial income, human capital, investment and policy variables, the latter author showed that sustained democratic (electoral) transitions, by themselves, increase per capita GDP growth while almost no support was found for the hypothesis that sustained autocratic transitions, by themselves, increases it.

However, a number of studies have found a negative effect of democracy on growth. Barro (1996), using the Gastil measure of political rights, finds that once the maintenance of the rule of law, free markets, small government consumption, human capital, and the initial level of real per capita GDP are held constant, the overall effect of democracy on growth is weakly negative. Helliwell (1992), using the Gastil indices as proxies for democracy and adjusting for the simultaneous determination of income and democracy, finds the direct effect of democracy on economic growth to be negative but insignificant.

Theoretical literature suggests that external debt has a positive effect on growth up to a certain threshold. With this in mind, we estimate the level of debt at which the (marginal) effect of debt on growth becomes negative. The economic reason for the existence of these thresholds is one-fold. Initially, capital in developing countries is scarce and the countries have an incentive to borrow for investment as long as the marginal product of capital is above their borrowing interest rate. Assuming that the borrowed funds are used for productive investments, this should lead to higher growth and thereby allow timely debt repayment (Pattillo *et al*., 2004). However, beyond a certain threshold level, debt adversely affects growth.[11] In particular, crowding-out and debt overhang[12] theories present the main theoretical arguments and rationale for this negative relationship (Clements *et al*., 2003; Fosu, 1999). We will explicitly include the debt service as percentage of exports to account for the approximate crowding-out effect. Green and Villanueva (1991) found that external debt service dampens private investment, while Serieux and Samy (2001) and Cohen (1991) found a similar effect on total investment. In a similar vein, Savvides (1992) found that debt service crowds out public investment in a sample of developing countries. In this context, splitting investment into its public and private components seems to be a natural step to follow.

Theory also suggests that debt may have non-linear effects on growth. In the present paper we also take non-linearities into account in our econometric specification, particularly when estimating a Laffer type convergence equation and correcting for

[11] Clements *et al.* (2003) found that the average impact of debt on growth becomes negative at around 20-25 percent of GDP or 100-105 percent of exports.

[12] Serven and Solimano (1993), Desphande (1997) and Chowdhury (2001) did find support for the debt overhang hypothesis.

potential endogeneity problems by interacting debt with governance proxies. Elbadawi *et al*. (1997) find a Laffer-type statistical significant relationship between external debt and growth in Sub-Saharan Africa.

3. DATA AND METHODOLOGY

3.1 . Data, Sources and Definitions

Our analysis uses a panel of 72 developing countries over the 1970-2005 period. The data set excludes countries with poor data collection, whose figures are based on little primary data, as measurement error is likely to be large. Small countries (with population less than 500.000 inhabitants) are also excluded since their real incomes are likely to be determined by idiosyncratic factors. Countries for which oil production is the dominant industry are excluded from analysis, as a large portion of their recorded GDP represents the extraction of existing resources and not value added. Countries with extremely high net present value of debt to GDP ratios, including Guyana and Nicaragua were also dropped from analysis as outliers.

Data was collected from several sources. The net present value (NPV) of debt as a share of GDP comes from Pattillo *et al*. (2004). Openness, budget balance, terms of trade, real Purchasing Power Parity GDP, GDP per capita growth, and public, private and gross domestic investment are from the Growth Development Network Growth Data Base. Gross secondary school enrolment, population growth and debt service are from the World Development Indicators. The control of corruption indicator is from the World Bank governance data set, starting from 1996[13] and the political rights and civil liberties indicators are from the Freedom House 'Freedom in the World Survey', available from 1972 onwards.[14]

The model includes per capita GDP growth as the dependent variable and lagged real per capita income as an explanatory variable, to test for convergence towards a common level of real per capita income over time. Additional regressors include the following: the population growth rate and gross domestic investment as a percent of GDP are used as proxies for the rates of growth of factor inputs in the production process. The gross secondary school enrolment rate is used as a proxy for the quality of human capital. The central government fiscal balance as a percent of GDP is included to control for the impact of fiscal balances on growth and should have a positive coefficient reflecting the positive effects of macroeconomic stability on productivity. The change in terms of trade variable is added to account for external shocks to the economy and is expected to have a positive coefficient. An openness indicator, exports plus imports as a share of GDP, is

[13] It is measured in units ranging from -2.5 to 2.5 with higher values corresponding to better governance.

[14] These are measured on a 1 to 7 scale, with 1 representing the highest level of freedom in a country.

included following the view that more open economies experience higher growth through transfers of knowledge and efficiency gains.[15]

Some qualifications of the data should be mentioned. Since available indicators of governance are in essence noisy measures of "true" governance, this might lead to underestimation of the impact due to the usual attenuation bias caused by poorly measured right hand side variables. Furthermore, the data used to model the quality of governance also suffers from large standard errors which limit the policy implications that can be drawn (Kaufmann *et al*., 1999b). Finally, the control of corruption indicator is an aggregated indicator an despite allowing us a much larger sample of countries (reducing the selection bias) and computing estimates of the variance of the disturbance term for each indicator, nevertheless the robustness of the aggregation methodology used decreases significantly if the assumption about the independence of stochastic errors across the sub-indices does not hold (Andvig, 2004).

3.2. Methodological and Empirical Approach

Since the seminal contribution of Mankiw *et al*. (1992) the empirical literature on growth and development has progressed toward rather sophisticated methods, most recently using Bayesian Model Averaging and Model Selection algorithms, to identify growth "determinants". With this in mind, we start by describing the empirical strategy for dealing with model uncertainty faced by research on the determinants of higher growth, with the central focus placed on the Bayesian Model Averaging (hereafter, BMA) approach. The motivation for the use of this technique rests on the raising concern over the robustness of the candidate variables in any cross-section regression used to explain the successful overall increase of GDP per capita growth. Essentially BMA treats parameters and models as random variables and attempts to summarise the uncertainty about the model in terms of a probability distribution over the space of possible models.[16] The output of the BMA analysis includes the posterior inclusion probabilities for variables and a sign certainty index.

A modified neoclassical growth model provides the analytical framework for this investigation. This model suggests that poor countries should have a high return to capital and a fast growth rate in transition to the steady-state; there are, however, several factors that could interfere with his result. In this context, a high debt level can reduce growth rates in the transition to a steady-state. Furthermore, various institutional distortions can affect the return to capital and those transitional rates. In general, developing country growth rates will depend on lagged income, institutional and policy

[15] Summary statistics are presented in the Appendix.

[16] To evaluate the posterior model probability the BMA uses the Bayesian Information Criteria (BIC) to approximate the Bayes factors that are needed to compute the posterior model probability, as discussed in more detail in Raftery (1995), Sala-i-Martin *et al*. (2004) and Malik and Temple (2009).

distortions, debt and debt interacted with distortions (together with other controls). While we form some of the relationships among institutional quality, debt and growth using an underlying neoclassical model, other factors can complicate the picture and are therefore worth considering in the final econometric specification.

Our growth model includes GDP per capita growth as the dependent variable. On the right hand side it includes lagged income per capita and, as control variables, the investment rate, the secondary school enrolment rate, the population growth rate (all in logs), openness, terms of trade growth and fiscal balance (these accounting for policy-type variables).[17] The NPV of debt as a share of GDP is used as a measure of the expected debt service burden, accounting for the degree of concession of loans. Debt service as a percentage of exports of goods and services is included to approximate the crowding out effect, as opposite to debt overhang effect.

The first specification assumes a linear relationship between external debt and growth,

$$y_{it} = \alpha_{it} + \beta_0 y_{it-1} + \beta_1 x_{it} + \gamma D_{it} + \varepsilon_{it}, \quad (1)$$

where y_{it} represents per capita growth, x_{it} the control variables; D_{it} the debt indicator, and ε_{it} is some mean zero column vector. β_0, β_1 and γ are unknown parameters to be estimated. Following Pattillo *et al*. (2002) and Clements *et al*. (2003), three year averages of the data are used to smooth the effects of short run fluctuations.

To capture the possible debt and growth Laffer curve relationship we estimate a non-linear model:

$$y_{it} = \alpha_{it} + \beta_0 y_{it-1} + \beta_1 x_{it} + \gamma D_{it} + \delta D^2{}_{it} + \varepsilon_{it}. \quad (2)$$

This specification would support a debt and growth Laffer curve relationship if the coefficient on debt is positive while the coefficient on debt squared is negative.

These dynamic panel specifications will be initially estimated using fixed effects (FE) which are presented for completeness reasons and will serve as our baseline specification. However, in the present model, the lagged dependent variable and (possible) endogenous variables (e.g., fiscal balance, debt service, the level of debt)[18]

[17] Hansen (2001) found that the inclusion of three additional variables (the budget balance, inflation and openness) led to the rejection of any statistically significant negative effect of external debt on growth.

[18] The debt-to-GDP ratio on the right hand side of the regression equation is itself a function of GDP. It is quite possible that countries with higher growth potential can support a higher level of debt. Moreover, simultaneity may arise between debt and growth: the level of debt is likely to be influenced by demographics, in particular an increasing share of elderly. At the same time the latter is correlated with GDP. Furthermore, high debt is likely to negatively affect both physical capital accumulation and total factor productivity. On the

violate standard regularity conditions and the resulting estimates are therefore biased and inconsistent (also referred as Nickel (1981) bias). In particular, the coefficient on the lagged income variable is negatively biased. To correct for endogeneity and the bias introduced by the lagged income variable in the presence of FE, we also estimate these equations using GMM (instrumented with appropriate lags). The first-differenced GMM estimator can be poorly behaved if the time series are persistent. This problem can get very serious in practice, and authors like Bond *et al*. (2001) suggest using a more efficient GMM estimator, the system estimator, to exploit stationarity restrictions.[19] Although stationarity means of investment rates and population growth rates are quite consistent with the Solow growth model, constant means of the per capita GDP series clearly not. Fortunately, the inclusion of the time dummies allows for common long-run growth in per capita GDP, consistent with common technical progress,[20] without violating the validity of the additional moment restrictions used by the system GMM estimator. So, to ensure that time specific effects do not drive the results all the specifications are run with time dummies.

Hence, we estimate the above equation by system-GMM which jointly estimates the equation 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 (levels) equation, as work by Bowsher (2002) and, more recently, Roodman (2009) has indicated, when it comes to moment conditions (and thus instruments), more is not always better ("overfitting bias").

Finally, given some of the econometric problems and shortcomings, we will carry out a panel version of a Granger-causality test. Given that causality may run in either direction, we cannot treat say *GDPpcgrowth*, *debt* or *instqual*[21] as strictly exogenous. Instead we estimate partial adjustment models that allow feedback using sequential moment conditions to identify the model. This approach is fully described in Arellano (2003). The most common approach in the empirical literature would be to specify an

other hand, the impact of high debt on human capital accumulation is likely to be small given the very long lag effects associated.

[19] Weeks and Yao (2003) have applied the system GMM estimation technique for testing conditional income convergence in provinces of China.

[20] Since the empirical model assumes that production technology is homogeneous across countries there is nothing inherently inconsistent with the assumption that TFP growth is the same across countries. The period covered by the data includes a number of characteristic slumps (e.g., the two oil crises in the 1970s), but nevertheless one is able to identify a generally upward movement of TFP, particularly in the 1990s.

[21] This variable measuring the general quality of institutions is the first principal component of Control for Corruption, Political Rights and Civil Liberties. This new composite index accounts for 72% of the variance.

AR(1) model of the form:[22]

$$y_{it} = \alpha_1 y_{it-1} + \beta_1 x_{it-1} + \eta_i + \phi_t + v_{it}, |\alpha_1| < 1, \quad (i = 1,2,...,72;\ t = 1,2,...,12) \tag{3}$$

where in our application y_{it} is *GDPpcgrowth* and x_{it} will be *debt* or *instqual*. The model allows for unobserved heterogeneity through the individual effect η_i capturing the combined effect of time-invariant omitted variables. ϕ_t is a common time effect, while v_{it} is the disturbance term. This model can be estimated by first-differencing Equation (3) ("DIF-GMM") - and, under assumptions developed in Arellano and Bover (1995) and Blundell and Bond (1998), the "system GMM" estimator can be used to alleviate the weak instruments problem ("SYS-GMM").

In the AR(1) model in Equation (3), one hypothesis of economic interest is the null $\beta_1 = 0$, which can be interpreted as a panel data test for Granger causality. Although a Wald-type test of this restriction could be implemented, we use an alternative approach. This is to estimate both the unrestricted and the restricted models using the same moment conditions, and then compare their (two-step) Hansen statistics using an incremental Hansen test of the form:

$$D_{RU} = n(J(\tilde{\gamma}) - J(\hat{\gamma})), \tag{4}$$

where $J(\tilde{\gamma})$ is the minimized GMM criterion for the restricted model, $J(\hat{\gamma})$ for the unrestricted model, and *n* is the number of observations.[23] The intuition for the test is that, if the parameter restriction is valid, the moment conditions should remain valid even in the restricted model.[24]

Turning to some additional issues of interpretation, one may be interested in the stability of the estimated model. If the model is stable, we can calculate a point estimate for the long-run effect[25] of x_{it} on y_{it}:

$$\beta_{LR} = \frac{\beta_1}{1-\alpha_1}. \tag{5}$$

[22] Qualitatively our results don't alter much if one estimates an AR(2) model instead.

[23] Under the null, D_{RU} is asymptotically distributed as χ^2, where r is the number of restrictions.

[24] For more details see Bond *et al.* (2001) and Bond and Windmeijer (2005).

[25] One can estimate an approximate standard error for this long-run effect using the Delta Method.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Benchmark: Linear and Non-Linear Specifications between Debt and Growth

Table 1 presents the determinants of growth according to our BMA analysis. As we can see, the model that behaves better (in terms of predicted signs for the explanatory variables and PMP) is the one in which the "controls" block suggest a positive effect of both human capital (schooling) and investment in physical capital and a negative sign for the population growth rate, which are in accordance to standard neoclassical growth theory. Comparing models 2 and 5 we have less clear effects coming from policy-related variables, in particular, openness; the same is true for the "debt-related" and "institutional variables" blocks - with higher degrees of uncertainty associated to those regressors. All in all, the BMA results show that the relationships mentioned by the growth literature and some of the existing controversy and contradictory evidence discussed in the literature review section, do exist.

Table 1. Determinants of GDPpc Growth Rate by Using BMA

	GDPpc Growth Rate									
Spec.	(1)		(2)		(3)		(4)		(5)	
Variable	PIPs	Sign	PIPs	Sign	PIPs	Sign	PIPs	Sign	PIPs	Sign
Convergence Condition										
Log(income)*t*-1	0.78	-	0.75	-	0.61	-	0.78	-	0.85	-
Controls										
Log (schooling)	0.72	+			0.50	+			0.42	
Log (pop.growth)	0.58	-			0.44				0.30	
Log (invest)	0.82	+			0.62	+			0.67	+
Policy										
Openness			0.55	+					0.44	
Terms of Trade Growth			0.21						0.11	
Budget Balance			0.60	+					0.59	+
Debt-related										
Debt Serv/Exports					0.15				0.10	
Log (debt/GDP)					0.55	+			0.30	
Institutional Variables										
Control Corruption							74	+	0.45	
Political Rights							41		0.24	
PMP	*0.65*		*0.53*		*0.58*		*0.32*		*0.44*	

Notes: The dependent variable is GDPpc growth over the sample full period, 1969-2001. The variables' description is in the main text. The BMA analysis yields the posterior probabilities of inclusion (PIPs) and the sign certainty index of a relationship. A sign is given to the PIPs greater than 0.5. No sign means the sign of estimated relationship being uncertain.

Source: Author's estimates.

Table 2 shows the estimated coefficients of the independent variables in the "basic convergence equation"[26] - following the first implementation by Mankiw *et al*. (1992) - under different specifications, corresponding to Eq. (1) and (2) estimated through FE[27] and GMM, respectively. Econometrically, our work is close to that of Islam (1995), Caselli *et al*. (1996), Burnside and Dollar (2000) and Bond *et al*. (2001). To fully justify the validity of lags of the endogenous variables as IV in the GMM estimation, additional specification tests should be reported as well. We first checked the estimation results (statistical significance of coefficient estimates) from the first stages of an IV estimation. The F-statistics of the first stage estimates were high enough to pass the test. Moreover, in all specifications the Hansen-J statistic does not reject the over-identifying restrictions, confirming that the instrument set can be considered valid (i.e., all the instruments being exogenous).

Our results are consistent with theory and growth literature.[28] In particular, negative lagged income and positive secondary schooling in the GMM specification.[29] One exception is the coefficient on terms of trade which is not significant under any of the specifications and Pattillo *et al*. (2002) find it to be occasionally significant under the FE specification, but never under the GMM specification. The effect of debt on growth is negative however it is not significant (which is in line with Clements *et al*., 2003). This linear construction may, however, underestimate the true effect of debt on growth. The effect of debt on growth may be positive at low levels by reducing liquidity constraints which may increase the growth-inducing effects of capital inflows. The effect could, however, become negative when external indebtedness becomes excessive, as the debt overhang may be growth retarding. We therefore re-estimate the above equation with a quadratic debt term (Eq. 2), corresponding to specifications (3) and (4) in Table 2. Again, our results have expected signs in economic terms. The coefficients on the debt variables are significant in the FE case but not in the GMM specification, that is, there is some evidence supporting the existence of non-linearities in the debt-growth relationship. The FE results therefore suggest that debt affects growth via the efficiency of investment, either because the same nominal expenditure on investment is not allocated to the most productive activities, or because there is limited innovation. The GMM specification, on

[26] Even though we refer the empirical framework as "convergence equation", there is a common misconception of naming it as "growth equation".

[27] It is worth mentioning that all regressions were tested to see whether the fixed-effects model was the correctly specified model (vis-à-vis OLS), by testing the joint significance of the entity-specific effect dummies by an F-test. The results showed that the FE model should be used.

[28] Note that the dependent variable is in percentage terms (e.g., 3, rather than 0.03), while the independent variables are in logs of levels (income pc) or percentage terms (investment, debt).

[29] The fact that schooling is not significant under the FE specification may be due to the presence of lagged dependent variable included in the equation to address the problem of serial correlation or it may also be due to the fact that, under FE, the effect of education is reflected in the country specific term.

the other hand, suggests that if debt affects growth, it is via the volume of investment.[30]

Table 2. Benchmark: The Effect of Linear and Quadratic Terms between Debt and Growth

	FE	FE	GMM	GMM
	Linear	Quadratic	Linear	Quadratic
Specification	*(1)*	*(2)*	*(3)*	*(4)*
Log(income)*t*-1	-3.19***	-3.17***	-1.26**	-1.01*
	(-4.39)	(-4.34)	(-2.35)	(-1.69)
Debt Serv/Exports	-0.02	-0.02	-0.009	0.006
	(-1.64)	(-1.32)	(-0.32)	(-0.21)
Budget Balance	0.07**	0.08**	0.23***	0.23***
	(2.06)	(2.13)	(2.98)	(2.94)
Openness	0.02*	0.022**	0.007	0.008
	(1.80)	(2.05)	(0.48)	(0.572)
Terms of Trade Growth	-1.40	-1.82	-0.07	-0.09
	(-1.08)	(-1.25)	(-0.02)	(-0.02)
Log (schooling)	-0.20	-0.45	1.57**	1.66**
	(-0.41)	(-0.85)	(2.09)	(2.08)
Log (pop.growth)	-0.69	-0.89*	-0.32	0.21
	(-1.30)	(-1.70)	(-0.04)	(0.27)
Log (invest)	1.21*	1.18*	3.32***	2.79**
	(1.67)	(1.74)	(2.60)	(1.85)
Log (debt/GDP)	-0.49	3.02**	-1.12	2.79
	(-1.11)	(2.05)	(-1.56)	(0.60)
[Log (debt/GDP)]^2	(-)	-0.57**	(-)	-0.63
		(-2.49)		(-0.948)
R-squared	0.78	0.79	0.33	0.38
AR(1)	(-)	(-)	-2.4**	-2.3**
AR(2)	(-)	(-)	0.2	0.2
Hansen J Test (p-value)	0.168	0.252	0.201	0.375
Log (debt/GDP) & [Log (debt/GDP)]^2	(-)	0.006	(-)	0.043

Notes: The dependent variable is GDP growth per capita. For the different regressors definitions and main sources refer to the main text. All specifications include the estimate of a constant term, not reported for reasons of parsimony. Year dummies were included in all regressions. As instruments for the GMM case we use all available lagged values of endogenous variables. Heteroskedasticity consistent robust t-statistics are in parenthesis. AR(1) and AR(2) test for first and second order Arellano and Bond tests for autocorrelation, respectively. The Hansen's test p-value for over-identifying restrictions is also shown. The last row report the p-values of the two tailed t-test of annulment of debt/GDP and (debt/GDP) ^2 when inserted alone in the regression. ***, **, and * denote significant coefficients at 1%, 5% and 10% respectively.
Source: Author's estimates.

[30] Clements *et al*. (2003) show strong significance of both the debt terms under the GMM specifications and Pattillo *et al*. (2002) find a significant negative effect of debt on growth under the GMM specification.

Overall, debt service is generally negative but insignificant. One reason for its insignificance may be that its effect is realised through its impact on investment.

To test whether debt may affect growth by influencing the volume of investment, investment is excluded from the convergence regression, the coefficients on the debt variables become statistically and economically more significant once investment is excluded from analysis. We can conclude that the effect of debt on growth is most likely not only through the quality of investment but also through the volume of investment, supporting the debt overhang arguments mentioned above. The size and significance of the coefficient on the debt service variable, although remaining insignificant, increases under the GMM specification. This lends some support to the argument put forth by Clements *et al*. (2003) that debt service may be insignificant in the first growth equation because its effect is realised through its impact on investment. If we re-estimate the growth equation with gross domestic investment disaggregated into private and public investment, most of the effect on growth comes via public investment (not shown).

4.2. The Level of Debt at Which the (Marginal) Effect of Debt on Growth Becomes Negative

An alternative way to test whether governance affects the relationship between debt and growth is to test whether the level of debt at which the impact of debt on growth becomes negative varies across countries depending on their levels of governance. This approach is similar to the one followed by Imbs and Ranciere (2005) who make use of different methods to estimate the debt thresholds and better address the issue of reverse causality. If the postulated relationship between debt, growth and governance holds we should see that in countries with poor governance this level of debt is lower than in countries with good governance.

In order to find the level of debt at which the overall impact of debt becomes negative, we add a set of dummies into the convergence regression:

$$y_{it} = \alpha_{it} + \beta_0 y_{it-1} + \beta_1 x_{it} + \gamma_2 D_2 + \gamma_3 D_3 + \gamma_4 D_4 + \varepsilon_{it}\,, \tag{6}$$

where D_2-D_4 are dummies[31] representing inclusion in the second to the fourth quartile of debt.[32] The thresholds were chosen such that they contain approximately the same number of countries. Following partly the work by Pattillo *et al*. (2002) the logarithmic specification is not used since it imposes a functional under which curvature is minimal at high levels of debt and in turn identifies a very high level of debt at which the overall impact of debt on growth becomes negative.

[31] The first dummy is omitted from the regression to avoid multicollinearity, so the coefficients on the remaining dummies need to be interpreted with respect to the first quartile.

[32] The thresholds are defined as follows 1: 0-20; 2: 21-30; 3: 31-45; and 4: 45-onwards, respectively.

We find evidence (not shown) supporting the argument that with better governance the threshold level of debt at which the effect of debt on growth becomes negative should be higher than in countries with poor governance. Under the good governance sample the effect of debt on growth becomes significantly negative only with the dummy representing the third quartile of debt. For the sample based on countries with poor control of corruption the negative effect is already significant with the second quartile of debt. We can therefore conclude that in countries with good control of corruption, the effect of debt on growth becomes negative somewhere between 31 and 45 percent of NPV of debt to GDP.

Furthermore, using the non-linear debt specification and the standard convergence model, we can investigate the relationship between debt, governance and growth by testing whether the level of debt at which the marginal impact of debt on growth becomes negative differs between countries with good and poor quality of governance. This would correspond to the turning point of the non-linear function and it represents the threshold for the growth maximizing level of debt. According to the theory outlined above: 1) it should be lower than the threshold for negative average impact of debt based on the debt dummies approach; 2) we should also find that it is higher for the countries with good governance. The turning points are, in fact, higher under both the FE and GMM specifications in countries with good control of corruption compared to those with poor control of corruption (see Table 3).[33] The thresholds, as expected, are lower than those found for the point where the effect of growth on debt becomes negative. Nevertheless, the high variability suggests that it is difficult to identify precisely the growth maximising level of debt.

Table 3. Level of Debt at Which the Marginal Effect of Debt on Growth Becomes Negative

	Debt Turning Points	
	Low corruption countries	High corruption countries
Specification	*(1)*	*(2)*
FE	22.99	10.02
	(3.648)	(1.757)
95% CI	[15.839-30.1401]	[6.574-13.465]
GMM	16.74	15.73
	(2.219)	(1.497)
95% CI	[12.39-21.08]	[12.794-18.66]

Notes: Turning points are computed as exp[-$\beta d/2\beta d$^2], where "*d*" is the debt variable. Standard errors (in parenthesis) and Confidence Intervals were computed using the Delta Method.

Source: Author's estimates.

[33] Standard errors and lower and upper values for a 95% CI are presented (computed using the Delta Method).

4.3. Linear and Non-Linear Specifications between Debt, Growth and Governance

Having established the non-linear relationship between debt and growth we now move to investigate whether different quality levels of governance change this relationship. First, to confirm the positive relationship between good governance and growth, the convergence Eq. (2) is re-estimated with the governance-based proxies included. Second, the data are divided into two sub-samples of data characterized by a good quality of governance and a poor quality of governance and the convergence equation is then re-estimated.[34] In this way we can inspect the possibility that the debt-growth relationship is heterogeneous with respect to institutional quality.

The effect of corruption on growth (corresponding to specifications (1) and (2)) is statistically significant, supporting the above presented theory (see Table 4). Another indication of the importance of the level of corruption for growth is the rise in the significance and size of the coefficient on the lagged income variable, showing stronger evidence for conditional convergence, compared to that in the regression without corruption. In countries with higher corruption, as expected, the steady state level of income to which the country can aspire should be lower.

The coefficient on the investment variable, in comparison to that in the regression without the corruption variable, is smaller, suggesting that the effect of corruption on growth is probably via the volume of investment as well as via the quality of investment. The effect of political rights and civil liberties on growth, however, is not clear (see Table 4, specifications (3) and (4)). The coefficients on the political rights and civil liberties indicators are highly insignificant under all three specifications. This fact is not surprising as institutional quality could simultaneously determine economic growth and the degree of indebtedness. There is not a significant change in the significance of the investment variable indicating that democracy is not a determinant of investment as strong as institutional quality. Institutional quality, in part characterized by the control of corruption, does matter for economic growth, while the effect of democracy on growth is indeterminate. The standard Debt-Laffer curve found in Pattillo *et al*. (2002) loses its significance when the effect of governance proxies is taken into account, suggesting that institutional quality could be a common determinant of both low growth and high debt, as suggested by Ims and Ranciere (2005).

[34] The thresholds for dividing the sample into two groups is based on mean values, i.e., the cut-off point between “low” and “high” corruption is based on the mean of the scale in which the variable is measured.

Table 4. The Effect of Linear and Quadratic Terms between Debt, Growth and Governance (Endogeneity Issues)

	FE	GMM1	FE	GMM1	GMM2	GMM2
	Control for corruption		Political Rights		Control for corruption	Political Rights
MODEL	Model I				Model II	
Specification	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Log(income)*t*-1	-4.13***	-2.26***	-3.2***	-1.3**	-2.87***	-1.77***
	(-4.73)	(-3.49)	(-4.37)	(-2.29)	(-3.05)	(-3.17)
Debt Serv/Exports	-0.03	0.02	-0.02	0.00	0.001	0.023
	(-1.81)	(1.49)	(-1.27)	(0.13)	(0.91)	(0.53)
Budget Balance	0.08**	0.15	0.08**	0.19**	0.25*	0.131*
	(2.43)	(1.62)	(2.19)	(2.21)	(1.98)	(2.02)
Openness	0.04***	0.02	0.02**	0.01	0.051	0.002
	(3.82)	(1.49)	(2.02)	(0.50)	(1.13)	(0.33)
Terms of Trade Growth	-2.46	0.22	-1.76	-2.2	0.015	-0.32
	(-1.55)	(0.05)	(-1.24)	(-0.59)	(0.64)	(-1.03)
Log (schooling)	0.09	1.91**	-0.43	1.56*	1.52*	1.301*
	(0.15)	(2.22)	(-0.82)	(1.93)	(1.87)	(1.95)
Log (pop.growth)	-0.59	-0.47	-0.91	-0.16	-0.335	-0.216
	(-1.20)	(-0.56)	(-1.76)	(-0.19)	(-0.78)	(-0.66)
Log (invest)	0.85	1.21	1.14*	2.4*	1.88*	3.01**
	(1.21)	(0.94)	(1.64)	(1.87)	(2.22)	(2.84)
Log (debt/GDP)	3.17**	8.8**	3.16**	1.32	6.31*	2.24*
	(2.19)	(1.98)	(2.01)	(0.27)	(2.11)	(1.85)
[Log (debt/GDP)]^2	-0.54**	-1.53**	-0.56**	-0.42	-1.78*	-0.901
	(-2.54)	(-2.43)	(-2.44)	(-0.63)	(-2.15)	(-1.31)
Control Corruption	1.86***	1.76**	(-)	(-)	2.04**	(-)
	(7.36)	(2.47)			(2.77)	
Political Rights	(-)	(-)	-0.04	0.08	(-)	1.065*
			(-0.44)	(0.50)		(1.95)
R-squared	0.78	0.41	0.79	0.36	0.35	0.30
AR(1)	(-)	-2.3**	(-)	-2.2**	-1.9**	-2.0**
AR(2)	(-)	0.3	(-)	0.1	0.2	0.4
Hansen J Test (p-value)	(-)	0.746	(-)	0.582	0.469	0.325

Notes: The dependent variable is GDP growth per capita. For the different regressors definitions and main sources refer to the main text. All specifications include the estimate of a constant term, not reported for reasons of parsimony. Year dummies were included in all regressions. As instruments for the GMM1 case we use all available lagged values of endogenous variables. Heteroskedasticity consistent robust t-statistics are in parenthesis. In Model II we use as additional instruments for governance proxies: *durable*, *latitude* and *ethnic*. AR(1) and AR(2) test for first and second order Arellano and Bond tests for autocorrelation, respectively. The Hansen's test p-value for over-identifying restrictions is also shown. ***, **, and * denote significant coefficients at 1%, 5% and 10% respectively.

Source: Author's estimates.

Two additional points are worth discussing before addressing the two-samples' case. The first deals with endogeneity problems[35] of governance-based regressors included in the convergence equation, even if Olson *et al*. (2000) argue that the endogeneity of corruption is not a serious problem and that their cross-sectional estimates are free of bias. The authors believe that simultaneity bias is only a theoretical, not a real, possibility between growth and governance.[36] Second, the data set combines countries with heterogeneous institutional quality patterns, which may not be appropriate. Both control for corruption and political rights are a function of a number of variables that do not belong in the growth regression. Endogeneity[37] between right-hand side measures of control for corruption and political rights and a standard set of control variables is corrected for by estimating a new set of system GMM panel regressions - corresponding to "GMM2" in Table 4 - where the measures of control for corruption and political rights are instrumented as suggested in Mauro (1995), La Porta *et al*. (1997), Hall and Jones (1999), Acemoglu *et al*. (2001) and Dollar and Kraay (2003). These two measures are instrumented by the durability (age in years) of the political regime type (DURABLE);[38] latitude;[39] and ethnic fragmentation ("ETHNIC").[40] For the three instruments chosen the exclusion restriction is that durability, latitude and ethnic do not have any impact on present economic growth other than their impact on either control for corruption or political rights. This procedure purges the correlation of either control for corruption or political rights with the error term in the growth regression.[41] Ehrlich

[35] In line with the empirical growth literature, there is a priori no reason to suspect that other "standard" regressors should be considered endogenous.

[36] In support of their view, the authors argue that in many countries a change in the quality of governance has occurred without a prior change in income or productivity.

[37] And also the existence of possible measurement errors when accounting for governance-based proxies.

[38] Retrieved from Jaggers and Marshall's database. The average age of the party system is also used in Przeworski *et al*. (2000) and Beck *et al*. (2001). This potential instrument is also in line with Bockstette *et al*. (2002) paper which documents the use of the state antiquity index as an appropriate instrument for institutional quality.

[39] Hall and Jones (1999) launched the general idea that societies are more likely to pursue growth-promoting policies, the more strongly they have been exposed to Western European influence - for historical or geographical reasons. Hence, two other possible instruments could be common and civil law (see La Porta *et al*., 1998).

[40] On a broad level, the role of ethnic fragmentation in explaining the (possible) growth effect of democracy can be derived from the literature of the economic consequences of ethnic conflict.

[41] F-statistics of the first-stage regressions exceeded the threshold value of 10 proposed by Staiger and Stock (1997), so there is a priori no evidence that the present results suffer from weak instruments. Moreover, the Hansen test for overidentifying restrictions suggest that the instruments are valid ones (p-values in excess of 10 in all specifications), i.e., uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. Furthermore, we performed Anderson's (1984) canonical

and Lui (1999) and Mendez and Sepulveda (2006) address the endogeneity problem of corruption through country time invariant fixed-effects such as culture, colonial past, geographical location and religion. Model II in Table 4 -the "GMM2" case- also addresses the possibility that too many instruments may overfit endogenous variables in the system-GMM, generating biased estimates and weakening the Hansen test, by partly collapsing the instrument set - as suggested by Roodman (2007).

Our new results, corresponding to columns 5 and 6, suggest that, once the 3 IVs are used to account for endogeneity of either Control for Corruption or Political Rights, the overall statistical significance of the resulting estimates decreases, and particularly the strength associated with a Debt-Laffer type curve (e.g., column 6 presents the coefficient of the [Log (debt/GDP)]^2 negative, but insignificant). Moreover, the coefficients of determination in specifications 5 and 6 decrease (relative to the ones in specifications 2 and 4, respectively).

Another point concerns the fact that the increased speed of convergence upon inclusion of the corruption variable is suggested to be an indication of the importance of the level of corruption for growth. We have computed the annual convergence rates (in percentage terms)[42] for both the FE and GMM approaches estimated (with quadratic terms) first without and then with the inclusion of the "control for corruption" variable (these correspond to a comparison of specifications (2) and (4) of Table 2 with specifications (1) and (2) of Table 4). We find that for the FE case the convergence speed increases from 3,57 to 3,84% after the inclusion of "control for corruption"; as for the GMM case, we go from an initial 2,49% of convergence speed to a 3,25% once corruption has been accounted for. These percentages lie within the usual ranges found by several previous studies (for various regions and time periods).

When sub-samples[43] are analyzed, differences in the results (between the convergence regression based on countries with good control of corruption as opposed to those with bad control of corruption) support the premise that the level of governance affects the debt-growth relationship (see Table 5, specifications (1)-(4)). The negative quadratic term is larger in absolute value for countries with high corruption. Moreover, in countries with high corruption only the coefficient next to the squared debt term is significant. In the low-corruption sample, both the positive and negative effects of debt

correlation likelihood-ratio test to check whether or not the excluded instruments are correlated with the endogenous regressors. The null that the model is underidentified was rejected at the 1% level. Finally, the Anderson and Rubin (1949) Chi-squared statistics rejected the null hypothesis that the coefficients of the endogenous regreossors jointly equal zero. In short, all of the above provide sufficient confidence that the instruments perform well and that the specification is justified.

[42] The underlying convergence speed is obtained from the formula: $speed = \left[\ln(1-\beta^* T)\right]/T$, where β^* is the coefficient of the lagged income and T=11 in the present case.

[43] Cordella, Ricci and Ruiz-Arranz (2010) also allow for different effects across countries sub-samples (in their case, defined in terms of market access and institutional quality).

on growth are significant. The GMM specification supports the premise that institutional quality affects the relationship at hand. Differences in the results between the convergence regression based on countries with high levels of political rights as opposed to those with low levels of political rights do not support the premise that the democratic nature of a country affects the debt growth relationship (see Table 5, specifications (5)-(8)). There is no consistent difference between the coefficients on the positive and negative debt indicators between the two sub-samples. This is not surprising as we have already shown that democracy has no clear impact on growth. Due to the lack of evidence that the level of democracy in a country affects the debt-growth relationship, the remainder of the paper sub-sampling is defined in terms of the country's level of corruption.[44]

In Model II with "GMM3" we are also instrumenting for the interactive terms, Log (debt/GDP)×CC and Log (debt/GDP)×PR, and the quadratic terms [Log (debt/GDP)]² ×CC and [Log (debt/GDP)]²×PR. Thus, we include some non-linear instruments such as DURABLE×*i*, latitude×*i*, ETHNIC×*i*, with *i*=CC, PR. The last 4 columns of Table 5 allow for both linear and quadratic interaction terms to enter explicitly the econometric equation. In columns 9 and 10, the better the Control for Corruption the more negative is the effect of an increased debt level on economic growth. As for the second governance proxy, Political Rights, no significant coefficient was found. However, when endogeneity of institutional variables is taken into account in columns 11 and 12, not only the significance level increases but so does the absolute magnitude of the estimated coefficients on the interaction terms. That is, we still have that CC has stronger statistical power vis-a-vis PR, but both suggest that in countries with "good" governance a larger debt implies lower growth. Overall, evidence suggests that institutional quality is a key element in the debt-growth relationship, however, once both governance proxies and endogeneity issues are considered, we find no support for a Debt-Laffer curve effect.[45]

[44] Redoing this section's exercise but excluding investment as before we obtained that under the FE specification the increase in economic and statistical significance of the coefficients for the sample with poor governance. This indicates that in countries with poor control of corruption the effect of debt on growth through the volume of investment channel is greater than in countries with good control of corruption. Under the GMM specification, the statistical significance increase is only slightly higher in the case of countries with poor control of corruption also showing some support for the theory that the effect of debt through the volume of investment seems to be greater in the poor governance sample. In both, a big part of the effect is through quality of investment.

[45] The validity of the results discussed has been tested through a number of robustness tests. In particular, the main findings are robust to changes in the econometric methodology and in the set of control variables.

Table 5. The Effect of Linear and Quadratic Terms between Debt, Growth and Governance (Sub-Sampling, Interaction Terms and Endogeneity Issues)

	FE	GMM1	FE	GMM1	FE	GMM1
	Low Corruption		High Corruption		Low Political Rights	
MODEL	Model I					
Specification	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Log(income)*t*-1	-2.78***	-0.41	-7.97***	-3.17***	-6.12***	-2.45***
	(-4.67)	(-0.41)	(-3.52)	(-3.86)	(-3.41)	(-2.94)
Debt Serv/Exports	-0.02	-0.002	-0.05*	-0.006	-0.06	-0.003
	(-1.28)	(-0.1)	(-1.86)	(-0.09)	(-1.42)	(0.050)
Budget Balance	0.04	0.14*	0.13	0.12	0.16**	0.23**
	(1.05)	(1.69)	(1.34)	(1.11)	(2.77)	(2.40)
Openness	0.03***	0.01	0.06**	0.05	0.04**	0.02
	(3.82)	(0.95)	(2.35)	(1.32)	(1.98)	(0.62)
Terms of Trade Growth	-3.8**	-5.3	-1.3	5.9*	1.36	-2.24
	(-2.01)	(-0.91)	(-0.52)	(1.75)	(0.72)	(-0.48)
Log (schooling)	-0.77	0.49	0.19	3.1***	-0.73	2.03***
	(-1.15)	(0.62)	(0.25)	(3.28)	(-0.74)	(4.54)
Log (pop.growth)	0.00	-0.74	-4.29**	-4.7	-3.08***	-2.19*
	(0.001)	(-1.04)	(-2.16)	(-0.95)	(-3.28)	(-1.93)
Log (invest)	0.50	3.19***	2.09*	0.48	1.01	3.3***
	(0.59)	(2.93)	(1.76)	(0.23)	(1.06)	(2.81)
Log (debt/GDP)	2.32*	6.20*	4.98	14.0	5.62*	-10.4*
	(1.79)	(1.70)	(1.32)	(1.33)	(1.82)	(-1.71)
[Log (debt/GDP)]^2	-0.37*	-1.10**	-1.08**	-2.54*	-0.76*	0.98
	(-1.93)	(2.01)	(-2.01)	(-1.75)	(-1.85)	(1.10)
Control Corruption	0.98*	0.79	1.82**	1.95*	(-)	(-)
	(1.88)	(1.25)	(2.26)	(1.91)		
Political Rights	(-)	(-)	(-)	(-)	0.09*	0.20
					(1.71)	(1.55)
Log (debt/GDP)*CC	(-)	(-)	(-)	(-)	(-)	(-)
[Log (debt/GDP)]^2*CC	(-)	(-)	(-)	(-)	(-)	(-)
Log (debt/GDP)*PR	(-)	(-)	(-)	(-)	(-)	(-)
[Log (debt/GDP)]^2*PR	(-)	(-)	(-)	(-)	(-)	(-)
R-squared	0.76	0.32	0.83	0.52	0.79	0.40
AR(1)	(-)	-2.0*	(-)	-1.9*	(-)	-1.8*
AR(2)	(-)	1.1	(-)	-1.3	(-)	-1.1
Hansen J Test (p-value)	(-)	0.435	(-)	0.633	(-)	0.371

Table 5. The Effect of Linear and Quadratic Terms between Debt, Growth and Governance (Sub-Sampling, Interaction Terms and Endogeneity Issues)(continued)

	FE	GMM1	GMM1	GMM1	GMM3	GMM3
	High Political Rights		CC	PR	CC	PR
MODEL	Model I		Model I		Model II	
Specification	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
Log(income)*t*-1	-2.25***	-1.88***	-3.34***	-2.92***	-3.55***	-2.03***
	(-4.63)	(-3.30)	(-3.98)	(-4.01)	(-2.88)	(-3.15)
Debt Serv/Exports	-0.01	0.05**	0.11	-0.04	0.09	0.07
	(0.50)	(2.10)	(1.02)	(-0.25)	(0.98)	(0.78)
Budget Balance	0.12***	0.22***	0.21	0.29*	0.15*	0.34**
	(3.17)	(2.73)	(1.15)	(2.02)	(1.77)	(2.87)
Openness	0.00	0.016	0.09*	0.001	0.05**	0.02*
	(0.39)	(1.23)	(1.75)	(1.23)	(1.99)	(1.78)
Terms of Trade Growth	-2.38	-2.07	-1.97	-2.11	-3.04*	-2.33
	(-1.28)	(-0.43)	(-1.20)	(-0.99)	(-1.88)	(-1.43)
Log (schooling)	0.30	3.24***	2.25**	3.01*	1.97*	2.74*
	(0.51)	(2.88)	(2.54)	(2.10)	(1.87)	(2.02)
Log (pop.growth)	0.06	0.71	0.12	-0.56*	-0.32	-1.01*
	(0.15)	(1.02)	(0.67)	(-1.79)	(-0.80)	(-1.93)
Log (invest)	1.15	2.34*	1.65**	1.86**	2.28***	2.54**
	(1.54)	(1.81)	(2.74)	(2.82)	(3.61)	(2.44)
Log (debt/GDP)	2.02	9.35***	3.67*	4.76*	4.07*	6.40*
	(1.86)	(3.84)	(1.83)	(2.01)	(2.15)	(2.09)
[Log (debt/GDP)]^2	-0.42**	-1.72***	-0.66*	-1.14*	-0.377*	-0.95*
	(-2.24)	(-4.60)	(-1.77)	(-1.98)	(-2.18)	(-2.05)
Control Corruption	(-)	(-)	1.25	(-)	1.67*	(-)
				0.15	(2.01)	0.98
Political Rights	-0.07	0.02	(-)		(-)	(1.60)
	(1.08)	(0.73)				
Log (debt/GDP)*CC	(-)	(-)	-0.687*	(-)	-2.857*	(-)
			(-1.76)		(-2.03)	
[Log (debt/GDP)]^2*CC	(-)	(-)	0.132	(-)	0.769*	(-)
			(1.32)		(1.94)	
Log (debt/GDP)*PR	(-)	(-)	(-)	-0.242	(-)	-1.697*
				(-1.19)		(-1.91)
[Log (debt/GDP)]^2*PR	(-)	(-)	(-)	-0.043	(-)	0.367
				(-0.76)		(0.52)
R-squared	0.80	0.39	0.56	0.44	0.61	0.53
AR(1)	(-)	-2.0**	-2.5**	-1.9*	-2.0***	-2.3**
AR(2)	(-)	0.6	0.8	0.2	0.4	0.1
Hansen J Test (p-value)	(-)	0.401	0.598	0.741	0.460	0.503

Notes: The dependent variable is GDP growth per capita. For the different regressors definitions and main sources refer to the main text. All specifications include the estimate of a constant term, not reported for reasons of parsimony. Year dummies were included in all regressions. As instruments for the GMM1 case we

use all available lagged values of endogenous variables. Heteroskedasticity consistent robust t-statistics are in parenthesis. Detail on the sub-sampling between high and low levels of Corruption and Political Rights is presented in the main text. "CC" stands for Control for Corruption and "PR" stands for Political Rights. In Model II, "GMM3" we use as additional instruments for governance proxies non-linear IVs such as DURABLE×*i*, latitude×*i*, ETHNIC×*i*, with *i*=CC, PR. AR(1) and AR(2) test for first and second order Arellano and Bond tests for autocorrelation, respectively. The Hansen's test p-value for over-identifying restrictions is also shown. ***, **, and * denote significant coefficients at 1%, 5% and 10% respectively.
Source: Author's estimates.

Finally, our results for the panel Granger-causality tests are presented in Tables 6a-6b. We are particularly interested in whether the GDPpc growth rate depends primarily in either the debt level or the level of institutional quality. We first test the restriction that β_1=0. In general, when we allow for fixed effects in this dynamic context, we find that the effects of the independent variable persist into the long-run (Table 6a).

Table 6a. Panel Granger-Causality: GDPpc Growth and Debt (Full Sample)

Dep.Var.	OLS	Within Group (FE)	DIF-GMM	SYS-GMM	SYS-GMM-1	SYS-GMM-2
Model	(1)	(2)	(3)	(4)	(5)	(6)
Instrument set	None	None	Full	Full	Reduced	Reduced
Lag1 growth	-3.54***	-2.98**	-1.95**	-2.01***	-1.85***	-1.91**
	(-3.45)	(-2.61)	(-2.25)	(-5.14)	(-3.07)	(-2.95)
Lag1 debt	5.61	5.71*	-0.28	5.67**	6.17	-4.49
	(0.79)	(1.69)	(-1.25)	(-2.06)	(0.98)	(-0.93)
Hansen p-value			0.06	0.69	0.16	0.62
Diff-Hansen p-value			0.05	0.23	0.16	0.32
Granger causality p-value	0.43	0.10	0.55	0.07	0.17	0.15
LR effect point estimate	4.01	6.76	-3.71	6.75	5.51	-2.30
(standard error)	(4.88)	(3.81)*	(3.07)	(3.32)**	(5.24)	(7.76)

Notes: Year dummies are included in all models (coefficients not reported). Figures below point estimates are t-ratios. *, **, *** denote significance at 10, 5 and 1% levels. The GMM results reported here are two-step estimates with heteroskedasticity-consistent t-statistics. The Hansen test is used to assess the overidentifying restrictions and is asymptotically distributed as χ^2. The test uses the minimised value of the corresponding two-step GMM estimator. The difference Hansen test is used to test the additional moment conditions used by the system GMM estimators in which SYS-GMM uses the standard moment conditions, while SYS-GMM-1 only uses the lagged first-differences of growth dated *t*-1 as instruments in levels and SYS-GMM-2 only uses lagged first-differences of debt dated *t*-1 as instruments in levels. The Granger causality test examines the null hypothesis that growth is not Granger-caused by debt; the test statistic is criterion based, using restricted and unrestricted models (see text). In the OLS and fixed effects models, the tests of restrictions are based on conventional Wald tests. The LR effect is the point estimate of the long-run effect of debt on GDPpc growth. Its standard error is approximated using the delta method.
Source: Author's estimates.

We find evidence that increases in the debt level are associated with increases in the GDPpc growth rate in the short run. The Granger-causality tests reject the null of non-causality at the 10 and 5% level for the fixed and SYS-GMM models, respectively and we find a stable long-run effect. With respect to Table 6b, models 2 and 5 present positive and statistically significant coefficients of the effect of institutional quality on the GDPpc growth rate. However, as in Table 8a, this effect is not robust across different specifications. We also find evidence of Granger-causality for these 2 models, but with significance levels close to 10%. All in all, this technique did not help us much in finding clear and objective evidence favouring one direction running from either "debt" or "inst_qual" to GDPpc growth. Nevertheless, our results are similar to Chowdhury's (2001) who, also using panel causality tests, provided supporting evidence that causality runs from debt to growth in both HIPC and non-HIPCs. We can then recall that the concerns presented before in Section 2, still hold and that more research is needed to unveil signs of the relationships at hands.

Table 6b. Panel Granger-Causality: GDPpc Growth and Institutional Quality (Full Sample)

Dep.Var.	OLS	Within Group (FE)	DIF-GMM	SYS-GMM	SYS-GMM-1	SYS-GMM-2
Model	(1)	(2)	(3)	(4)	(5)	(6)
Instrument set	None	None	Full	Full	Reduced	Reduced
Lag1 growth	-2.59**	-3.12***	-3.45**	-2.03*	-2.77**	-1.62***
	(-2.54)	(-3.98)	(-2.35)	(-1.69)	(-2.07)	(-3.10)
Lag1 inst_qual	-2.23	1.20**	1.26**	2.91	2.60	-5.16
	(-1.04)	(2.22)	(2.27)	(1.08)	(1.14)	(-0.88)
Hansen p-value			0.14	0.08	0.23	0.86
Diff-Hansen p-value			0.08	0.06	0.11	0.71
Granger causality p-value	0.004	0.07	0.08	0.10	0.11	0.55
LR effect point estimate	-3.25	1.65	1.53	4.11	3.53	-1.55
(standard error)	(3.01)	(0.78)**	(0.61)**	(3.67)	(3.00)	(2.80)

Note: Mutatis mutandis as in Table's 6a note. Institutional Quality is a composite index created by taking the first principal component of Control for Corruption, Political Rights and Civil Liberties (for more details, refer to the main text).

Source: Author's estimates

5. PROBLEMS, SHORTCOMINGS AND CRITICISMS: A BRIEF DIGRESSION

The following paragraphs highlight a number of shortcomings in the wider cross-country regression literature (e.g., Durlauf *et al*., 2005) which equally apply to our paper, but dealing with all the issues to be raised below go beyond the scope initially defined for this study. The growth literature has held on to a relatively restrictive empirical framework which typically imposes common parameter values on all countries in the sample, as well as assuming cross-section independence and the stationarity of all variables and processes in the model. In particular, three main points are worth mentioning:

(i) Convergence regressions: The single convergence regression equation introduced in the second part of the MRW paper has been subjected to a great deal of criticism in the literature, e.g., Islam (1995); Caselli *et al*. (1996); Durlauf *et al*. (2005), highlighting (a) the induced downward bias in a panel due to the presence of a lagged dependent variable (endogeneity) and (b) the overly restrictive assumption of random cross-country differences in the time-invariant unobservables in the cross-section regression. Furthermore it is unclear how these estimators perform in the presence of nonstationary variables. Finally, it can be shown quite easily that instrumentation is invalid if technology is heterogeneous across countries (see below).

(ii) Nonstationarity and cointegration: as pointed out by Phillips and Moon (1999, 2000) many macro panel datasets display strongly evident nonstationarity. If variable series are nonstationary, regressions may render spurious results, even if the time-series dimension becomes large (Granger and Newbold, 1974); although asymptotically pooling spurious regression equations for N countries may yield consistent estimates of some average across countries, it is well-known that in the case of nonstationary error terms the t-statistics are invalid (Kao, 1999). Thus any inference based on conventional t-statistics is rendered invalid as well. Pooled regression errors may be nonstationary for two reasons: (a) the true relationship is heterogeneous across countries, or (b) the empirical equation does not represent the cointegrating vector. A theoretical justification for technology heterogeneity is provided by the "new growth" literature, (e.g., Azariadis and Drazen, 1990; Durlauf, 1993), while existing empirical papers in this vein include Durlauf *et al*. (2001) and Pedroni (2007).

(iii) Cross-section dependence: Such cross-section correlation can arise from common shocks across or spillovers between countries. Standard panel estimators assume cross-section independence. Recent econometric theory has therefore developed estimation methods which allow for heterogeneity in the impact of both observables and unobservables, adopting common factor models for empirical modelling (Bai and Ng, 2002, 2004; Pesaran, 2006; Kapetanios *et al*., 2009; Bai, 2009).[46]

[46] An example in Pesaran (2004) shows that tests for the GDP series in the Penn World Table dataset provide clear evidence of cross-section dependence. New empirical methods such as the Pesaran (2006)

6. CONCLUSION AND POLICY CONSIDERATIONS

The above research and analysis has revealed that the control of corruption, a proxy for institutional quality and governance in general, influences the growth performance of developing countries. Moreover, weak governance and corruption, in particular, also affect the debt-growth relationship in these countries. Our results show that in countries with lower levels of corruption both the positive and negative effects of debt on growth, modelled with a non-linear debt specification, are significant. On the other hand, in countries with higher levels of corruption, only the negative effect of debt on growth is significant. Poor institutional quality therefore implies that a country is not capable of taking advantage of its borrowing opportunities. Moreover, the level of debt at which the effect of debt on growth becomes negative is higher in countries with lower corruption. In such countries the effect of debt on growth becomes negative when the net present values of debt reaches 31-45 percent of GDP, while in countries with high levels of corruption, the corresponding level is lower, about 21-30 percent of GDP. These results suggest that countries with better institutional quality can incur a higher foreign debt to support their growth. In a similar vein, the level of debt at which the marginal effect of debt on growth becomes negative is higher in countries with good control of corruption. Moreover, once endogeneity is taken into account and interaction terms between governance proxies and debt allowed to enter the econometric specification, there is no strong evidence supporting the existence of a strong Debt-Laffer curve. Furthermore, Granger-causality tests do not allow us to uniquely state the sign nor the causality direction (e.g., going from either debt or institutional quality to growth), as results depend on the econometric specification being employed.

Our analysis may have some policy implications for developing countries with varying degrees of good governance. In countries with low levels of corruption, the HIPC Initiative should be implemented and additional disbursements should be extended. The indebtedness of these countries should be reduced to a point where debt does not have an adverse effect on growth and, in this sense, the Initiative would therefore contribute to growth by boosting both capital accumulation and productivity growth via the debt-growth channel. Additional disbursements in countries with good governance should also be encouraged since these countries will use the resources efficiently and the returns in terms of growth and poverty reduction are likely to be large.

In countries with high levels of corruption, the debt reduction under the HIPC Initiative alone is not enough to reduce the debt to levels where debt no longer has a negative effect on growth. However, if these countries are extended higher debt relief than those with good governance, the international community would be setting the wrong incentives which would soon result in new borrowing without any concrete

Common Correlated Effects estimator allow the checking of cross-section independence.

changes in the countries. On the other hand, not providing aid to the countries is also not a feasible solution as it would prompt the rulers of the countries to descend into isolation where the only victims would be the citizens of those countries. A possible solution is a combination of higher debt relief, but lower net aid flows, primarily in the form of grants, the disbursements of which should be closely linked with measures to improve governance. To make optimal use of the resources available, in countries with poor governance, the Initiative should therefore shift emphasis from poverty reduction spending to spending on improvements in governance in the earlier stages of the program. This would create better conditions for increasing the efficiency of poverty reduction spending, as well as other spending, in the medium and long terms.

APPENDIX

Table A1. Summary Statistics

Variables	Mean	Standard Deviation
GDP Growth	1.690	3.340
Lagged Income	3107.500	2311.500
Terms of Trade Growth	0.014	0.069
Population Growth	2.060	0.820
Debt Service to Exports	21.190	12.630
Schooling	43.060	21.890
Gross Domestic Investment	20.530	6.450
Private Investment	13.700	6.180
Public Investment	8.020	3.900
Fiscal Balance	-3.780	4.290
Openness	57.540	29.320
NPV of Debt to GDP	45.010	26.750
Control of Corruption	-0.180	0.560
Political Rights	3.690	1.870

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