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Abstract

The paper investigates whether differences in public sector management quality affect the link between public debt and economic growth in developing countries. For this purpose, we primarily use World Bank's institutional indices of public sector management (PSM). Using PSM thresholds, we split our panel into country clusters and make comparisons. Our linear baseline regressions reveal a significant negative relationship between public debt and growth. The various robustness exercises that we perform also confirm these results. When we dissect our dataset into 'weak' and 'strong' county clusters using public sector management scores, however, we find different results. While public debt still displayed a negative relationship with growth in countries with 'weak' public sector management quality, it generally displayed a positive relationship in the latter group. The tests for non-linearity shows evidence of an 'inverse-U' shape relationship between public debt and economic growth. However, we fail to see a similar significant relationship on country clusters that account for PSM quality. Yet, countries with well managed public sectors demonstrate a higher public debt sustainability threshold.

Keywords: public debt, economic growth, public sector management, developing countries

JEL Classification: E62, F34, H63, H83, O11

1. Introduction

Although there is an increasing focus on debt sustainability, one noticeable weakness of the current line of research is the failure to account for cross-country heterogeneity in the public debt vs. growth dynamics (Kourtellos et al., 2013).[1] In an effort to close this literature gap, and also supplement the existing empirical works that account for country heterogeneity, this paper will study the debt-growth relationship while focusing on a specific set of institutional measures of public sector management quality. In this regard, this work tries to complement existing studies of public debt sustainability that utilize aggregate institutional measures. As a further contribution, the paper will use robust tests of non-linearity and check if non-linearity prevails in a similar fashion between countries with different institutional scores for public sector management. The main interest of this paper will be to find out if differences in the quality of the public sector, other things remaining constant, bear differences in the debt-growth nexus in developing countries.

The quality of public sector management, e.g. property rights, budget management, transparency etc., has been shown to positively affect growth (Duvanova, 2014). However, the special interest of this paper is to analyze if country differences in public sector management result in differential outcome in the debt-growth relationship. There are different channels through which the quality of the public sector might have an impact on the debt-growth nexus. For instance, countries with lower public sector quality (say those with lower rate of revenue mobilization, poor budget management and low transparency) are more prone to higher public debt levels as they tend to borrow more (Heylen et al., 2013; Fernandez and Velasco, 2014). Shleifer and Vishny (1993) also state that inefficient and corrupt governments and public sectors have the tendency to redirect funds from high value investment areas such as education and health to less productive sectors like defense and superfluous infrastructure projects.

However, there might also be counterintuitive arguments. That is, even public sectors with good governance quality may sometimes behave in a less efficient manner. Jalles (2011), for instance, notes that a democratically elected government may not be very enthusiastic about budget sustainability or public debt levels since their primary concern is fulfilling the demands of their voters in the short term, i.e. while they are in office. Financing short run consumption with debt is argued to yield positive growth (Elmendorf and Mankiw, 1999). However, unrestrained and unsustainable consumption level will push sovereign debt levels higher and higher, which may on the longer term lead to a negative growth rates.

Furthermore, in countries with weaker public sector management, we would expect a lower level of investment compared to countries where good institutions exist. Weaker institutions bring uncertainties to the investment atmosphere. Public funds would also be redirected to inefficient sectors that are more conducive to misappropriation rather than productivity. Scully (1988) argues that the presence of freer institutions, such as business freedom and personal liberties, yield higher economic growth rates.

With the foregoing brief introduction in to the importance of institutions in the analysis of public debt, and its relationship with growth, we will proceed to the discussion of a specific aspect of institutional quality (i.e. public sector management) and its possible effects up on the debt-growth nexus.

[1] For the issues behind rising concerns of debt-sustainability: see e.g. Michel and Von Thadden (2010), Helm (2011), Jogiste et al. (2012), Dell'Erba et al. (2013), Panizza and Presbitero (2013).

2. Public Sector Management Quality

The focus of most studies on public sector management and public spending has been examining the 'efficiency' of the public sector (Gupta and Verhoeven, 2001; Afonso et al., 2005; Hauner, 2008). In doing so, such studies often dwell on particular socio-economic projects and sectors towards which public spending flows. They measure 'efficiency' by linking public expenditure to specific socio-economic gains. For instance, school enrollment (relative to public expenditure) is often used to measure the efficiency in education sector while infant mortality is used for the health sector. Apart from the estimations of respective scientific papers, it is often difficult to find databases that are dedicated to measuring public sector efficiency or quality at the aggregate level, and even more so to compare multiple countries.

One reliable measure of public sector management quality for developing countries has been the Country Policy and Institutional Assessment (CPIA) database of the World Bank (WB). Various empirical papers dealing with cross-country institutional differences have been adopting this measure in their analysis (Knack et al., 2011; Dabla-Norris and Gunduz, 2014).[2] As its name implies, CPIA evaluates the quality of policy and institutional frameworks in developing countries. To make sure that there is consistency in the process of applying the criteria for various countries, the WB follows a rigorous internal review process (IDA, 2004; GTZ, 2008). CPIA is widely used to gauge the allocation of resources to developing countries. The International Development Association (IDA) of the WB and various other institutions (both private and public) are dependent on this rating for their operational decisions. The increasing attention given to the CPIA by WB and other development partners emanates from their belief that aid and concessional lending is effectively utilized in countries with a good policy and institutional environment.

The CPIA ranks countries on the scale of 1 to 6, where higher is better. The index also has 16 specific indicators. The 16 individual criteria within the overall CPIA index are grouped in to four categories, namely: economic management, structural policies, policies of social inclusion and equity, and also public sector management and institutions (*PSM*). Our study focuses on the last category, i.e. *PSM*, and its 5 individual sub-components. The five indicators that constitute the *PSM* index are:

- Property Rights and Rule-based Governance,
- Quality of Budgetary and Financial Management,
- Efficiency of Revenue Mobilization,
- Quality of Public Administration, and
- Transparency, Accountability, and Corruption in the Public Sector

As an alternative, we consider The Heritage Foundation's (THF) Index of economic Freedom (IEF). This dataset is also commonly used by researchers who model economic growth, cross-country institutional differences and performances of the public sector (see Alonzo, 2002; Dawson, 2003; Altman, 2013). Out of ten specific indicators that constitute the IEF, this paper will be utilizing five indicators that match the WB's *PSM*. Specifically, our paper will use 'property rights', 'freedom from corruption', 'fiscal freedom', 'government spending', and 'business freedom' in an effort to calibrate an alternative index to the WB's *PSM* index. Each one of these

[2] The CPIA index is compiled by the WB annually (WB, 2011). In order to direct the IDA lending process, the WB kicked-off country assessment programs in the late 1970s (GTZ, 2008). The assessment criteria have evolved to assume its current version in 2004. The revisions have also been made with the intention of facilitating international comparability in performance across countries.

indices is graded on a scale ranging from 0 to 100 (THF, 2014). To match the *PSM*, the IEF index has been converted to the scale of 1 to 6.

3. Methodology and Data

The econometric modeling of the debt-growth nexus in the literature often utilizes linear models (Schclarek, 2004; Blavy, 2006; Greiner, 2012; Bal and Rath, 2014). However, there is a growing argument that this relationship could be non-linear (Kourtellos et al., 2013; Panizza and Presbitero, 2013). To address these issues we will commence with a linear estimation first and later on add a test for non-linearity.

3.1. Linear Estimation

To estimate the relationship between public debt and economic growth we will consider an augmented version of Solow's growth model. Variants of Solow's model are widely used in the literature of economic growth (Durlauf et al., 2001; Ding and Knight, 2009) and public sector (Bajo-Rubio, 2000; Silaghi et al., 2014). The model we are utilizing comprises of public debt and other control variables;

$$g_{it} = \alpha + \beta Debt_{it} + \eta X_{it} + \varepsilon_{it},\ i=1,\ldots,n \qquad (1)$$

Here, g_{it} represents *economic growth* and it is calibrated as the log difference of per-capita GDP. $Debt_{it}$ represents *public debt* and is calibrated as the log of general government gross debt as percent of GDP. In our analysis, we will specially focus on the sign, magnitude and significance of the coefficient of public debt (β) – in relation to our dependent variable, per-capita GDP growth. We will control for various standard determinants of economic growth that we find in growth literature (X_{it}). In addition, ε_{it} represents random error.

The vector of standard control variables (X_{it}) includes; log of initial per-capita GDP (*Init_income*), log of investment as percentage of GDP (*Investment*), log difference of total population (*Population*), the log ratio of import plus exports to GDP (*Openness*), log difference of average CPI (*Inflation*), log of primary school enrollment (*schooling*), log difference of net barter terms of trade (*TOT*) and log of net Official Development Assistance receipts (*ODA*). These variables are routinely used by cross-country studies of economic growth (Alesina et al., 2003; Durlauf et al, 2005) and public debt (Cordella et al., 2010; Presbitero, 2012; Kourtellos et al., 2013). They also explain much of the variation in per-capita GDP growth across countries (Kathavate and mallik, 2012).

Among the set of controls are also institutional measures of public sector management, towards which this paper will be paying a special attention to. These are the index of Public sector management (*PSM*) and its five subcomponents, namely: Property Rights and Rule-based Governance (*Property_right*); Quality of Budgetary and Financial Management (*Budget_mgt*); Efficiency of Revenue Mobilization (*Revenue_mobil*); Quality of Public Administration (*Public_admin*); and Transparency, Accountability, and Corruption in the Public Sector (*Transparency*).

As we are especially interested in finding out possible divergences in the debt-growth relationship across clusters of developing countries, we will split our sample in to country clusters based on the scores of public sector management indices. To determine our clusters, we use both exogenous and endogenous thresholds. The exogenous CPIA threshold (i.e a median value of 3.5, out of a scale of 1 to 6) are used as rough guides to categorize countries as 'strong'

or 'weak' performers, regarding the quality of their public sector management. To make our clustering robust, we will also internally determine the policy thresholds by using Hansen's novel technique of threshold regression (see Hansen, 1999 and 2000).

As a further tool of robustness, we will include an interaction term between public debt and the index of public sector management. This should enable us to capture the possible heterogeneous effect that public debt may have on economic growth due to cross-country differences in institutional quality. It is sensible to assume that countries with well-run public sectors suffer less from the negative impacts of debt compared to countries where the public sector is not functioning well, *ceteris paribus*. A negative coefficient for public debt (β in equation-1) and a positive coefficient for an interaction term between a public sector management index and public debt (see table-1) would prove this to be true.

While examining the impact of public debt ($Debt_{it}$) on economic growth (g_{it}) in equation (1), we will rely on a System Generalized Method of Moments (SYS-GMM) regression as a base model. There is a growing popularity of GMM models in the growth literature, owing to their reliable estimation results for cross-country panels.[3] In the face of heteroscedasticity, for instance, the GMM estimator outperforms a normal IV regression (Baum et al., 2003).[4] Further, as Kathavate and Mallik (2012) note, customary techniques like pooled OLS do not consider the potential endogeneity of explanatory variables. In other words, these estimations do not reflect on the impacts of unobserved and unmodelled country specific differences. As Hansen and Tarp (2001) explain, results from OLS estimations will be inconsistent if unmodelled country specific elements are significantly correlated to explanatory variables. GMM estimation, on the other hand, tackles endogeneity problems among country-specific elements and right hand side variables.[5] Therefore, the use of SYS-GMM estimation in this study is justified.

3.2. Test for Non-Linearity ('Inverse-U' Shape)

Some researchers (Pattillo et al., 2003; Adam and Bevan, 2005; Dogan and Bilgili, 2014) argue that the relationship between public debt and growth could be positive in lower debt levels and in the presence of well-functioning institutions. As Pattillo et al. (2003) explain, in the presence of good institutions where the borrowed funds are directed to productive investment areas, there will be economic growth, which will also repay or refinance the borrowed money in a timely manner. Yet, if debt becomes very high, i.e. exceeds the sustainability threshold or 'tipping point', then the relationship between growth and public debt becomes negative. As Clements et al. (2003) argue, the theories on 'debt overhang' and 'crowding-out' help explain the negative relationship seen in the debt-growth nexus at higher sovereign debt levels. In an effort to address such assertions of non-linearity in the debt-growth nexus, we will be making appropriate tests.[6]

[3] The SYS-GMM estimator was introduced by the seminal work of Blundell and Bond (1998). See Durlauf et al. (2005) for the applications of GMM models in growth regressions.

[4] As commonly done in panel growth regressions, we will be utilizing instrumental variables (see Raghuram and Subramanian, 2008; and Kathavate and Mallik, 2012). Apart from the potentially endogenous explanatory variables themselves (i.e. the lagged and differenced macroeconomic and institutional variables listed in table-1), we will be using additional instruments for legal origin and religious composition, taken from La Porta et al. (2008), and ethnic and linguistic fractionalization, taken from Alesina et al. (2003). We will be testing the validity of our instruments by making use of Hansen's J statistic of over-identifying restrictions. Further, for the tests of first and second order serial autocorrelations, we will report the Arellano and Bond (1991) AR (1) & AR (2) tests.

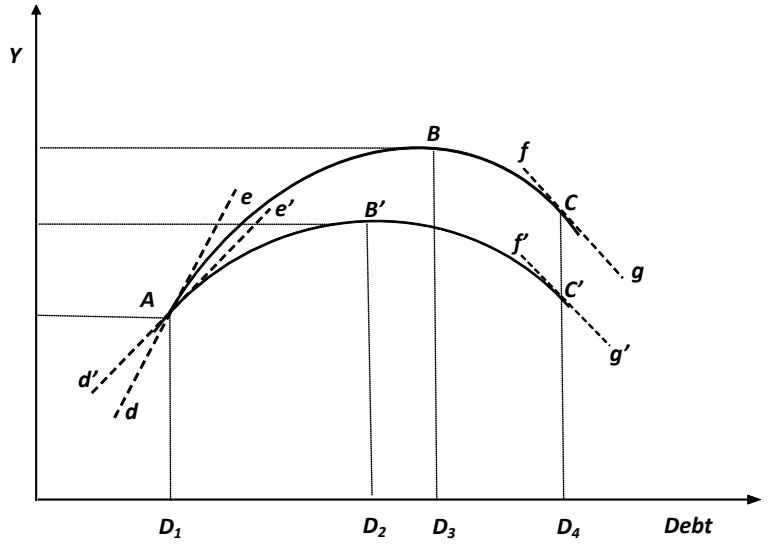
[5] GMM estimator uses first differencing and the lagged values of the endogenous variables as instruments (Raghuram and Subramanian, 2008; and Kathavate and Mallik, 2012).

[6] The presence of a 'Laffer-curve' or 'inverted-U' type relationship in the debt-growth nexus is often reported in

The non-linearity tests in the debt literature are often conducted via spline regressions. However, Panizza and Presbitero (2013) argue that these are not robust due to the arbitrary setting of the cut-off points. Here, as in Megersa (2014), we will be using a robust technique of testing non-linearity proposed by Lind & Mehlum (2010). The presence of an 'inverse-U' shape relationship between public debt and economic growth would imply a relationship that can be depicted with the following graphical relationship.

Figure-1: A non-linear ('inverse-U') relationship between public debt and growth

(For 'strong' and 'weak' PSM country clusters)



As the hypothesis of the '*debt-laffer curve'* shows, the slopes of $\overline{AB'C'}$ & $\overline{AB'C'}$ will be positive at lower levels of public debt and will be negative at higher levels of public debt. That is, $\overline{d}$ & $\overline{d'e'}$ will be positively sloped while $\overline{\underline{g}}$ & $\overline{f'g'}$ will be negatively sloped. The additional hypothesis we make here is that, countries with better institutions (i.e. better public sector management), will have a higher curve ($\overline{ABC}$) compared to countries with bad public sector management ($\overline{AB'C'}$). This also gives them a higher debt sustainability threshold (*B*) compared to countries with weaker institutions (*B*'). However, in both cases - as the literature argues (e.g. Sachs, 1989; Claessens, 1990), we expect a non-linear - specifically an 'inverse-U' shaped relationship between public debt and economic growth.

If we specify equation (1), i.e. the growth regression in section 3.1, as

$$g_{it} = \alpha + \beta Debt_{it} + \eta f(X_{it}) + \varepsilon_{it},\ i=1,\ldots,n \qquad (2)$$

Then, assuming the 'inverse-U' quadratic relationship between public debt and per-capita GDP growth depicted in Figure-1 holds true, we may state equation (*2*) as

$$g_{it} = \alpha + \beta(Debt_{it})^2 + \eta f(X_{it}) + \varepsilon_{it},\ i=1,\ldots,n \qquad (3)$$

public debt literature (see Krugman, 1989; Claessens, 1990; Megersa, 2014).

We can then test the presence of the 'inverse-U' relationship with the following joint conditions;

$$\beta+2\eta f'(D_1) > 0 > \beta+ 2\eta f'(D_4) \quad (4)$$

This may also alternatively be specified as a composite hypothesis of the following null and alternative hypothesis;

$$H0: \beta+2\eta f'(D_1) > 0 \text{ and } \beta+2\eta f'(D_4) < 0 \quad (5)$$

$$H1: \beta+2\eta f'(D_1) \leq 0 \text{ and/or } \beta+2\eta f'(D_4) \geq 0 \quad (6)$$

For more on this non-linearity ('inverse-U') test, please refer to Lind and Mehlum (2010).

3.3. Data

The dataset is composed of an unbalanced panel of 57 developing countries over the period 1990 to 2011.[7] This list is dependent up on the availability of institutional data for PSM and we have taken developing countries for which there is a CPIA report. While classifying countries in to separate clusters on the basis of PSM scores, we use an average score over the 2005-2011 period. The detail list of the variables in our analysis and their summary statistics has been depicted in table-3. The macroeconomic variables come from the World Economic Outlook (WEO) of the IMF and World Development Indicators (WDI) of the WB. The institutional measures of public sector management come from WB's CPIA dataset. However, we also construct and use an alternative measure of public sector management from THF's IEF dataset to control for the WB's CPIA data (see table-3).

4. Results and Discussion

4.1. Results from Linear Modeling

The linear baseline estimations of our growth model, given in equation (1), for different specifications (specifications with and without the debt-growth interaction term) and different policy indices (indices of WB & THF) are displayed in Table-1. Column-1 displays the estimation of the growth model incorporating public debt and the other control variables but without our institutional variable, i.e. *PSM*. The rest of the columns, however, incorporate it. Columns-2&4 deliver estimations without the interaction term between *PSM* and public debt (i.e. *Debt_PSM*) while columns-3&5 include the term. Columns-2&3 are based on indices from the WB's CPIA index while Columns-4&5 are based on indices from THF's IEF.

[7] The countries included in the analysis are: Angola, Albania, Armenia, Azerbaijan, Burundi, Benin, Burkina Faso, Bosnia And Herzegovina, Bolivia, Bhutan, Central African Republic, Cote D'Ivoire, Cameroon, Congo, Rep., Comoros, Cape Verde, Djibouti, Eritrea, Ethiopia, Georgia, Ghana, Guinea, Gambia, Guinea-Bissau, Guyana, Honduras, Haiti, India, Kenya, Kyrgyz Republic, Cambodia, St. Lucia, Lesotho, Moldova, Madagascar, Mali, Mozambique, Mauritania, Malawi, Niger, Nigeria, Nicaragua, Nepal, Pakistan, Rwanda, Sudan, Senegal, Solomon Islands, Sierra Leone, Chad, Togo, Tajikistan, Tanzania, Uganda, St. Vincent and the Grenadines, Vietnam, Zambia.

Table-1: SYS-GMM baseline regressions

	(1)	(2)	(3)	(4)	(5)
Init_income	-0.00580*	-0.00656**	-0.00636**	-0.00789*	-0.00599
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Investment	0.0107	0.00724	0.00627	0.00709	0.00993
	(0.012)	(0.015)	(0.015)	(0.015)	(0.014)
Population	-0.744***	-0.715***	-0.796***	-0.720***	-0.761***
	(0.181)	(0.177)	(0.182)	(0.184)	(0.194)
Openness	0.00181	0.00395	0.00221	0.00597	0.00286
	(0.011)	(0.011)	(0.011)	(0.013)	(0.013)
Inflation	0.105***	0.104**	0.119***	0.124	0.134*
	(0.041)	(0.041)	(0.043)	(0.076)	(0.076)
Debt	-0.00786*	-0.00718*	-0.0643***	-0.00840*	-0.0740**
	(0.004)	(0.004)	(0.025)	(0.004)	(0.030)
Schooling	0.0101	0.00821	0.0065	0.0076	0.0103
	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
TOT	-0.0661**	-0.0648*	-0.0625*	-0.0493	-0.0478
	(0.034)	(0.034)	(0.033)	(0.037)	(0.037)
ODA	-0.00181	-0.00178	-0.00114	-0.00152	-0.00145
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
PSM		0.00563	-0.0726**	0.00922	-0.0745**
		(0.008)	(0.031)	(0.010)	(0.037)
Debt_PSM§			0.0188**		0.0184**
			(0.008)		(0.009)
_cons	0.0336	0.0332	0.281**	0.0292	0.301**
	(0.054)	(0.054)	(0.112)	(0.051)	(0.121)
N	643	643	643	572	572
AR (1)	0.001	0.001	0.001	0.003	0.003
AR (2)	0.024	0.024	0.020	0.030	0.027
Hansen OIR	0.899	0.874	0.714	0.836	0.664

Standard errors in parentheses

*Significance levels:*p<0.10, **p<0.05, ***p<0.010*

§*Debt_PSM is an interaction term between public debt and PSM*

Columns-1: regression without PSM; 2&3: PSM from WB data; 4&5: PSM from THF data

The magnitude and sign of the coefficients as well as their significance is robust across the different specifications of the growth model, with respect to the public debt and public sector management variables. Going to the details, the coefficients of public debt are negative and significant in all cases (see columns-1 to 4). The coefficient of our policy variable, *PSM*, is positive but not significant (see columns-1&3). It, however, becomes negative and significant once we introduce the interaction term (see columns-2&4). This reaffirms the strong negative relationship between public debt and growth, even while controlling for the potential positive impacts of good policy on growth and public debt.[8] The coefficients of the control variables also mostly match the theoretical and empirical literature. The coefficients of investment, openness, inflation and schooling are positive.[9] On the other hand, the coefficients of initial GDP per-capi-

[8] Presbitero (2012), Cordella et al. (2010), and Kourtellos et al. (2013) also arrive at comparable findings from their analysis of public debt.

[9] Further estimations we made (not shown here) using alternative regressions (Differenced-GMM, Fixed Effects, Instrumental Variables) show comparable results to our baseline SYS-GMM. The Differenced-GMM yielded the closest results to the baseline regression. This is to be expected given that it is related to SYS-GMM estimation (see Arellano

ta, population growth, terms of trade growth and official development assistance are negative.[10]

Based on the P-values at the foot of columns-1 to 5, we cannot reject the Arellano and Bond (1991) test for the presence of first and second order serial autocorrelation, i.e. AR(1) & AR(2). However, as can be seen from table-5&6, the second order serial autocorrelation is mostly absent once we take disaggregates of the *PSM* index and account for the differences in quality of public sector management, i.e. running regressions on separate country clusters. The robustness exercise that we run on lower frequency dataset, where we take four year period averages to deal with possible business cycles, strongly confirms the absence of second order serial autocorrelation (see column-5 of table-7). The validity of the instruments used is also confirmed by Hansen's J-statistic for over identifying restrictions, as can be seen in the table-2.

4.2. Robustness Tests

We will run different kinds of robustness exercises to see the consistency of the results against different specifications. Roodman (2007) and Kathavate and Mallik (2012) show the importance of conducting robustness exercises that involve changes in specification, variable definition and datasets. On the basis of such recommendations, we will carry out the following list of robustness checks.

- we use an alternative dataset for the public sector management index (Table-1, columns-4&5);
- we use a disaggregated measure of the index of public sector management (Table-4);
- we use WB's median CPIA threshold (i.e. a score of 3.5) and an alternative robust technique (Hansen's threshold regression) to create country clusters and then run regressions (Table-5 & Table-6);
- we use a dynamic specification where we consider the lagged values of debt (Table-7, columns-1&2);
- we filter our data and control for trends (Table-7, columns-3&4);
- we take consecutive four year period average to control for business cycles (Table-7, column-5);[11]

In the following section, we will deal with the aforementioned robustness exercises - following the same chronological order.

The outputs of the growth regression for equation (1) using the alternative THF's IEF dataset are given in columns-3&4 of Table-1. As explained in the foregoing section (*section-4.1*), the results are quite stable and match the regressions conducted using the WB's CPIA data.

The results of the regressions run with the disaggregated indices of public sector management are given in table-4. As noted in *section-2*, the *PSM* index is the average of five indices that measure different aspects of public sector management quality. Countries often tend to score high on some measures and low on others. Further, the different aspects (subcompo-

and Bond, 1991 and Blundell and Bond, 1998).

[10] It is interesting to see that the coefficient of initial GDP per-capita is negative and significant in most of the cases (see columns-1 to 3). This confirms the 'convergence-hypothesis' among countries in the literature of economic development.

[11] This is done in various empirical works employing growth regressions (see Kourtellos at al., 2013, Kathavate and Mallik, 2012).

nents) of *PSM* may exert a different magnitude or direction of influence on economic growth or the debt-growth relationship. Therefore, it becomes useful to use disaggregates of the index, as a complement to the analysis made with the *PSM* index itself. As we can indeed see in table-4, there is no uniformity in the coefficients of the subcomponents of the *PSM* index. All sub-indices except one, i.e. *revenue mobilization*, have positive coefficients. Though, we find a significant positive effect only from one index, i.e. *budget management*.

The results shown in the table-4 enable us to see the direction and significance of the relationship between growth and the policy disaggregates that constitute the *PSM* index. We could see that four of the subcomponents of the index, namely: good *property rights, budgetary and financial management, public administration, transparency,* have a positive relationship with economic growth, as we might expect. Of these, good *budgetary and financial management* appears to have a very significant effect on growth, even at 1%. On the other hand, the coefficient for *efficiency of revenue mobilization* has a negative sign. It is also significant, though weakly, just at 10%.[12]

As a further test of robustness, we will check if different country clusters (based on the quality of their institutions) witness similar pattern of relationship between economic growth and public debt. Towards achieving this objective, we will first use the CPIA median to create clusters (see *section-3*). Next, we will use a novel threshold regression technique pioneered by Bruce Hansen to create clusters that are statistically different from each other (Hansen, 1999). We will use the *PSM* index and its five subcomponents as threshold variables to create the country clusters. The threshold regression technique that we adopt has been widely applied by recent researches to optimally dissect databases and see how one cluster compares with another (see Van Campenhout and Cassimon, 2012; Kuo et al., 2013).

Table-5 shows the results of the regression that we run on the clusters of countries with 'strong' and 'weak' public sector management. The first two columns use the *PSM* index itself while the rest of the columns use the five subcomponents of *PSM* to create the clusters. As explained in *section-2*, each of these policy and institutional variables are measure on a scale of 1 to 6 and the WB uses a median score of 3.5 as a threshold. Countries with policy scores above 3.5 will be treated as 'strong' performers and countries scoring below that will be treated as 'weak' (see IDA, 2004; Eifert and Gelb, 2007). Irrespective of the policy variables that are used, public debt appeared to have a negative relationship with economic growth, especially for the country clusters with 'weak' score. Further, in most of these cases the coefficient of public debt was not only negative but also significant. For the clusters with 'strong' score, the coefficient of public debt was positive and even significant in half of the cases. We have only one instance, i.e. the cluster formed by *revenue mobilization*, where the coefficient is negative out of the six clusters of countries with 'strong' policy score.

Table-6 basically delivers the same information as table-5. The difference here is that we internally determine the thresholds as opposed to using the CPIA median. The results in these two tables are very similar. In the cluster of countries with 'weak' scores, public debt has a consistent negative (and mostly significant) coefficient. However, in the cluster of countries with 'strong' scores, public debt mostly has positive (but rarely significant) coefficients. As in table-5,

[12] To score good in the measure of '*Efficiency of Revenue Mobilization*', a country is expected to have a broad tax base, less reliance on tax from international trade, low import tariffs, significant income tax, etc. However, even those developing countries that witness rapid growth rates (and have better scores in other institutional and policy measures) often have problems with tariffs and taxation. They often rely on their small formal sector and international trade as major source of taxation. This might, therefore, lead to the counterintuitive negative coefficient of the indicator.

only in one case – i.e. the cluster formed by *revenue mobilization*, we have a negative coefficient.

Table-7 gives regression results that address issues of dynamic modeling of public debt, filtering of data against trends, and averaging periods to control for business cycles.[13] Columns-1&2 of the table report the regressions on lagged values of public debt.[14] Columns-3&4 report the regressions run on panel data filtered against trends with the popular Hodrick-Prescott procedure. Finally, column-5 reports the regressions run on a smaller panel which has undergone a four year averaging to deal with potential business cycles.[15] Columns-1&3 report the growth regressions consisting of the policy variable, without the interaction term. However, columns-(2, 4, 5) report regressions that include the interaction term between public debt and the policy variable. Going to the results, public debt displays negative coefficients – as was in our foregoing analysis. In two instances of the regressions that include the interaction term (i.e. columns-2&4), the negative coefficient is also significant.

4.3. Results from Non-Linearity ('Inverse-U') Test

Table-2 addresses the hypothesis of non-linearity in the debt-growth nexus and also the differential thresholds for the set of countries having 'lower' and 'higher' *PSM* ratings. The detail of the non-linearity test adopted in this paper is shown in *Section-3.2*. As we can see from column-1 of the table, there is evidence of a non-linear (*'inverse-U'*) relationship between public debt and economic growth when our whole set of developing countries is considered. The extreme value lies within the lower and upper bounds. Further, the slopes are positive and negative at the lower and upper bounds, respectively. The overall t-test for the presence of an 'inverse-U' shape is significant, though weakly at 10%.

Table-2: Non-linearity test

(Using the Lind-Mehlum test for 'inverse-U' shape)

	(1)All countries		(2)Countries with 'weak' public sector management (PSM <3.5)		(3)Countries with 'strong' public sector management (PSM ≥3.5)	
Bounds	Lower	Upper	Lower	Upper	Lower	Upper
Interval	1.26186	6.11999	1.26186	6.11999	1.26186	6.11999
Slope	.02435	-.03557	.0116915	-.031210	.18468	-.06554
Test for slope : P>t =	.07322	.00663	.282763	.02851	.27202	.37559
Extreme point:	3.23628		2.58581		4.84755	
Overall test of presence of a bell shape: P>t =	.0732		.283		.376	

However, as we can see from columns-2&3, the significance tests failed once we split our sample in to 'strong' and 'weak' country clusters, based on the *PSM* scores. Yet, we can still trace a weak 'inverse-U' shape for both clusters as the slopes are negative at the lower

[13] These robustness exercises are routinely implemented in panel data analysis. For dynamic modeling of public debt, see Ureche-Rangau and Burietz (2013). For de-trending time series using the Hodrick-Prescott procedure; see Kathavate and Mallik (2012). For dealing with business cycles via time-series averaging; see Roodman (2007) and Kathavate and Mallik (2012).

[14] We ran regressions with more lags but did not report them here. The results are quite similar to the first lag estimations reported here.

[15] We take the average of four years to control for business cycles. Since we have 22 years (1990 to 2011), we formed five time periods - each consisting of four years (i.e. 1990-1993, 1994-1997, 1998-2001, 2002-2005, 2006-2009) and one time period consisting of the vestige two years (2010-2011).

bounds and positive at the upper bounds. Furthermore, the extreme points lie within the lower and upper bounds in both cases. Even more interesting, the extreme point for the strong scoring cluster (Debt/GDP in log. ≈ 4.85) is higher than the weak scoring cluster (Debt/GDP in log. ≈ 2.59). This is also graphically shown in Figure-1 *(see B & B')*. This result supports the argument that countries with better institutions, i.e. *PSM*, have (and deserve) higher public debt sustainability targets compared to those with weaker institutions (see Reinhart et al., 2003; Caner et al., 2010; Cordella et al., 2010).

5. Conclusion

The concern over the sustainability of public debt and its negative impacts on economic growth is legitimate and has a sound theoretical backing. In this enquiry, however, one has to make distinctions between developing countries. It will be wrong to expect that rising levels of public debt will have similar impacts on economic growth across developing countries with 'strong' and 'weak' institutions. In line with this, our paper investigates the link between economic growth and public debt while focusing on country differences in public sector management.

When we consider our dataset in its entirety, disregarding cross-country differences in public sector management quality, the results from our linear baseline regressions show that public debt has a significant negative relationship with economic growth. The wide arrays of robustness exercises that we conducted also yield comparable results. However, we find a different patter of relationship once we dissected our dataset in to country clusters, on the bases of public sector management quality. In countries with 'weak' or poorly managed public sectors, public debt displays the familiar negative relationship with economic growth. However, in countries with 'strong' or well managed public sectors, public debt generally shows evidence of positive relationship with growth. This outcome largely prevails on alternative country clusters determined using disaggregated indices of public sector management and also on optimal clusters determined using threshold regressions.

The non-linearity tests we made also show signs of dependence on the country clusters used. We have a significant evidence of non-linear ('*inverse-U*') relationship between public debt and economic growth, when we consider the whole set of our dataset. However, we only have a weak (non significant) 'inverse-U' relationship between public debt and economic growth after we split our dataset in to country clusters of 'strong' and 'weak' public sector management quality. Interestingly, countries with strong institutions have displayed a higher debt sustainability threshold, as the sovereign debt literature seems to suggest.

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Appendix

Table-3: Variables' descriptions, sources and summary statistics

Variable	Descriptions and sources of data	Source	Mean	Std.dev.	Min	Max
	Growth, public debt and control Variables					
Growth	log difference of per-capita GDP growth at constant US 2000 prices.	WDI	.0259	.0455	-.181	.316
Init_income	log of initial per-capita GDP.	WDI	5.987	.735	4.851	8.334
Investment	log of gross investment as percentage of GDP.	WEO	3.037	.428	1.518	4.340
Population	log difference of total population.	WDI	.022	.012	-.011	.103
Openness	log ratio of import plus exports to GDP.	WDI	.738	.396	0	2.091
Inflation	log difference of average consumer price index.	WEO	.081	.098	-.088	.927
Debt	log of government gross debt as percent of GDP.	WEO	4.100	.689	1.262	6.120
Schooling	log of primary school enrollment.	WDI	3.737	.239	2.507	4.010
TOT	log difference of net barter terms of trade.	WDI	.010	.116	-.975	.518
ODA	log of net Official Development Assistance receipts.	WDI	1.917	1.056	-2.226	4.117
	Institutional variables					
PSM	Public Sector Management and Institutions. NB: The five PSM subcomponents are listed beneath.	CPIA	3.112	.465	2.257	3.971
	Alternative *PSM* index constructed from IEF's indices of 'Property Rights', 'freedom from Corruption', 'fiscal freedom', 'government spending' and 'business freedom'	IEF	3.634	.397	2.484	4.714
Property_right	Property Rights and Rule-based Governance	CPIA	2.922	.554	2	4
Budget_mgt	Quality of Budgetary and Financial Management	CPIA	3.255	.575	1.786	4.286
Revenue_mobil	Efficiency of Revenue Mobilization	CPIA	3.496	.499	2.5	4.357
Public_admin	Quality of Public Administration	CPIA	3.006	.465	2	4
Transparency	Transparency, Accountability, and Corruption in the Public Sector	CPIA	2.879	.604	1.786	4.5

WDI= World Development Indicators, World Bank
WEO= World economic Outlook, IMF
CPIA= Country Policy and Institutional Assessment, World Bank
IEF= Index of Economic Freedom, The Heritage Foundation

Table-4: SYS-GMM regressions

(Regressions fit the five *PSM* subcomponents)

	(1)	(2)	(3)	(4)	(5)
Init_income	-0.00957***	-0.00617**	-0.00882***	-0.00931***	-0.00930***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Investment	0.0203	0.00505	0.0329***	0.0187	0.0255**
	(0.013)	(0.013)	(0.010)	(0.014)	(0.011)
POP	-0.819***	-0.727***	-0.818***	-0.847***	-0.829***
	(0.166)	(0.168)	(0.160)	(0.162)	(0.168)
Openness	0.00335	0.00605	-0.00268	0.00409	0.00153
	(0.011)	(0.010)	(0.010)	(0.012)	(0.011)
Inflation	0.0969***	0.146***	0.0664*	0.0994***	0.0908**
	(0.034)	(0.040)	(0.035)	(0.034)	(0.036)
Debt	-0.00665*	-0.0055	-0.00598	-0.00689*	-0.00662
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Schooling	0.00351	0.00093	0.0104	0.00374	0.00425
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
TOT	-0.0579*	-0.0522	-0.0626**	-0.0576*	-0.0612*
	(0.032)	(0.033)	(0.031)	(0.033)	(0.032)
ODA	-0.00116	-0.00019	-0.00128	-0.00043	-0.00056
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Property_right	0.00409				
	(0.006)				
Budget_mgt		0.0129***			
		(0.005)			
Revenue_mobil			-0.00774*		
			(0.004)		
Public_admin				0.00415	
				(0.007)	
Transparency					0.000674
					(0.004)
_cons	0.0358	0.0265	0.0113	0.0373	0.0267
	(0.053)	(0.048)	(0.051)	(0.051)	(0.053)
N	643	643	643	643	643
AR (1)	0.001	0.001	0.001	0.001	0.001
AR(2)	0.024	0.024	0.026	0.025	0.025
Hansen OIR	0.063	0.130	0.084	0.053	0.057

Standard errors in parentheses

*Significance levels:*p<0.10, **p<0.05, ***p<0.010*

Table-5: SYS-GMM regressions (For 'strong' and 'weak' country clusters; using CPIA median of 3.5 as threshold)

	PSM		Property rights		Budget Mgt		Revenue Mobil		Public Admin		Transparency	
Country cluster	Weak	Strong	Weak	Strong	Weak	Strong	Weak	Strong	Weak	Strong	Weak	Strong
Init_income	-0.00727*	-0.0319***	-0.0109**	-0.0171***	-0.00741	-0.0171***	-0.0215***	-0.00267	-0.00706	-0.0265***	-0.00811**	-0.00245
	(0.004)	(0.010)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.007)	(0.004)	(0.008)
Investment	-0.00044	0.0815***	0.0125	0.0775***	0.00251	0.00446	0.026	0.011	0.00122	-0.015	0.00735	0.0172
	(0.014)	(0.030)	(0.016)	(0.020)	(0.012)	(0.014)	(0.018)	(0.013)	(0.015)	(0.030)	(0.016)	(0.020)
Population	-0.651***	-2.843***	-0.740***	-1.976***	-0.115	-1.257***	-0.377	-1.047***	-0.614**	-2.125**	-0.751***	0
	(0.174)	(0.637)	(0.198)	(0.260)	(0.466)	(0.274)	(0.379)	(0.208)	(0.254)	(0.954)	(0.187)	(0.000)
Openness	0.00508	-0.0790**	0.0128	-0.0605***	0.0159	-0.00292	0.0278**	-0.0126	0.00523	0.000308	0.0104	-0.00458
	(0.012)	(0.033)	(0.013)	(0.011)	(0.014)	(0.010)	(0.013)	(0.009)	(0.012)	(0.017)	(0.011)	(0.011)
Inflation	0.138***	-0.19	0.163***	0.0682	0.110***	-0.197	0.0921***	0.116	0.136***	-0.237	0.138***	0.0107
	(0.050)	(0.184)	(0.055)	(0.110)	(0.037)	(0.127)	(0.031)	(0.148)	(0.046)	(0.161)	(0.048)	(0.134)
Debt	-0.0110**	0.0637**	-0.0102*	0.00609	-0.0137***	0.0133**	-0.00813	-0.00446	-0.0112**	0.0389***	-0.0118**	0.0052
	(0.004)	(0.029)	(0.005)	(0.007)	(0.003)	(0.005)	(0.005)	(0.006)	(0.005)	(0.012)	(0.006)	(0.022)
Schooling	0.00676	0.254**	0.00518	0.111***	-0.00948	0.0411***	-0.00558	-0.00115	0.0126	0.0327**	0.0104	-0.00028
	(0.009)	(0.110)	(0.010)	(0.031)	(0.016)	(0.014)	(0.011)	(0.025)	(0.012)	(0.014)	(0.010)	(0.092)
TOT	-0.0524	-0.00155	-0.0388	-0.151*	-0.0326	-0.105*	-0.0719**	-0.0845**	-0.0648*	0.061	-0.0595*	0.0466
	(0.033)	(0.079)	(0.033)	(0.080)	(0.040)	(0.055)	(0.034)	(0.039)	(0.034)	(0.047)	(0.033)	(0.433)
ODA	0.00214	-0.0136**	0.00229	-0.00645	0.0000	-0.00501*	-0.0006	0.00145	0.000976	-0.00083	0.00449	-0.0047
	(0.003)	(0.007)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.005)	(0.003)	(0.005)	(0.004)	(0.006)
N	510	133	456	187	326	317	229	414	492	151	522	121
AR(1)	0.004	0.044	0.009	0.012	0.017	0.023	0.030	0.008	0.005	0.013	0.003	0.413
AR(2)	0.067	0.083	0.048	0.217	0.156	0.155	0.140	0.142	0.074	0.129	0.029	0.774
Hansen OIR	0.638	0.868	0.347	0.380	0.940	0.484	0.300	0.829	0.530	0.748	0.380	1.000

*Notes: Regressions include a constant that is not reported to save space. Standard errors are in parentheses. Significance levels:*p<0.10, **p<0.05, ***p<0.010*

Table-6: SYS-GMM regressions (For the 'strong' and 'weak' country clusters; using Hansen's threshold regression)

	PSM		Property rights		Budget Mgt		Revenue Mobil		Public Admin		Transparency	
Country cluster	Weak	Strong	Weak	Strong	Weak	Strong	Weak	Strong	Weak	Strong	Weak	Strong
Init_income	-0.00989	-0.0109**	-0.0110**	-0.0174***	-0.00345	0.0168**	-0.00607	-0.00472	-0.00706	-0.0265***	-0.0127**	-0.00631
	(0.007)	(0.005)	(0.005)	(0.005)	(0.004)	(0.008)	(0.004)	(0.003)	(0.005)	(0.007)	(0.006)	(0.004)
Investment	0.0304*	0.011	0.0135	0.0416**	0.0108	0.00831	0.00612	0.0339***	0.00122	-0.015	0.0397**	0.0149
	(0.017)	(0.016)	(0.016)	(0.018)	(0.013)	(0.030)	(0.017)	(0.008)	(0.015)	(0.030)	(0.016)	(0.014)
Population	-0.956**	-0.981***	-0.732***	-1.521***	-0.435**	1.236**	-0.771***	-1.161***	-0.614**	-2.125**	-1.252***	-0.989***
	(0.374)	(0.221)	(0.198)	(0.304)	(0.217)	(0.593)	(0.185)	(0.385)	(0.254)	(0.954)	(0.447)	(0.215)
Openness	0.0103	-0.00843	0.0135	-0.0340***	0.00613	0.0192	0.0123	-0.0367***	0.00523	0.000308	0.00199	-0.0199***
	(0.014)	(0.012)	(0.013)	(0.010)	(0.012)	(0.021)	(0.013)	(0.007)	(0.012)	(0.017)	(0.014)	(0.007)
Inflation	0.126***	-0.048	0.165***	-0.0747	0.127***	-0.286***	0.0894**	0.136	0.136***	-0.237	0.144***	0.0108
	(0.049)	(0.114)	(0.055)	(0.117)	(0.040)	(0.106)	(0.045)	(0.123)	(0.046)	(0.161)	(0.050)	(0.099)
Debt	-0.00888	0.00476	-0.0107**	0.00273	-0.00951**	0.0268***	-0.00794	-0.00574	-0.0112**	0.0389***	-0.0129**	0.00346
	(0.006)	(0.007)	(0.005)	(0.007)	(0.004)	(0.006)	(0.006)	(0.005)	(0.005)	(0.012)	(0.005)	(0.006)
Schooling	0.0106	0.0152	0.00497	0.0535**	-0.0006	0.168***	0.00727	-0.00451	0.0126	0.0327**	0.0166	0.00975
	(0.011)	(0.018)	(0.010)	(0.027)	(0.007)	(0.029)	(0.010)	(0.024)	(0.012)	(0.014)	(0.013)	(0.019)
TOT	-0.055	-0.0491	-0.0416	-0.0554	-0.0516	-0.0857	-0.0442	-0.0381	-0.0648*	0.061	-0.0236	-0.0746
	(0.034)	(0.052)	(0.033)	(0.072)	(0.038)	(0.058)	(0.032)	(0.055)	(0.034)	(0.047)	(0.028)	(0.055)
ODA	-0.00267	-0.00322	0.00234	-0.00411	0.00197	-0.0268***	0.000585	0.00275	0.000976	-0.00083	-0.00673	0.00101
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.003)	(0.005)	(0.005)	(0.003)
N	330	313	445	198	461	182	426	217	492	151	250	393
AR(1)	0.019	0.011	0.010	0.010	0.004	0.187	0.006	0.010	0.005	0.013	0.045	0.005
AR(2)	0.051	0.237	0.041	0.360	0.167	0.160	0.126	0.065	0.074	0.129	0.037	0.501
Hansen OIR	0.372	0.218	0.339	0.251	0.975	0.360	0.331	0.073	0.530	0.748	0.476	0.696

*Notes: Regressions include a constant that is not reported to save space. Standard errors are in parentheses. Significance levels:*p<0.10, **p<0.05, ***p<0.010*

Table-7: SYS-GMM regressions

	(1)	(2)	(3)	(4)	(5)
Init_income	-0.00669*	-0.00615*	-0.00542	-0.00539	-0.00789**
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)
Investment	0.011	0.010	0.0085	0.00691	0.0126
	(0.014)	(0.014)	(0.015)	(0.015)	(0.017)
Population	-0.695***	-0.763***	-0.679***	-0.768***	-1.051
	(0.193)	(0.203)	(0.194)	(0.196)	(0.672)
Openness	-0.000425	-0.00211	0.00321	0.00199	-0.00096
	(0.011)	(0.011)	(0.011)	(0.011)	(0.014)
Inflation	0.082	0.096	0.110***	0.124***	0.210***
	(0.061)	(0.068)	(0.042)	(0.044)	(0.077)
Schooling	0.014	0.013	0.00907	0.00728	-0.00287
	(0.009)	(0.009)	(0.009)	(0.009)	(0.011)
TOT	-0.0556	-0.0557	-0.0693**	-0.0683**	0.0873
	(0.036)	(0.036)	(0.035)	(0.035)	(0.176)
ODA	-0.00321	-0.00282	-0.00145	-0.0009	0.00085
	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)
Debt	-0.00526	-0.0592**	-0.00625	-0.0619**	-0.0719
	(0.003)	(0.025)	(0.004)	(0.025)	(0.070)
PSM	0.004	-0.0703**	0.00517	-0.0704**	-0.0937
	(0.007)	(0.031)	(0.008)	(0.031)	(0.091)
Debt_PSM		0.0177**		0.0182**	0.0241
		(0.008)		(0.008)	(0.023)
_cons	0.008	0.238**	0.0161	0.260**	0.328
	(0.054)	(0.116)	(0.058)	(0.111)	(0.342)
N	584	584	617	617	138
AR(1)	0.003	0.002	0.001	0.001	0.054
AR(2)	0.029	0.029	0.020	0.017	0.915
Hansen OIR	0.971	0.908	0.767	0.617	0.546

Standard errors in parentheses

*Significance levels:*p<0.10, **p<0.05, ***p<0.010*

Columns-1&2: regressions with lagged public debt values; 3&4: trend filters; 5: business cycle control

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