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Public Debt and Economic Growth Nexus: Evidence from South Asia

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Abstract

It is well established in literature that the public debt and economic growth bear positive and non-linear relationship. However, in recent literature, evidence of no causal relationship is found when accounted for endogeneity in case of advanced economies (Panizza and Presbitero, 2014). Chudik, et al. (2017) analyse the data on forty countries and find no evidence of universally applicable threshold effect in the relationship between debt and growth. These advancements in the debt-growth literature provides the motivation to re-explore the relationship between public debt and economic growth under non-linearity and endogeneity in context of developing economies of South Asia including Pakistan, India, Bangladesh, and Sri-Lanka for the period 1980-2014. There exists a significant, positive but non-linear relationship between the public debt and economic growth for the selected set of developing countries when accounted for endogeneity and non-linearity. The negative association between the public debt and economic growth for the SAARC region is found when the debt level is higher than 61% of GDP, which is significantly lower than developed economies (90% of GDP). Individual threshold levels for debt-to-GDP ratio divulge that Sri Lanka, Pakistan, and India need to control their public borrowings as their current debt levels are higher and/or around the respective threshold levels.

Keywords: Endogeneity, Non-linearity, Threshold, FMOLS

1. INTRODUCTION

The neoclassical growth theory suggests the direct and positive effect of debt on economic growth if the borrowed amount is used optimally and stimulates investment. On the other hand, according to debt overhang hypothesis, debt has a positive effect to economic growth up to a threshold point where an additional debt will be growth retarding. The resources available for investment are utilized in debt servicing.

The hypothesis of non-linear relationship between debt and economic growth has got its due attention in the literature [Reinhart and Rogoff (2009), (2010); Checherita-Westphal and Rother (2012); and Kumar and Woo (2010)] and, in general, there is a consensus among the researchers regarding the existence of debt-threshold effect on growth however, Chudik, *et al.* (2017)

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The issue of eendogeneity has recently been highlighted in the debt-growth literature [Kumar and Woo (2010); Panizza and Presbitero (2014); and Chudik, *et al*. (2017)]. On balance, researchers find significant relationship between public debt and economic growth after catering for endogeneity. On the contrary, for developed economies, Panizza and Presbitero (2014) establish that debt and economic growth bear no relationship when controlled for endogeneity.

With the given advancements in the debt-growth literature on the threshold effect (non-linearity) and endogeneity issues, we hardly find any study focusing on both the problems simultaneously in context of developing economies of South Asia. The present study is an attempt to bridge this gap in literature by exploring the relationship between public debt and economic growth by incorporating non-linearity and endogeneity in the econometric model for the major developing economies of South Asia including India, Pakistan, Bangladesh and Srilanka[1] for the period 1980-2014.

The rest of the paper is organized in three sections. Data and methodology are covered in section 2. Section 3 provides the estimation results and discussion. Finally, the section 4 concludes the findings.

2. DATA AND METHODOLOGY

Mankiw, *et al.* (1992) assumed that households fix the saving and educational spending ratios which allows augmented Solow model by based on Cobb-Douglas form:

$$Y=AK^{\alpha}L^{\beta} \qquad \ldots (1)$$

where, $\alpha > 0$, $\beta > 0$ and $A > 0$

According to Bräuninger, (2003), the steady state growth rate increases if an increase in public debt is used to redistribute tax burden of every individual from youth to middle age. Hence, in context of open economy, public debt may not be harmful for growth.

[1] The contribution of these four economies to the total GDP of the region is 99% [Mahmood, Arby, & Sherazi (2014)].

Bräuninger, (2003) provides the proposition that the steady-state growth is possible if the deficit ratio stays below a critical level by deriving the following result.

$$\hat{K}=\hat{H}=\hat{Y} = A(s[1+b-g]-b)^{\alpha}(z[1+b-g])^{\beta} \quad \dots (2)$$

where, s, b, g and z are the saving ratio, deficit ratio, government purchase ratio and educational spending ratio respectively. The effect of deficit ratio is given by:

$$\frac{d\hat{Y}}{db} = \frac{\beta\hat{Y}}{(1+b-g)} + \frac{(s-1)\alpha\hat{Y}}{s(1+b-g)-b} \quad \dots (3)$$

$$\frac{d\hat{Y}}{db} < 0 \text{ if } b > b' = \frac{(s-\alpha)(1-g)}{(1-s)} \quad \dots (4)$$

It is pertinent to mention the assumption that the budget deficit adds to public debt $\dot{D} = B = bY$ made while deriving the aforementioned results.

2.1. Endogeneity

Panizza and Presbitero (2012) establish that the OLS parameters are biased due to the existence of endogeneity problem in context of a bivariate model in which growth is a function of debt.

$$G= a+ bD+ u \quad \dots (5)$$

$$D= m+ kG+ v \quad \dots (6)$$

where, economic growth (G) is a function of public debt (D) and vice-versa. Where reduced forms of both the equations are:

$$G=\frac{a+bm}{1-bk}+\frac{bv+u}{1-bk} \quad \dots (7)$$

$$D=\frac{m+ak}{1-bk}+\frac{v+ku}{1-bk} \quad \dots (8)$$

To calculate $\hat{b}$, we know that:

$$\hat{b} = \frac{Cov\,(G,D)}{Var\,(D)} \quad \dots (9)$$

$$\hat{b}=\frac{b\sigma_v^2+k\sigma_u^2}{\sigma_v^2+k^2\sigma_u^2} \quad \ldots(10)$$

And the bias of the OLS estimator is:

$$E\left(\hat{b}\right)-b=\frac{k(1-bk)}{\frac{\sigma_v^2}{\sigma_u^2}+k^2} \quad \ldots(11)$$

Since stability requires that bk <1shows that OLS estimations are unbiased if and only if $k = 0$ (i.e., if debt is not endogenous).

According to Phillips and Hansen (1990) and Phillips (1995), in presence of endogeneity, limiting distribution of OLS parameters contains second order bias and non-centrality bias comes from the fact that regression errors are serially correlated. Phillips and Hansen (1990) proposed a correction in β^{OLS} formula by applying a transformation which allows for correcting for endogeneity bias and non-centrality bias. The resulting method is known as FMOLS.

2.2. Non-linearity

According to Checherita-Westphal and Rother (2012), the simplest test for non-linearities is to include the quardratic term in the model. Through signs and significance of quadratic specification (β_1 and β_2), it is easier to establish the existence of non-linear relationship between debt and growth. Threshold or optimal point can be calculated through first order condition.

$$Growth_{it}=\beta_i+\beta_1 Debt_{it}+\beta_2 Debt_{it}^2+X_{it}\eta+\varepsilon_{it} \quad \ldots(12)$$

where, the *X* matrix contains the growth rates of labour and capital, human capital (Government expenditure on education as percentage of GDP), inflation, trade openness, and dependency ratio (ratio of population aged 0-14 and 65 above to total population). The data on the aforementioned variables are taken from the World Development Indicators and Penn tables for the time period 1980-2014.

3. RESULTS AND DISCUSSION

Due to regional integration, economic variables start depending on each other and a shock happening in a particular country may have large impact on its neighboring country if integration is very high [Pesaran (2004)]. This

study is based on panel data, which require the testing for cross-sectional dependence in the error terms and the results divulge to accept the null hypothesis of cross sectional independence (p-value=0.1032). This leads us to the panel unit root test proposed by Im, Pesaran, and Shin (2003) with the assumption of cross sectional independence. It is evident from the results summarized in Table 1 below that growth rate of GDP, human capital, labour growth and inflation are stationary at levels while the other variables are integrated of order one. This further strengthens the power of our selected method as Fully Modified estimators allow modeling variables with different order of intergration reported by Kao and Chiang, (2000).

Fisher's cointegration test proposed by Maddala and Wu (1999) is the most suitable choice due to its less restrictive alternative hypothesis and mixed order of integration of variables. Both the Fisher's cointegration statistics, trace and maximum eigen value tests, confirm the existance of cointegration among the varaibles (see Appendix Table 1).

Durbin–Wu–Hausman test (augmented regression test) is applied to test the existence of endogeneity issue in the model. The data do not provide enough evidence (p-value=0.049) to support the null hypothesis of exogeneity (see Appendix Table 2). This leads to the inconsistency of OLS. Thus, Fully Modified OLS is applied to estimate the empirical model and the results are summarized in Table 2.

Table 1. Unit Root Test Results

Variable	Level	First Difference
GDP Growth	-3.04148	
	(0.0012)	
Capital Growth	0.93442	-5.10051
	(0.8250)	(0.0000)
Labour Growth	-3.05048	
	(0.0011)	
Human Capital	-2.39392	
	(0.0083)	
Debt/GDP	-1.20834	-3.45493
	(0.1135)	(0.0003)
Inflation	-3.37978	
	(0.0004)	
Trade Openness	2.27268	-6.37398
	(0.9885)	(0.0000)
Dependency Ratio	3.70669	-11.3786
	(0.9999)	(0.0000)

P-values are given in the parenthesis.

Table 2. Fully Modified Ordinary Least Square

Dependent Variable: GDP Growth				
Variable	Coefficient	Standard Error	t-values	Prob.
Capital Growth	0.007897	0.003112	2.537477	0.0124
Labour Growth	0.696475	0.148292	4.696642	0.0000
Human Capital	0.017182	0.008989	1.911413	0.0582
Debt/GDP	0.258933	0.020798	12.44971	0.0000
Debt/GDP^2	-0.002069	0.000163	-12.66404	0.0000
Dependency Ratio	-0.054461	0.009907	-5.496966	0.0000
Inflation	-0.057829	0.021281	-2.717459	0.0075
Trade Openness	0.022279	0.006296	3.538805	0.0006
R-squared				0.232839
Adjusted R-squared				0.190885
Long-run Variance				1.073117
Durbin-Watson stat				1.772961

All the conventional variables carry the expected signs and significance. For instance, labour, capital, human capital, and trade openness have positive and significant impact on growth. On the other hand, dependency ratio and inflation are growth retarding. The coefficient for capital is positive and significant which shows that increase in capital accelerates economic growth. The increase in capital formation will enhance the production capacity of an economy. The increase in overall output level of country induces positive effect on growth. The estimated coefficient on labour is slightly larger than one would expect to predict from neoclassical theory. The possible explanation could be the rise in labour reduces the rate in technological progress. These results are in line with the findings in Shahzad and Javed (2015); Salotti and Trecroci (2012); and Panizza and Presbitero (2014). The R-square of model is quite low but that is not an issue in our research as low R-squared values are problematic when you need precise predictions [Florian (2016)].

Statistical significance and the opposite signs of debt-to-GDP ratio and its squared form prove the existence of non-linear relationship between debt and growth. This is in line with the finding in Kumara and Cooray (2013) and Panizza and Presbitero (2014). The positive sign of debt to GDP is indicative of the fact that debt helps to accelerate the growth. However, the negative sign of its square form divulges the existence of a threshold point beyond that the debt will bring deleterious impacts on the economy. Differentiating the growth model with respect to debt-to-GDP variable allows us to compute the threshold levels for the selected set of countries. Results are summarized in Table 3.

Table 3. Threshold Levels

Country	Threshold level	Current Level (2014)
SAARC	61%	--
Pakistan	62%	64%
India	66%	66%
Bangladesh	40%	19%
Sri-Lanka	66%	75%

In case of Pakistan, the level of debt sustainability is 62% of GDP which is in line with the findings in Saqib (2014). The debt sustainability level for Sri-Lanka is 66% of GDP which is slightly lower than the findings in Kumara and Cooray (2013) which was 68% of GDP. This difference of two percentage points may be due to the use of non-overlapping growth spells by Kumara and Cooray (2013) and the difference in time period. The threshold level for India is 66% of GDP which is equal to the current debt level of country. In case of Bangladesh, the level is lowest, 40% of GDP, which can be backed by the fact that overtime the heavy reliance of economy on debt has decreased in Bangladesh and the statistics show that the debt-to-GDP share remain lower than 50% of GDP during the selected time period.

While comparing with the current situation, India and Pakistan's debt levels are approximately equal to their respective threshold levels. This reveals that further debt will bring negative impacts on these economies. In case of Sri-Lanka, the situation is worst as the threshold level is 66% of GDP and current level of debt is 75% of GDP which mean that the government need to take steps to lower down overall debt of country to avoid its negative impacts as suggested by Cohen (1993) that, debt servicing crowds out investment in areas like infrastructure development, health, and education leading to slow economic growth.

4. CONCLUSION

We explore the relationship between economic growth and public debt under the assumptions of endogeneity and non-linearity and the results reveal significant dependence of economic growth on public debt for the selected developing countries of the SAARC region.

The threshold levels for individual countries indicate that Sri Lanka's current level of debt (75% of GDP) is far beyond the benchmark level (66% of GDP) which may have growth retarding impact on the economy. It is evident

from the literature that the debt relief might have a stimulating effect on investment and economic growth in this regard.

Pakistan and India are around their respective threshold levels (62% and 66% of GDP). Further borrowing will bring negative impacts on their economies. Even at the current levels, these developing economies may have to face the problem of illiquidity as the willingness to pay declines due to domestic and external factors [Leta J. G., (2002)]. The domestic factures may include the wrong macroeconomic policies exchange rate misalignment, etc. However, external factors may include the deterioration in terms of trade and rising foreign interest rate.

Bangladesh's current debt level (19% of GDP) is well below the threshold level (40% of GDP). Reinhart and Rogoff (2010) conclude that the low level of debt seems to have little impact on growth rate as compared to countries that have accumulated high amount of debt. But, accumulation of debt is only sustainable when it is kept under the threshold level.

We find the negative association between public debt and economic growth when the public debt-to-GDP ratio is higher than the benchmark which is in line with the findings in Reinhart and Rogoff (2010).

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APPENDIX

Table 1. Panel Co-Integration Test Results

Hypothesized No. of CE(s)	Fisher Stat. (from trace test)	Prob.	Fisher Stat. (from max-eigen test)	Prob.
None	131.7	0.0000	200.1	0.0000
At most 1	206.7	0.0000	76.87	0.0000
At most 2	119.0	0.0000	60.37	0.0000
At most 3	70.51	0.0000	25.71	0.0012
At most 4	48.03	0.0000	20.01	0.0103
At most 5	31.34	0.0001	12.48	0.1309
At most 6	23.38	0.0029	12.76	0.1204
At most 7	17.68	0.0237	15.34	0.0528
At most 8	12.68	0.1233	12.68	0.1233

Table 2. Endogeneity Test Results

Null hypothesis: Debt/GDP is exogenous				
	Coefficient	Std. Error	t-Statistic	Prob.
2SLS Residuals Stats	-0.018911	0.011516	-1.982178	0.0489