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Role of Corruption in Overall Total External Borrowing and Growth Relationship: A Study of Developing Countries

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Abstract: This study has investigated the impact of total external borrowing (including both concessional and non-concessional borrowings) on growth and its sources, including factor accumulations and total factor productivity. Additionally, an assessment is conducted regarding the nonlinearity present in the link between debt and growth. Additionally, it attempts to examine the interactive effect of corruption on the debt and growth relationship. Balanced panel data from 51 developing nations between 1990 and 2018 is used in this study. For empirical analysis, the generalized method of moment (GMM) technique has been applied. We assessed the nonlinear link between total external borrowing and growth using Sarel's (1996) technique. Our analysis determines the various cutoff points for each of the three growth drivers, following which the impact of overall borrowing shifts from positive to negative. The findings indicate that the individual effect of corruption is adverse to all the sources of growth. Further, our results indicate the nonlinear effect of external borrowings on growth and its sources. Additionally, the interaction effect of corruption with low and high borrowings changes from positive to negative due to the beneficial effect of low borrowings and the highly detrimental impact of borrowings above the thresholds. For the consistent growth of GDP control of corruption and external borrowings are equally important.

Keywords: Overall external borrowing, sources of growth, corruption

1.Introduction

The deficiency of domestic capital forces governments of developing countries to look for external borrowing. External borrowing is either concessional in the form of net official development assistance or non-concessional in the form of public and publicly guaranteed external debt. So, the governments of developing countries take financial resources through external debt and foreign aid to run the process of development. When domestic financial resources are insufficient then external borrowing could help to increase economic growth [Hameed *et al.* (2008)]. The need for more investment increases the need for external debt [Bilginoglu and Aysu (2008)]. If the government cannot perform adequately and efficiently by depending on its resources, then it will also rely on foreign aid [Sulaiman and Azeez (2012)]. In considering the importance of external borrowing in terms of both concessional and non-concessional many researchers have done theoretical and empirical research and concluded different results. The existing theoretical and empiricalliterature about the impact of overall

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external borrowing on growth is divided into three groups.Theories in the first group explain reasonable external borrowing can affect growth positively. The second group of studies illustrate that excessive borrowing hurts growth. The third group of studies explain that the effect of total borrowing is nonlinear on economic growth.

The studies lying in the first group are accompanied by the dual gap study of Chenery and Strout (1966) and the three gap model by Taylor (1990) and Bacha (1990). All gap models stated that aid from advanced countries can increase domestic revenues, foreign exchange and domestic savings. Several models theoretically proposed that a reasonable level of foreign debt can positively influence economic growth. In earlier or traditional neo-classical models, countries can freely borrow and lend, which, in turn, will lead to transitional growth. Until the marginal product of capital remains higher than the world's interest rate, then countries can easily borrow and invest. According to Cohen (1991), with the repudiation risk model, a low level of debt is still related to a higher rate of growth than the financial autarky position.By extending the model of Uzawa and Lucas, Eaton (1993) demonstrated that if the rate of foreign capital increases, that results in lower external borrowing and low economic growth.Many proponents,based on empirical research, concluded that external borrowing by developing countries helps to fulfil their macroeconomic objectives [Papanek (1973); Warner (1992); Hatemi and Irandoust (2005); Kaosar and Idrees(2010); Sulaiman and Azeez (2012); Angahar *et all.* (2015)].

As some theorists proposed the negative impact of external borrowing on growth, Ward and Bauer (1968) rejected the idea that foreign borrowing (concessional) leads to economic growth. Opponents of concessional debt expressed their views in terms of reduction in domestic savings. A number of previous studies concluded that foreign aid doesn't supplement domestic savings. Domestic savings fall due to low tax receipts or changes in the composition of government consumption expenditures [Griffin (1970); Weisskopff (1972); Mosley (1980)]. Burton (1981) criticized the growth model of foreign aid. According to him, earnings from foreign exchange include two types of earnings. One is the earned foreign exchange, and the other is the unearned foreign exchange. He argued that the inflow of foreign exchange in the form of remittances and foreign aid did not considerably support increasing the growth rate. At the same time, the flows from exports produced by the indigenous sectors help to stimulate the growth rate. The well-recognized debt overhang hypothesis implies a high level of current debt deteriorates the economic performance by increasing future tax on the output that modifies the individual's motivation to save and invest [for example, Corden (1988), Krugman (1988); Froot (1989); Sachs (1989)]. According to Farhana and Chowdhury (2014), Yeasmin et al. (2015), Onafowora and Owoye (2017), Kharusi and Ada(2018) andNdieupa (2018), GDP growth is negatively impacted by external debt. The findings of Iqbal and Zahid (1998) and Ramzan and Ahmad (2014) for Pakistan are likewise in line with the negative association between external debt and growth.

Another stream of thought of researchers proposed that when external borrowing is at a low level, that enhances economic growth, but borrowing at a high-level results in a decline in economic growth. Such thoughts lead to the nonlinear, Laffer curve-type relation between external borrowing and growth Durbarry *et al.* (1988)[2], Sach (1989)[3], Pattillo *et al.* (2002)[4]. After a particular level of

[2]Durbarry *et al.* (1988) proposed the existence of optimal level of foreign aid.

[3] Through the theory of debt overhang Sach (1989) introduced the debt Laffer curve. According to him high debt level result in decline of efficiency.

[4]Pattillo *et al.* (2002) assessed the nonlinear impact of external debt. Impact of external debt has a negative impact on per capita GDP growth, if net present value of debt around 35–40 % of GDP and 160- 170 of exports

debt, growth reduces due to the debt overhang scenario. At the earlier stages, borrowing countries can easily pay debts because creditors are more patient and growth in debtor countries is greater than in lender countries [Cohen (1989)].The paper of Hadjimichael *et al.* (1995) gave the idea of restraints on absorptive capacity. They stated that a country reaches its absorptive capacity limit for aid, after which the return rate on the additional increment of foreign aid declines to a lower level. According to Soludo (2003), countries from abroad borrow for two purposes: one is to finance the temporary deficit in the balance of payments, and the other is for macroeconomic purposes. He also gave the opinion that when initial debt stock reaches a particular threshold, after that limit,debt servicingbecomes a burden that leads the countries on the downside of the Laffer curve. Wagner (2014) addressed the nonlinearity issue by concluding that aid has an absorptive capacity, after which the impact turns positive to negative. The study addressed the nonlinear impact of aid by using a semi-parametric strategy. The study was based on a set of 61 countries from 1970 to 2001.

Both theoretical and empirical literature revealed that total external borrowing could influence overall growth and the sources of growth, including human capital, physical capital and total factor productivity.According toRadelet (2006), there are three main channels for the probable impact of foreign aid on growth. According to the first channel, foreign aid raises the savings of the recipient country which helps to increase investments in the capital stock. The second channel demonstrates that foreign aid could expand labour productivity via investment in human capital. The last channel explains that foreign aid could enhance developing countries access to innovations through technical assistance, direct exchanges of advancements, or imports.

Overall external borrowing may affect investment in physical capital both positively and negatively. An optimistic view is given by [Dollar and Easterly (1999)] i.e., in developing countries, the saving rate is usually low; in such situations, foreign aid (concessional borrowing) can help to fill this gap, resulting in increasing investment through funds of foreign aid. The pessimistic view proposed by the concept of debt overhang theoryis thatonce external debt becomes larger, the opportunities for returns from the investment become low by considering that more progressive and highly distortionary taxes are required to repay debt [Krugman (1988), Agenor and Montiel (1996)].The impact of external borrowing on human capital is also controversial. Foreign aid could expand labour productivity via investment in human capital as more funds are available for education and health [Morrissey (2001)].At a low level of debt, when countries can make repayment of debt in time, then the government does not need to cut expenditures on the social sector (education and health). In the presence of high debt liability, a large amount of public funds is used to pay the debt servicing that reduces the spending on the social sector, especially education and health [Oxfam International (1999); Serieux and Samy (2001); Fosu (2008)].

Total factor productivity comprises technology and efficiency.When external borrowing is at a low level, it can enhance economic growth in developing countries by increasing total factor productivity. Developing countries have a small stock of capital at earlier stages of development but have more investment opportunities with high rates of returns [Pattillo *et al.* (2004)]. High levels of external debt can lower the total factor productivity because governments may not undertake difficult and excessive policy reforms by relying on the perception that foreign creditors will partially share gains from higher output [Pattillo *et al.* (2004)].

Anti-corruption measures at the international level started in the 1990s and corruption was defined as a challenge to development. According to the World Bank report (1998), corruption was recognized as one of the vital variables influencing development in developing countries. Corruption has many dimensions, including embezzlement of funds, diverting public funds to private pockets, bribery, and misallocating resources. Thus, corruption can be seen from many angles. For this study,

corruption is defined as a diversion of funds to unproductive sectors and evaluated as a factor that can influence the relationship between overall total external borrowing(including both concessional and non-concessional borrowings) and economic growth. For developing countries, there is a possibility that corruption can reduce the effectiveness of external resources through the diversion of funds. In the case of weak institutions,corruption plays a role, which affects the effective utilization of borrowed resources.

Corruption can affect overall external borrowing in the following way: As mentioned by Bauer (1972), foreign aid is assisted through the government of the recipient country and then to the local bodies; hence, politicians have enticement of using the aid for political consideration instead of useful long-term investment. According to Bardhan (1997) corruption could be considered as the utilization of public office for personal gain. Corruption is not a new phenomenon; it made itself evident at the same time when the institution of government was established. In the presence of corruption, if the government finances its expenditures through external debt, that may lead to a debt burden problem as to service the debt,the government imposes high distortionary taxes that further reduce the investment by domestic and foreign investors [Kaufmann (2010)]. An economy cannot run on the right way of development only by obtaining funds as institutional quality matters a lot for enhancing the efficiency of capital [Agenor and Montiel (2010)]. Further, borrowing by the government of a more corrupt country is higher than borrowing from less corrupt countries as they have a higher discount on the future than the latter [Jalles (2011)].

Theory suggests that the impact of corruption on growth can also be channelled via sources of growth, both physical and human capital and productivity.Theoretical consideration of some studies suggested that through the channel of influence on physical capital investment, corruption can affect growth [Romer (1994); Mauro (1995); Ades and Di Tella (1997); Wei (2000))]. According to them, corruption can affect investment due to uncertainty of returns in investment activities. The reason for such a suggestion is as follows: Firstly, in the presence of corruption in the economy, extra costs must be incurred. Moreover, to obtain access to their interest markets, entrepreneurs are forced to surrender a share of the profits from their investment to corrupt officials. In this manner, corruption decreases individuals' motivation to invest because of tax on ex-post profits. Secondly, ambiguity arises due to the illicitness and confidentiality related to corruption.According to Shleifer and Vishny (1993), corruption can affect the decision of borrower's spending. High levels of corruption divert the borrowed resources from high-value projects such as, (health and education) to possibly less valuable projects (defence and infrastructure).According to Baumol (1990) and Murphy *et al.* (1991), corruption could affect growth by hurting productivity growth. Channel of productivity is supported by the arguments that corruption deteriorates the allocation of human resources by devoting qualified people to rent-seeking activities despite innovative activities. Corruption affects access to new technology by restricting licenses to favored firms or individuals. Thus, a reduction in efficiency results in lower economic growth. As pointed out by Acemoglu and Verdier (1998), the existence of corruption in any economy decreases investment in innovative sectors because of higher transaction costs. This results in less investment in research and development. [Olson *et al.* (2000)].

Based on a balanced panel data set of seventy-two developing countries from 1970 to 2005, Jalles (2011) evaluated the influence of quality of governance measured by (corruption and democracy) on the debt and growth relationship. The study used a neo-classical growth model by including the debt variable for evaluation. Then, the debt indicator interacted with the quality of governance (democracy and corruption). The study used debt dummies and debt-squared termsto analyze the nonlinear impact of debt. Fixed effect and generalized method of moment techniques were used. Results proposed that those countries can manage their debt in a better way, which has lower corruption. In addition,

empirical outcomes have not revealed a clear debt Laffer curve, as in nonlinear specification, the negative effect of debt is also larger in nations with low corruption levels.

The review of the above theoretical and empirical studies shows that the relationship between external borrowing (concessional and non-concessional) and economic growth is still debatable. Many studies evaluated the impact of foreign aid and external debt. We try to contribute to the existing studies differently: No study, up to our knowledge, evaluates the joint impact of both concessional and non-concessional borrowing on growth and its sources. Further, we extend the previous work that emphasizesthe role of institutions by evaluating the role of corruption as an essential factor affecting the relationship between overall external borrowing and growth and its sources in the present study. The impact of corruption interacting with borrowing at low and high levels of debt above the thresholds is also evaluated. We estimate the thresholds for each source of growth separately instead of estimating the threshold level of borrowing directly for growth because sources of growth have different intensities toward borrowed resources [Hajra and Ahmad (2015)].

By applying the methodology of [Sarel's (1996)] we will evaluate the threshold of overall external borrowing[5]. A helpful framework through which this task can be accomplished is the growth accounting framework, according to which output per worker is the weighted sum of per worker physical & human capital and total factor productivity. The present study follows this framework to analyze the channels through which external borrowing (accumulating concessional and non-concessional borrowing) affects growth. Our empirical analysis is based on four reduced-form equations for 1) physical capital per worker, 2) human capital per worker 3) total factor productivity, and 4) output per worker.

We take a panel of 51 developing countries over the period 1990-2018. For this purpose, we consider the classification of countries provided by the World Bank according to level of income. According to this classification, countries classified intoupper middle income, lower middle income, and low income are consideredas the developing countries. The rest of the paper is structured as follows. Section 2 presents the methodology. Section 3 presents variable definitions and data. The empirical results are discussed in Section 4. Section 5 presents conclusions.

2. Methodology

To examine the role of overall external borrowing in the process of economic growth, we begin our analysis by using growth accounting decomposition, which shows the role of the contribution of input factors, accumulation of physical and human capital, and total factor productivity.Several previous significant studies [Fischer (1993); Bosworth and Collins (2003); Pattillo *et al.* (2004, 2011)] used a growth accounting framework to analyze how different variables affect growth. We will use the standard Cobb-Douglas production that is given as follows:

$$\boldsymbol{Y_{it} = A_{it}K_{it}^{\alpha}H_{it}^{\beta}L_{it}^{1-\alpha-\beta}} \quad (2.1)$$

Where Y_{it} represents the real aggregate output in country i at the time t, A_{it}represents the total factor productivity, K_{it} represents physical capital, H_{it} representshuman capital, L_{it} represents the quantity of labor, α represents the share of per worker physical capital, β is the share of per worker human capital.To get the above production function in per worker formwe divide the production function (2.1) by L and then take the log of the production function, so the resulting function is as;

[5] Its also followed by Hajra and Ahmad (2015)

$y_{it} = a_{it} + \alpha k_{it} + \beta h_{it}$(2.2)

Equation (2.2) decomposes output per worker into total factor productivity (a_{it}), per worker physical capital (k_{it}), and per worker human capital (h_{it}).Firstly, we will inspect how overall borrowing, corruption and other conditioning variables have an impact on three sources of growth; total factor productivity (TFP), physical capital (k_{it}) and human capital (h_{it}). To analyzethe combined effect of several variables on output per worker, we will combine all three equations by merging them into equation (2.7).

Now we start with the general equation of total factor productivity (a_{it}) equation that incorporates several variables:

$$a_{it} = f(B_{it}, Cor_{it}, X_{it})$$

$\boldsymbol{a_{it}}$**:** logarithm of total productivity

B: overall total external borrowing (sum ofconcessional and non-concessionalborrowing) as a percentage of GDP.

Cor: Corruption

X: control variables

The nonlinear association between overall borrowing and total factor productivity (a) is assessed by using the following spline function:

$$a_{it} = b_0 + b_1 ln(B_{it}) + b_2 [ln(B_{it}) - ln(\widehat{B}_{it})]Z + b_3 Cor_{it} + b_4 Cor_{it} * ln(B_{it}) + b_5 Cor[ln(B_{it}) - ln(\widehat{B}_{it})] Z_{it} + b_6 (Open_{it}) + b_7 ln(Infl_{it}) + b_8 ln(gov_{it}) + b_9 ln(prim_enrol_{it}) + b_{10} ln(Sec_enrol_{it}) + b_{11} ln(Pop_{it}) + b_{12} ln(Invest_{it}) + b_{13} ln(I_net_{it}) + b_{14} a_{i(t-1)} + \mu_{it}$ (2.3)

ln: is the natural logarithm

$\hat{B}$: shows the turning point or threshold level of borrowing after which the marginal impact of borrowing turns out to be negative

Z: is the dummy variable; if borrowing is above the threshold Z=1 and 0; otherwise

Open: is the trade openness.

Infl: shows the inflation rate that is measured by the growth rate of the implicit GDP deflator

Gov: is the general government consumption as a percentage of GDP

Prim_enrol : shows here gross primary school enrolment

Sec_enrol : shows here gross secondaryschool enrolment

Pop :is the population growth rate

Invest : is the percentage of gross fixed capital formation to GDP

I_net : Internet users (for each 100 persons)

$a_{i(t-1)}$: represents here the lagged factor productivity

Similarly, the spline function for capital per worker (k_{it}) is;

$$k_{it} = c_0 + c_1 ln(B_{it}) + c_2[ln(B_{it}) - ln(\widehat{B}_{it})]Z + c_3 Cor + b_4 Cor_{it} * ln(B_{it}) + c_5 Cor * [ln(B_{it}) - ln(\widehat{B}_{it})]Z_{it} + c_6 ln(Open_{it}) + c_7 ln(Infl_{it}) + c_8 ln(gov_{it}) + c_9 ln(prim\_enrol_{it}) + c_{10} ln(Sec\_enrol_{it}) + c_{11} ln(pop_{it}) + c_{12} ln(I\_net_{it}) + c_{13} b_{i(t-1)} + \epsilon_{it} \quad (2.4)$$

where, k represents logarithm of capital per worker.

Similarly, the spline function for human capital per worker (h_{it}) is;

$$h_{it} = d_0 + d_1 ln(B_{it}) + d_2[ln(B_{it}) - ln(\widehat{B}_{it})]Z + d_3 Cor_{it} + d_4 Cor * ln(B_{it}) + d_5 Cor[ln(B_{it}) - ln(\widehat{B}_{it})]Z_{it} + d_6(Open_{it}) + d_7 ln(Infl_{it}) + d_8 ln(gov_{it}) + d_9 (prim\_enrol_{it}) + d_{10} ln(Sec\_enrol_{it}) + d_{11} ln(pop_{it}) + d_{12} ln(invest_{it}) + d_{13} ln(I\_net_{it}) + d_{14} h_{i(t-1)} + \theta_{it} \quad (2.5)$$

Where, h represents the logarithm of human capital per worker.

In the end, we substitute the equation of physical capital, human capital, and total factor productivity into equation (2.6) we get final output per worker equation as:

$$y_{it} = (b_0 + \alpha d_o + \beta c_0) + (b_1 + \alpha c_1 + \beta d_1) ln(B_{it}) + (b_2 + \alpha c_2 + \beta d_2)[ln(B_{it}) - ln(\widehat{B}_{it})]Z + (b_3 + \alpha c_3 + \beta d_3) Cor_{it} + (b_4 + \alpha c_4 + \beta d_4) Cor_{it} * ln(B_{it}) + (b_5 + \alpha c_5 + \beta d_5) Cor_{it} * [ln(B_{it}) - ln(\widehat{B}_{it})]Z + (b_6 + \alpha c_6 + \beta d_6) ln(Open_{it}) + (b_7 + \alpha c_7 + \beta d_7) ln(Infl_{it}) + (b_8 + \alpha c_8 + \beta d_8) ln(gov_{it}) + (b_9 + \alpha c_9 + \beta d_9) ln(Prim\_enrol_{it}) + (b_{10} + \alpha c_{10} + \beta d_{10}) ln(Sec\_enrol_{it}) + (b_{11} + \alpha c_{11} + \beta d_{11}) ln(pop_{it}) + (b_{12} + \beta d_{12}) ln(invset_{it}) + (b_{13} + \alpha c_{12} + \beta d_{13}) ln(I\_net_{it}) + (b_{14} + \alpha c_{13} + \beta d_{14}) y_{i(t-1)} + z_{it} \quad (2.6)$$

y_{it} describes the logarithm of per worker output. Equation (2.6) demonstrates that regression coefficients of output per worker are the weighted averages of the regression coefficients that are obtained from the three equations. For TFP, the given weightis (1), for physical capital (α) is the weight and for human capital (β) is the weight.

How can the threshold level of overall borrowing be calculated:

We found thresholds for each of the sources of growth separately and then simulated their impact on output per worker. The rationale behind this exercise is that physical capital, human capital and total factor productivity may have different sensitivity levels towards total external borrowing. The thresholdwhich is valid for the overall output may not closely match the behavior of each source of its growth.

The methodology of Sarel (1996) is used to find thresholds of total external borrowing. For the overall sample of 51developing countries with a time series dimension of 1990-2018 years each, we first sorted the data of total external borrowing in ascending order and then divided it into 34 groups of 42 observations each by constructing a dummy variable for the relevant range of debt data. Then, we estimate the regression equation for each source of growth on these dummy variables and other explanatory variables discussed above. The graphical representation of coefficients of debt dummies obtained from this regression equation helped determine the groups that capture a nonlinear function's

peak or turning point. After determining the relevant groups of debt values, we formed the debt extra term and its interaction with the variable of corruption by varying the threshold value within that range to analyze the impact of debt and its interaction with corruption as a measure of institutional quality. We picked the threshold by selecting the regression with the highest R Square value.

3. Data and Variable Definitions

We use panel data consisting of 51 developing countries for 1990-2018. We consider the classification of the World Bank, according to which countries lying in the category of low-income, lower-middle-income and upper-middle-income countries are classified as developing countries. The selection of countries and time dimensionsare dictated by the availability of data on external debt. The data of variables are taken from different sources:*World Development Indicators, International Country Risk Guide* data set, *Penn World Table*, and *World Atlas*base[6]. The data on human capital is computed by adjusting the labor force for improvement in education[7]and data of physical capital is calculated by perpetual inventory method[8] moreover the method to make the series of total factor productivity is mentioned in the appendix[9]. The definition of all variables and their source are given in Table 1.

Table 1 Description of Variable and Data Sources

Variable	Variable Symbol	Description	Source
GDP per worker	Log (y_{it})	Log of the ratio of real output to labor force	Author's calculation
Real GDP	Y	GDP in constant 2010 US$)	*WDI*
Labor force	L	Total labour force	*WDI*
Physical capital per worker	Log (k_{it})	Log of physical capital to labour force ratio	Author's calculation
Human capital per worker	Log (h_{it})	Log of human capital to labour force ratio	Author's calculation
Total factor productivity	Log (a_{it})	Log of total factor productivity	Author's calculation
Log of Overall external borrowing	Log (B_{it})	Log of ratio of concessional borrowing that measured by Net official development assistance foreign aid and of non-concessional borrowing in the form of public and publicly external debt. Both	*WDI*

[6]https://knoema.com/atlas
[7]See Appendix A-2
[8] See Appendix A-2
[9]See Appendix A-2

		types of borrowings are taken in current (US$). To getthe ratio we sum these two series and then divide the series by GDPcurrent (US$).	
Corruption	Log (Cor_{it})	In ICRG index higher corruption indicates that high government	*ICRG*

Table 3.1 (Continued): Description of Variable and Data sources

Variable	**Variable Symbol**	**Description**	**Source**
Corruption	Log (Cor_{it})	officials are likely to demand illegal payments in the form of bribes. The ICRG index of corruption ranges from 0 (most corrupt) to 6 (least corrupt). We have rescaled the ICRG index by subtracting the whole index from minus 6. So, in the index, the higher value implies higher corruption.	*ICRG*
Openness	Log ($Open_{it}$)	Trade as a percentage of GDP	*WDI*
Inflation	Infl	Inflation, as the annual growth rate of GDP implicit deflator	*WDI*
Population growth	Pop	annual (%) growth rate of the population	*WDI*
Government size	Log (gov_{it})	General government final consumption expenditure as a percentage of GDP	*WDI*
Primary enrollment	Log ($prim\_enrol_{it}$)	Gross (%) primary enrollment ratio	*WDI*
Secondary enrollment	Log (Sec_enrol_{it})	Gross (%) secondary enrollment ratio	*WDI*
Investment	Log ($Invest_{it}$)	Log of gross fixed capital formation % of GDP	*WDI*
Internet users	(I_net)	Internet users per (100) people	*WDI*

Before applying an econometric methodology, we must check the stationarity of variables. Non-stationary series have often been considered a problem for empirical analysis. Non-stationary series produce spurious results. Hence, it is important to check the stationarity of variables entering the

model. We use Im, Pesaran and Shin teststo check the stationarity of variables both at the log level and logarithmic first difference. We do not take logs of corruption, internet, inflation and population growth as they have zero values in data. Next,to check the long-run relationship between variables, we apply panel cointegration tests. The tests that we use are based on the Engle-Granger method. Panel cointegration test relies on the examination of regression residuals. We apply the Kao test to check the long-term relationship between variables. In the Kao test, we regressed output per worker on all non-stationary explanatory variables. The results indicated the existence of a long-run relationship.

4. Empirical results

We have summarized the empirical outcomes of external borrowing, corruption and other control variables of three equations 2.3, 2.4 and 2.5. The dependent variables of the three equations are represented respectively by total factor productivity, capital per worker, and human capital per worker. The empirical results are obtained from the GMM method and reported in Table 2. First of all, the results indicate that the thresholds are different for different sources of growth. It is lowest for physical capital perworker and highest for human capital per worker.These findings indicate a difference in the level of sensitivity of different sources of growth towards external borrowings.

Now, we explain the empirical outcomes of external borrowing, corruption and other control variables on the three sources of growth. The coefficient of the log of borrowing as a percentage of GDP at a low level is positive and significant for all three sources of growth. This result indicates that external borrowings are less distortionary and concessionary in nature at low

Table 3.Parameters estimates by using spline functions

(Dependent variables)_

Coefficients	Total Fctor Productivity (Equation 2.3)	Capital per Worker (Equation 2.4)	Human capital per Worker (Equation 2.5)
Threshold level of total external borrowing as a percentage of GDP	45.125.8		46.3
Constant	0.3065***	0.3512	-0.0822***
	(0.1149)	(0.2649)	(0.0311)
Log of Total External Borrowing/GDP	0.0946***	0.0269**	0.0154**
	(0.0022)	(0.0120)	(0.0073)
Log of Total External Borrowing/GDPExtra [1]	-0.1849***	-0.1109***	-0.0397**
	(0.0317)(0.0302)		(0.0171)
Corruption	-0.0763***	-0.0506***	-0.0169**

	(0.0154)	(0.0093)	(0.0077)
Log Corrup*Borrowing	0.0272***	0.0181***	0.0063**
	(0.0056)	(0.0041)	(0.0028)
Corrup* Log Borrowing/GDP Extra	-0.0497***	-	-0.0109**
	0.0329***(0.0090)	(0.0078)	(0.0046)
Log Government Consumption	-0.0216**	- 0.0183**	-0.0014
	(0.0094)	(0.0087)	(0.0022)
Log Investment	0.0165***		0.0014
	(0.0066)		(0.0030)
Log openness	0.0701***	0.0155*	0.0002
	(0.0131)	(0.0091)	(0.0029)

1: the variable of Log of borrowing/Extra refers to $[\ln(B_{it}) - \ln(\hat{B}_{it})]Z$
The values of standard errors are in parentheses.
*at 1% level significance
**at 5% level significance
***at 10% level significance

Table 3.1 (Continued): Parameters estimates by using spline functions

Coefficients	Dependent Variables: Total factor productivity Equation (2.3)	Capital per worker Equation(2.4)	Human capital per worker Equation (2.5)
Log Primary enrollment	0.0015	0.0018	0.0074***
	(0.0010)	(0.011)	(0.0031)
Log Secondary enrollment	-0.0283***	-0.0147	0.0072***
	(0.0089)	(0.0114)	(0.0022)
Population	0.0161***	-0.0167***	-0.0007
	(0.0044)	(0.0045)	(0.0008)
Internet	0.0071***	0.0032	0.0019***
	(0.0012)	(0.0031)	(0.0003)

Inflation	-0.0024***	0.00002	-0.0001
	(0.0011)	(0.0001)	(0.0003)
Lag dependentvariable	0.6594***	0.5863***	0.5762***
	(0.0369)	(0.0371)	(0.0310)
R- squared	0.8491	0.8141	0.8019

The values of standard errors are in parentheses. ***Significance at 1% level of significance, ** Significance at 5% level of significance, * Significantat 10% level of significance

levels; this, in turn, provides necessary finance for investing in research and development, thus stimulating productivity. Likewise, such a positive influence on capital per worker implies that countries have a small stock of capital in the early stages of development and have investment opportunities with a high rate of return. Moreover, borrowing at a low level is relatively cheaper and doesn't make a burden, enhancing capital investment. The positive sign of the coefficient for human capital per worker at low borrowing levels indicates that governments of developing countries try to repay the amount of debt servicing without cutting expenditures for social sector investment.

The spline specification tests the likelihood of structural break for the effect of borrowing at low and high levelsof borrowings. The borrowing variable above the threshold levels shows a significant and negative effect on all three sources of growth. With a high level of borrowing, returns from output become more uncertain because a part of the proceeds will be shared with foreign creditors. The negative coefficient of borrowing extra term in the equation of physical capital depicts the nonlinear impact of borrowing on capital per worker when borrowing is above the threshold level. Such a nonlinear result is consistent with the debt overhang concept, explaining that when borrowing grows large, it reduces new domestic and foreign investment. Investors expect low returns from investment because more distortionary taxes are generally required for repayment and servicing the debt. The negative effect of borrowing extra term illustrates that when borrowing is above the threshold level, it negatively impacts human capital. Such negative impact is consistent with the proponents of debt relief [Pattillo *et al.* (2004)]. According, to the supporters of debt relief high level of external borrowing is the constraint for the provision of social services and less investment in human capital.

Next, the coefficients of corruption show a significant negative impact on all three sources of growth, The negative effect of corruption on TFP indicates that corruption restricts the exploitation of new technology as the development of new products requires permits and licenses. So, corruption directly affects the acquisition of patents for innovation, negatively affecting total factor productivity. The possible explanation for this result is that corruption affects productivity through a negative impact on innovation that limits the possibility of accessing technology from developed countries [Adit *et al.* (2005)]. The negative coefficient of corruption in capital per worker regression explains that with high corruption, returns from investment become more uncertain, discouraging investment and capital accumulation. Corrupt officials force entrepreneurs to get access to their favourite market; they must

give a part of the profit from their investment. This, in turn, implies that corruption reduces individuals' incentives for investment by imposing a tax on ex-post profit.

The coefficient of corruption in the human capital equation indicates that the decision of borrower spending is affected due to corruption. They shift the borrowed resources to other projects, i.e., defence and infrastructure, that contain high investment costs because investment in such projects gives a higher opportunity for corruption than investment in the social sector, including education and health. Investment in education seems less attractive as it requires a longer time for returns than investment in infrastructure.

To analyze the interactive effect of corruption and total external borrowing, corruption interacts separately with borrowing at low and high levels of debt in all three equations for the sources of growth. At first,we consider the effect of corruption's interaction term with borrowing at a low level. The coefficients show the interaction variable positively and significantly impacts all three growth sources. This positive impact might be due tothe less distortionary nature of external borrowing atlow levels. Therefore, borrowing at low levels offsets the negative effect of corruption in resource-constrained developing countries.

The interaction term of corruption with borrowing above the threshold also shows a negative coefficient for total factor productivity, physical capital and human capital. External borrowing at a high level is distortionary, and the joint effect of corruption at a high level is also harmful. With levels of borrowing above the threshold and corruption, a large part of borrowed funds is used for debt servicing and invested in unproductive projects to gain the opportunity of bribes, respectively. In addition to high external borrowing, the presence of corruption leads to further misutilization of resources for the sake of personal gain. Thus, the joint effect of corruption and high level of borrowing negatively influences capital per worker. Further, with high levels of borrowing and the presence of corruption borrowed resources are misallocated for political gain and more funds are required for debt servicing. This in turn decreases the funds availability for investment in human capital and adversely affects TFP.

The influence of control variables, in general, is consistent with the theory. The variable of government consumption expenditure negatively affectstotal factor productivity and physical capital while its effect is insignificant on human capital. Due to more enormous government consumption expenditures, the tax burden and interest payments will be high. This will result in limited availability of resources in private markets that inhibit investment in innovation and lower productivity. The coefficient of government consumption expenditure shows that an increase in government consumption expenditure reduces capital per worker. The possible explanation for this result is if the government finances its consumption expenditure through taxation, it can influence private sector investment. Higher taxes might reduce disposable income for both households and businesses, potentially reducing private-sector investment.

The coefficient of investment is positive and statistically significant. Schumpeter (1939) mentioned that investment positively affects total factor productivity. Investment in physical capital such as machinery, infrastructure, and facilities can increase the capital stock available for production. This can lead to higher productivity as workers have access to better tools and equipment, which can help them perform tasks more efficiently.

There is a positive effect of trade openness on three sources of growth though it is insignificantfor human capital. in case of impact of trade openness on TFP and physical capital is consistent with the theory that trade openness facilitates the adoption of new ideas for the production of goods and a variety of inputs. Openness allows firms to access larger markets beyond their domestic borders. This provides firms with opportunities to expand their customer base, increase sales, and achieve economies of scale. Openness exposes domestic firms to increased competition from foreign

competitors. This competitive pressure incentivizes firms to innovate, improve product quality, and adopt more efficient production methods to remain competitive in both domestic and international markets.

The indicators of school enrolments indicate a significant positive impact on human capital and an insignificant impact on physical capital. The variable of secondary school enrollment shows a significant negative effect on productivity. The negative coefficient of secondary enrollment may indicate the underutilization of skills of secondary educated workers.

The coefficient of population growth shows a significant and positive effect on total factor productivity. The reason for such a positive impact may be that the growth of the population will induce production innovation specialization and create greater economies of scale that lead to greater productivity [Simon (1992); Kremer (1993)]. However, population growth exerts negative and significant impact on capital per worker. This result is persistent with the pessimistic view regarding the negative impact of the growth of the population and also consistent with the prediction of the Slow growth model. The coefficients of population growth highlight a negative but insignificant influence on per-worker human capital.

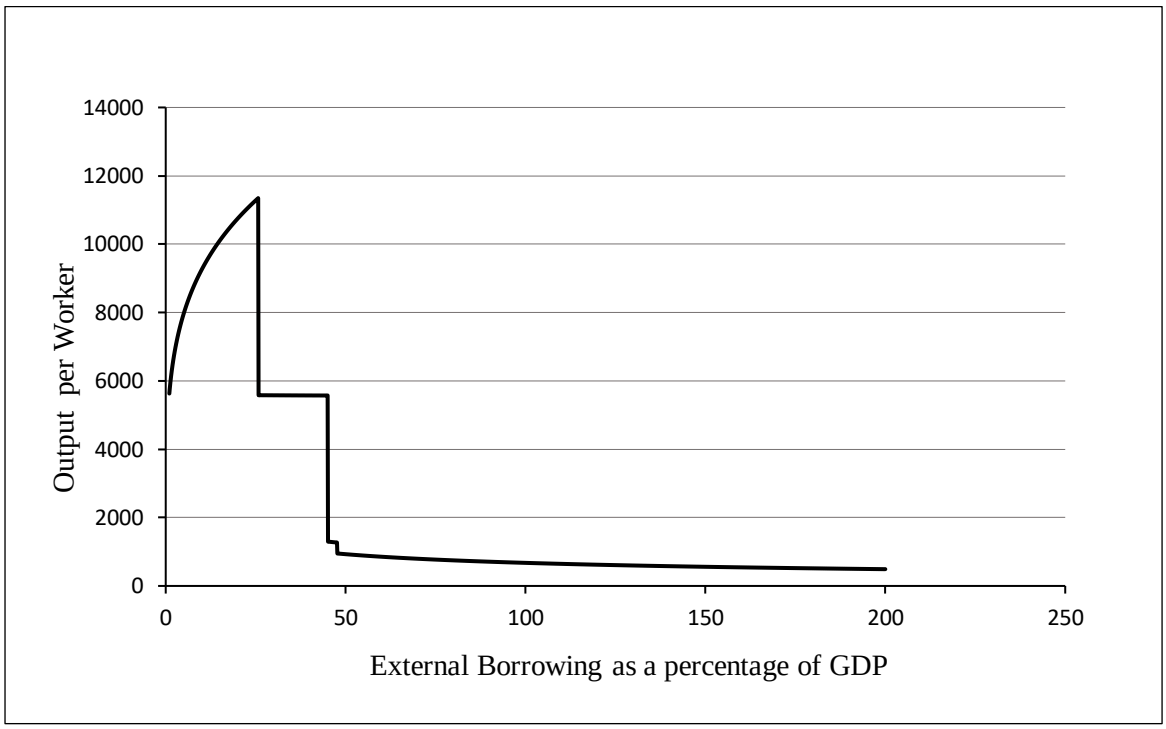
The variable of the internet shows a statistically significant and positive effect on TFP and human capital and insignificant influence on physical capital highlighting the vitalrole of internet for improvement in productivity and human skills due to virtually unlimited access to a vast amount of.

The variable of inflation affects productivity negatively. Inflation can distort relative prices by eroding the purchasing power of money. When prices rise unevenly across different sectors or inputs, relative prices may not accurately reflect underlying supply and demand conditions. This can lead to misallocations of resources, as firms may allocate resources based on distorted price signals rather than underlying productivity considerations. Inefficient resource allocation can hinder productivity growth by diverting resources away from more productive uses.

In the end, thelagged dependent variables provide positive and statistically significant impacts. In regression analysis, a lagged variable highlights the dynamic nature of the phenomena and helps to eliminate autocorrelation from the model. The value of R square describes that the regressions we have estimated are a good fit.

External Borrowing, Corruption and Output per Worker

After analyzing the effect of external borrowing, corruption, and the interaction variables on each source of growth, including physical capital, human capital and total factor productivity, we examine the impact of this relationship on output per worker. Here, we analyze this relationship with the help of a figure instead of reporting the results in a tabular form. To examine the impact on output per worker, we have used equation 2.6 (mentioned in the methodology section after merging the equations of all sources of growth into the equation of output per worker). For graphical visualization of the impact of external borrowing on output per worker, we have used equation 2.6 by setting the effect of all other variablesin relevant equations of sources of growth at their average values, excluding the terms including borrowing, borrowing extra, and the two interaction terms that involve the interactive effect of borrowing and borrowing extra with the variables of corruption. Figure 1 indicates the relationship between total external borrowing as a percentage of GDP and output per worker. The related threshold of borrowing for different sources of growth, which is mentioned in the first row of Table3 shows a clearly depressing effect on output. This diagram affirms that the relationship between external borrowing and growth is nonlinear.



5. Conclusion

The subject of the impact of external borrowing and corruption in developing countries is still a controversial issue. This study makes an effort to evaluate how total external borrowings affect growth through their effect on factor accumulations and via impact on factor productivity. The analysis used a panel of 51 developing countries from 1990-2018. Or results indicate that the different sources of growth have different threshold levels of borrowingsindicating their different sensitivities for external borrowing. If we utilize the single threshold which is derived based on output per worker (as done in Pattillo*et al.* (2002, 2011)) then that will be misleading for concluding the nonlinear impact of external borrowing and corruption on growth. Thus, it is better to calculate the thresholds separately for each source of growth. The spline functions for all sources of growth confirm the existence of the nonlinear impact of external borrowing. Below the threshold level or borrowings at a low level show a positive impact on all sources of growth. While the impact on factor productivity is larger as compared to other sources of growth. The coefficients of borrowing extra terms for all sources of growth are negative and statistically significant. Our results demonstrate that the adverse effect of borrowing above the threshold level for TFP is strongest followed by per-worker physical capital and human capital, respectively.

The variable of corruption in our model also matters for growth and all its sources. The impact of corruption is negative for all sources of growth. For human and physical capital per worker, the impact is quite stronger than the impact factor productivity. The influence of the variable of the interaction of corruption with borrowing is different in extent on all sources of growth. Further interaction of corruption with borrowing below the threshold and with borrowing above the threshold level affects differently to all sources of growth. The sign of interaction of corruption with the low level of borrowing is positive and significant for all sources of growth. For total factor productivity, it

indicates a greater effect as compared to per worker physical and human capital. Interaction variables with high levels of borrowing negatively affect and this effect is significant for all sources of growth.

In a nutshell, if we consider the absolute sign of our key variables, external borrowing, corruption, and interaction variables with low and high-level borrowing, the effect on total factor productivity is stronger than physical and human capital. Our empirical outcomes are according to the conjecture that high levels of debt decline the inducement to accept good policies and to invest. It is worth noting that less developed countries are suffering from critical challenges because of external borrowing and weak control of corruption. We can mention some policy recommendations based on our results as follows:

- The debt reduction initiative of indebted developing countries merely cannot help diminish the adverse effect of the high level of external borrowing if the countries are suffering from high levels of corruption. For the purpose of controlling corruption, the initiative should also emphasize making expenditures on improvements in governance. In developing countries, which have weak control on institutions especially on corruption, it is recommended that external borrowing either in the form of concessional or non-concessional should be issued on the condition of implementation of effective measures to improve the quality of institutions i.e. control of corruption.
- The presence ofinstitutional quality plays an important role in the the effective utilization of funds obtained from concessional and non-concessional borrowing.With the presence of institutional distortions in terms of corruption, it does not seem possible to make external borrowing an effective source of growth. Therefore, developing countries must fight againstcorruption if they want to have external borrowing.

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Appendix A-1

1. Albania	2. Bangladesh
3. Bolivia	4. Botswana
5. Brazil	6. Cameroon
7. China	8. Colombia
9. Congo, Dem. Rep.	10. Cost Rica
11. Cote d'Ivoire	12. Dominican Republic
13. Ecuador	14. Egypt
15. El Salvador	16. Gabon
17. Gambia	18. Ghana
19. Guatemala	20. Honduras
21. India	22. Indonesia

23. Iran, Islamic Republic	24. Jamaica
25. Jordan	26. Kenya
27. Malaysia	28. Mali
29. Mexico	30. Mongolia
31. Morocco	32. Niger
33. Pakistan	34. Panama
35. Paraguay	36. Peru
37. Philippines	38. Senegal
39. Sierra Leone	40. South Africa
41. Sri Lanka	42. Sudan
43. Thailand	44. Togo
45. Tunisia	46. Turkey
47. Tanzania	48. Uganda
49. Yemen	50. Zambia
51. Zimbabwe	

Appendix A2

Construction of K. H and TFP

Total factor productivity: The total factor productivity in log form calculated as a residual by rewriting equation (2.2) as follows:

$$a_{it} = y_{it} - \alpha k_{it} - \beta h_{it}$$

Physical capital (K):

For the present study we used perpetual inventory method to estimate the capital stock. The inventory method is as follows**:**

$$\mathbf{K_t = I_t + (1-\delta) K_{t-1}}$$

I_t represents here investment that is proxied by gross fixed capital formation at constant (2005 US$). Data on gross fixed capital formation is taken from WDI. (δ) is the depreciation rate that equal to 5% as used in Collins and Bosworth (1996).K_{t-1} shows the initial stock of capital that is calculated from such formula:

$K_{t-1}=I_t/(g^*+\delta)$.

g^* is the average compound growth rate. We firstly start with the determination of g^*. Formula to compute g^* is as follows**:**

$g^*=\lambda\, g+(1-\lambda)\, g_w$

In above formula g is the average growth rate of output for the country and g_w is the world growth rate which assume to equal 4% and λ =0.25, that is a measure of mean deterioration of output.

Human capital (H):

For calculating the index of human capital, first we take data of average years of total schooling of population of age 15 and above from Barro and Lee (2015) data set. After that we adjust the series of average schooling for signify the variation in its quality by using the following index:

$$E = (1+a)^{s}$$

Where *a* representsthe rate of return to each additional year of schooling and it assumed a 7 percent, and *s* shows the average years of total schooling. Finally, the index of human capital is obtained by:

$$H = E\,(1+a)^{s}$$