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**Impact of Debt on Aggregate Investment
and Productivity in Developing
Asian Countries**

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ABSTRACT

This study attempts to investigate the empirical relationship between debt and productivity and debt and investment for the Developing Asian Countries over the period of 1984-2007. The study uses two methodologies for empirical investigation, first is panel fixed effect using 5 year average data and second methodology is GMM applied on the annual data for the larger data set and to tackle the issue of endogeneity. The results show negative relationship between debt and investment and debt and productivity for Developing Asian Countries which confirms the presence of crowding out hypothesis. The results indicate negative impact of government size and budget deficit on investment. Productivity has positive relationship with investment. Trade openness and population growth are positively related to the productivity models. Financial development shows a positive relation in investment and productivity models. The present study confirms the existence of non-linearity of debt in investment and in productivity models. The implication that comes out from analysis that government needs to adopt debt reducing policies and reducing deficit will enhance private investment and productivity.

Keywords: Economic Growth, Debt, Debt Over-hang, Crowding Out Hypothesis, Productivity, Investment

1. INTRODUCTION

Economists have always been concerned with how a high and sustainable economic growth can be achieved. Since the beginning of the 1980s developing countries have experienced a pronounced slowdown in economic growth. An important among the reasons for this slowdown has been a decline in capital accumulation, which has direct and significant impact on real growth rates [International Monetary Fund (1988)]. Declining trend of investment can be explained in a number of ways for example interest rate, expectations, capital prices, technology etc. but this study focus on the foreign debt channel because there are very few studies in developing Asian countries. As there are significant differences among countries as the gross investment ratio to GDP varies across countries with the passage of time. Lower growth rates of gross capital formation has been experienced by the developing countries during 1980's because of the issue of high debt servicing in contrast with the developed economies who were not facing these difficulties of debt servicing [Joshua and Delano (1991)].

In neoclassical growth framework, first Modigliani (1961) and Diamond (1965) and latter Saint-Paul (1992); it is suggested that if there is an increase in public debt it will be always followed by a decrease in the growth rate of economy. High level of debt/GDP ratio slowdowns the investment which leads to low capital formation and low level of productivity. Most of the researchers' emphasis the impact of public debt on growth but less attention is given to its impact on productivity. Capital accumulation and productivity has always been the key determinants of long term growth in growth theories. To highlight this issue, Simon and Carmine (2012) analyse the impact of public debt on two key drivers of economic growth i.e. capital accumulation and productivity. Investigating these two determinants (capital accumulation and productivity) through debt suggest that high level of external debt always have been adversely affecting the dynamics of investment spending and productivity, which will definitely effect the long-term growth [Acemoglu (2009) and Bonfiglioli (2008)].

Some other considerations suggest that high levels of debt might work as a constraint to growth by reducing total factor productivity. Because if it is perceived by the government that benefits in future (in the form of) higher output will be taken by the creditor then it is possible that government is not going to take cost bearing and difficult policies. In turn the poor environment of

policies is assumed to effect the effective capital accumulation and productivity. Moreover high uncertainty and instability related to debt-over hang will be adversely affecting to improve technology and to the efficient use of productive resources. Because when there is a high uncertainty there are chances of misallocation of the investment spending to the quick return activities instead of long-term focusing. This misallocation of resources and less productive investment projects may result in the slower productivity growth.

There are a number of linkages through which public debt may affect the long-term growth. First, debt servicing through tax; crowd out the private investment by lowering the savings (which is a result of lower disposable income) and ultimately results in the distortionary taxation. Second, increasing public debt will give a hike to long-term non-linear yields as the chances of default increases. Higher long term rates crowd out the productive public investment and more importantly results in the reduction of private investment by increase in the cost of capital and “reduced investment in R&D will have long-lasting negative impacts on growth” [Elmeskov and Sutherland (2012)]. Third, in the environment of weak institutions public authorities take a decision to inflate away the debt and high inflation rates has a notorious detrimental effect on long-term growth [Kumar and Woo (2010)].

The main focus of the present study is to investigate the relationship of debt and investment and debt and productivity. This study further investigates the nature of this relationship that whether there is a linear relationship of debt-investment and debt-productivity or these two relations are non-linear.

There is a lot of research work done on the debt and growth and also on debt and investment relationship, but there is a very little work done on the relationship of debt with the two key determinants of the growth that are capital accumulation and productivity. Although there is enough stock present in the literature for the OECD and developed countries but for the Developing Asian Economies there is lack of serious work. Developing economies of Asia are suffering from the debt and deficit issues. This is the main motivation in this study to empirical investigate the impact of debt on investment and productivity for Developing Asian Countries. This study uses panel fixed effect on 5-year average data and for robustness check system GMM on the annual data. Two techniques are used to tackle the reverse causality, endogeneity issue and to smooth out the short term business cycle fluctuations. This study has taken a larger set of variables than the previous empirical studies.

After introduction in Section 1, the remainder of the study is organised as follows. Section 2 contains the literature review and in Section 3 theoretical framework is discussed which is followed by Section 4 in which data and methodology is described. In Section 5 empirical results and interpretation are discussed and in the last Section 6 offers conclusion and policy implications of the study.

2. LITERATURE REVIEW

This section briefly introduces intellectual's discussion for the open floor of "debt effectiveness for investment and productivity". Nearly 30 years it was believed that the impact of development aid is not fruitful for many of the countries and even today many of the scholars, politicians and policy makers are convinced. This issue opens the floor for the investigation of debt. The impact of debt is considered inversely related to investment as well as growth and this problem of debt is followed by 1980s debt crises in Latin America which states that; external debt has adverse impact on growth and investment. Generally, debt overhang theory given by Krugman (1988) and then Sachs (1989) has been carried in contrast with pure crowding-out theory supported by Cohen (1993).

Balázs Égert (2013) in his study contributed to the empirical literature on the debt threshold beyond which negative effects for economic growth appear. Reinhart and Rogoff (2010) first figure out the threshold level for the promising and advanced countries alike and argues that government debt-to-GDP ratio if exceeds to 90 percent then there is significant low economic performance. For the non-linear adverse connection among debt and economic growth there are few evidence and support. However, these arguments are very sensitive in the context of time dimensions covered, selection of the countries and data frequency (annual data sets vs. multi-year averages).

He further disagree that many recent empirical work required in order investigating the probable non-linear adverse connection of government debt and economic growth. Reinhart and Rogoff (2010) claim threshold (90 percent to GDP) level beyond which economic growth is affected and slowed down is advocated by many of the studied done in this area. Study done on a panel of 18 OECD countries for the time frame of 30 years (1980 to 2010) has claimed this threshold level as 86 percent [Cecchetti, *et al.* (2011)] and similar results are reported by Padoan. *et al.* (2012) for a set of alike economies when investigated over a time period of 1960 to 2010. Kumar and Woo (2010) establishes a threshold of 90 percent of GDP while exploring a set of advanced and promising market economies and Checherita and Rother (2010) and Baum, *et al.* (2012) states results in similar fashion. Beside these studies, work done by Carner, *et al.* (2010) and Elmeskov and Sutherland (2012) report different and lower threshold levels for debt-to-GDP ratio; for a group of 77 economies. The reported threshold level is 77 percent and for a group of dozed OECD economies is was 66 percent respectively.

A number of channels explain the adverse effectiveness of government debt over long-term economic performance. First, tax hikes needed to service a higher public debt crowd out private investment by reducing non-refundable income and saving, raise the distortionary costs of taxation, and are likely to result in non-neutral tax behaviour within and across asset classes, thus strengthening distortions. Second, high public debt will push up long-term

independent yields in a nonlinear fashion, as the likelihood of evasion increases. High long-term rates crowd out dynamic public investment, and, more importantly, condense private investment by increasing the cost of capital. Reduced investment in R&D will have long-lasting negative contact with growth [Elmeskov and Sutherland (2012)]. Third, public establishment, especially in countries with weak foundation, may decide to inflate away debt, and high inflation has a disreputably unfavourable effect on growth [Kumar and Woo (2010)].

Previous research work, confirming the Reinhart and Rogoff (2010) result of a 90 percent public debt ceiling ahead of which economic growth slows considerably, called for debt reduction to improve long-term growth. The propositions of his results are that 90 percent is not a magic number. The threshold can be different and lower and the nonlinearity may change across different samples and qualifications. Modelling non-linear impacts are more complex and hard to measure. Moving through time across countries and economic performances, non-linearity may cause instability in economies and becomes difficult to interpret. Finally author is of the view that there is a need of more deep research in order to fully understand the connection among debt and economic growth.

Ghani, *et al.* (1999) in their extensive work argued that one strand of available body of literature shows a direct connection of public investment and states that private segment growth and productivity is positively related to government investment and thus enhances economic growth.¹ This can be linked with consequence of government investment in leading long-term economic performance connected from the creation of positive and significant spillovers in the country via providing basic elements like education, basic scientific research, health and infrastructure and that might also crowd in the private investment which further creates economic growth.

In the development and economic progress, government investment remained the central policy and inquiry question for the both theorist and empiricist. Governments actions are always considered too strongly affect the economic position of the country; i.e. government investment may affect private investment through crowding in and also hampers long-term economic performance. Endogenous growth framework by Romer (1986) and Barro and Sala-i-Martin (1999) have highlighted the spillover effects of government investment and are largely non-excludable and non-rival in consumption. However, these models point out some external effects that may affect economic growth through government investment. Results of their study shows that economic performance heavily depends on private investment, hence there is no strong connection that explains the relationship of government investment and

¹See, for instance, Arrow and Kurz (1970); Barro (1990).

government expenditure on economic performance. Strikingly, government investment is adversely related with output, and this gives some concern regarding efficiency of government investment. Devarajan, *et al.* (1996) argue in a similar fashion that government investment can be harmful if unproductive capital expenditures are made and resources are misallocated. Furthermore results indicate that government investment crowd out the private investment.

During 1980's major developing economies are being affected by the factors emerged by decline of gross investment rates, which includes; falling prices of primary export goods, declining private external financing, countries large accumulation of foreign debt and achievement of adjustment plans considered to re-establish balance of payments possibility.

Greene, *et al.* (1991) in their extensive work attempted to learn more about the empirical determinants of private investment during the time frame of post-1974 era for a set of developing economies. Their major results suggests that private investment in most of the developing economies are influenced by some important macroeconomic determinants; inflation rate of the country and external debt are inversely related to private investment, whereas economic growth and government investment has a positive significant impact as well as GDP per capita, particularly for 1975 to 1982. Results also advocates the hypothesis that for the economies having high economic growth rates and high income levels, lower debt payments, higher public investment rates and lower inflation rates (macroeconomic stability) enjoy high levels of private investment in comparison to GDP.

Chow (1987); Kwan and Costomitis (1990); Jung and Marshall (1985); and Khan, *et al.* (1995) have done some focused work regarding the investigation in the context of nature and direction of causation between export growth and economic performance for Asian economies. Evidences based on these empirical studies are mixed and conflicting in some of the cases. Particularly in case of Asian economies, this absence of the consistent causal link might be related to the misspecifications of the casual framework used in these examinations and also because of the exclusion of a key determinant such as foreign debt. This omission of the key variable results in biased empirical connection among exports and economic growth for the group of economies under considerations.

Fischer (1993) and Bosworth and Collins (2003), they expand a conventional growth framework for conditional convergence by introducing some debt indicators and examined this growth framework for its different components (physical capital, human capital and total factor productivity TFP). At high levels of debt adversely affect economic performance and are significant however; at its low levels the impact is positive but insignificant. If we look at the channels in the course of which debt influence growth, negative effect of both physical-capital growth and of TFP growth hits growth through high debt.

The extent of the effects are alike to that of the effect on output growth: on average, one percent reduction in output growth and almost as much reduction in both physical capital and total factor productivity is caused by doubling of debt. Talking about the contributions to growth, at high levels of debt almost one-third of the effect is because of physical capital growth and two-thirds accounts for total factor productivity growth. However, human capital growth contributes very low and is mainly insignificant. At low levels of debt, debt influence total factor productivity growth positively and there is an inverse relation for capital but mainly not significant. In the context of policy implications, for an average economy in the sample the reported results proposed that, lowering the levels of debt would enhance economic growth via capital accumulation and productivity.

Cecchetti, *et al.* (2011) have named debt a bi-edged sword. If debt is used in a sensible and moderate way, it can promote welfare. But, if used in excess and carelessly, it results in distortions. At household and firms level, borrowing in excess quantity takes one to bankruptcy and financial devastate. However, at country level, debt over burden destroys government's capability to transport fundamental role to facilitate its citizens. For most of the emerging economies, finance plays a vital role in country's development. In the absence of debt and finance programmes, economies that are poor remain poor. If borrowing and savings are available, individuals can meet ends even without current income. It is debt, which allows business to invest even when their sales would not let it. Fiscal powers can play their extensive role in controlling macro-economic performance, when they are able to barrow. However, one can learn the vulnerabilities of borrowing from the history.

Krugman (1990) in his paper examines the tradeoff faced by creditors having such a large stock of debt which does not further allows them to create a center of attention for new lenders. The problem is best explained under *debt overhang*; some economies have not much present value of their resources to overcome the size of "inherited debt". According to the investigation, the option between debt servicing and debt forgiveness should not rely on liquidity vs. solvency question. On the other hand, it presents an exchange between the option value of large nominal debt and the reason of a debt that is hardly to be settled up. Creditors never try to forgive debt if by some extent it is possible for a country to repay. However, if a countries circumstance is not in favour of repaying the debt, then there is some incentive in order to adjust part of the debt to repay and creditor may wish to forgive part of the debt. The issue is difficult, that how much to rely on debt forgiveness and how much on financing it.

It seems to be more realistic case that the tradeoff among debt forgiveness and debt servicing can be improved by indexing the settle up with the state of nature. Finally, this study does propose that tradeoff between debt forgiveness and debt servicing might be based on economic performance of the country and thus could be beneficial for both the creditors and debtors.

Augustin (1999) has used an improved production function to investigate the effects of foreign debt on the economic performance. Study focuses on a group of Sub Saharan African economies for the time frame of 1980 to 1990 where all of these economies faced problems regarding debt. This type of modelling allows us to investigate “direct effect of debt hypothesis” which states that, even if the debt is very little or has no relation with levels of investment, it is still negatively related to economic growth. The result presents a generous collision of net foreign debt on economic growth, which chains the direct effect of debt hypothesis. For the moment, additional support shows rather a weak but negative result of debt on investment stages. Study concludes that, while investigating the foreign debt effectiveness in developing economies policy designers and researchers do not only focus on the investment rates, as has traditionally been the case. But effectiveness and nature of the investment plans implemented may in fact be fairly essential. Previously done studies, that reported the wide spread decline in the economic performance may be because of the foreign debt burden.

Micheal, *et al.* (2004) confirm the prevalence of both the problems of debt overhang and crowding out in Nigeria. The main focus of financing through external means is to enhance economic growth and foreign debt to GDP ratio concurs with this. Also GDP is directly connected with exchange rate of the economy and this short tempered nature of exchange rate still seems to encourage Nigerian GDP. Furthermore the private investment (real/physical) is inversely related to it. They argue that if the finance mode (external/internal); if not utilised in an appropriate manner will never benefit the economy’s performance and as a result the investment will decline. While focusing on foreign debt Chowdhury (2001) argues that a fair level of borrowing can enhance economic growth of the country if employed to gain capital accumulation and enhance factor productivity. This can be justified that; at initial levels of development economies have low capital assets and thus having low investment opportunities. Burnside (2000) in his work explains the benefits driven from external finance and suggests that best way to utilise external debt is to create capital growth and this further make it possible to achieve macroeconomic stability. Foreign debt in the form of capital flow has direct and significant impacts on domestic savings, domestic investment and economic performance [Eaton (1993)]. But, in case of high debt servicing; economic growth and investment do not show satisfactory results. On the other hand, domestic finance results in crowding out of private investment. Governments if borrow locally use domestic savings if available or looking to private lending. This in turn, raise cost of capital for local private borrowers and thus results in decreased in the demand of private investment [Diamond (1965)]. Burfuet (1998) claims that if observed comparatively, domestic debt is more costly than foreign debt.

In a neoclassical growth framework; firstly Modigliani (1961) and Diamond (1965) and then Saint-Paul (1992) used a theoretical approach and claims that, public debt always affects economic growth negatively. In a study done by Schlarek (2004) make use of panel set for 59 developing economies and 24 developed economies for the time frame of 32 years (1970-2002) concludes that, there is a significant inverse relation between debt and economic growth for developing economies. However, the results do not support this hypothesis for the set of developed nations and no significant impacts are shown. In their study, they have used panel of 155 developed and developing economies and the time frame for this investigation is 1970 to 2008. They have examined the relationship between fiscal policy improvements and economic growth and their results advocates that in full sample debt negatively affects the economic performance. Results verify that there is no support for Laffer-type association, because the quadratic term included for debt turns out to be statistically insignificant. Firstly, they have used diverse econometric approaches for complete sample and this reveals statistically negative coefficients for short-run as well as long-run debt. However, second definition supports direct relation for debt to economic growth in short-run for sub group containing OECD economies only. While looking for debt to GDP ratio, they have found that the economies having threshold level above 90 percent of GDP experiencing quite low economic growth rates while on the other hand the economies who did not suffer much have a sustainable threshold level i.e. below 30 percent of GDP throughout the period of investigation.

Siddiqui, *et al.* (2001) is of the view that foreign debt situations have been changed with the passage of time. Pakistan's has moved to "severely-indebted low income country" from "moderately-indebted low income countries" during 1997, while, India's standing has improved from "moderately indebted low income country" from "less indebted low income country" during 1997.² In case of Pakistan; this continuously increase of debt, growing reimbursement trouble and economically and politically debt inflow give raise to concern of debt to GDP ratio on economic growth. In most of the developing economies including Pakistan's economy, time to time adverse change in resource openness and varying composition in inflow of resources (short term maturity commercial loans increased share at a higher rate of interest and decreased share of debt forgiven) has certainly gave rise to the debt burden and worsened the debt financing opportunities. Pakistan has to recover the competitiveness in the international market in order to stabilise the economy. In the context of debt trouble circumstances for Pakistan, it is hard to reduce reliance on foreign aid. Kemal (1975) supports that, "*the elimination of aid flows within a reasonable time period implies increasing the marginal rate of saving and lowering capital*

²World Bank (2001).

intensity either through the adoption of less capital intensive techniques or by changing the sectoral composition of investment towards sectors with lower capital output ratios”.

Extensive literature available on debt/growth advocates that, unimportant external debt of most of the developing nations remained the biggest barrier against their macroeconomic stability and economic growth. Most of the developing economies during 1970's have contracted large number of foreign debts even at higher concessional rate of interests. With the dream of achieving higher levels of capital stocks and a faster pace of economic development based on these huge loans, but during 1980's when these loans reached at high levels; it seems clear that most of the countries became not able to pay back the amount of loan and thus hampers their economic performance. How economic growth is being affected by debt and is there any nonlinearity in the effects through which debt is connected to different determinants of economic growth? These are the central research questions addressed by Ricci in his extensive study. In particular, he examined the effects of debt on economic growth through factor accumulation effect and total factor productivity effect and also checked its nature of nonlinearity if exists.

Economic growth along with all of its sources is affected by debt pointed out in both theory and policy discussions. In this context capital growth channel is advocated in two ways. Firstly, the concept of debt overhang works here; when foreign debt is growing, domestic and foreign investors anticipate that government will employ high and progressive nature of taxation in future to pay back the debt, which discourages the investment opportunities and hence decline the capital formation. Other argument in the literature gave alike comments that, highly indebted economies creates uncertainties for the investors (domestic and foreign) and they hold back and as a result capital accumulation declines. Lower capital formation is likely to be followed by nonlinear impacts of debt over economic growth and supported by both arguments.

Now looking at the total factor productivity channel, high levels of debt also affects economic growth due to decreased total factor productivity. It can be justified by an example; suppose the debtor government perceived that fruits of high productivity will partly take by the lenders in coming future, in this case governments are less willing to employ costly policy reorganisation. This in turn creates a poor environment and more likely to affect the effectiveness of investment and slowdowns the productivity. Additionally, macroeconomic instability and highly uncertainties leads to debt overhang problem and thus hampers encouragement towards technological advancement and effectiveness of resources allocation. In highly uncertain and poor environment, misallocated investment to the activities with short term return rather than long-term, higher risk irreversible investment which would be more fruitful to long term productivity growth. Misallocation and unimportant utilisation of resources and ineffective investment plans will always contribute to low economic performance.

3. THEORETICAL FRAMEWORK

Theoretical framework is discussed in two parts, first part consists of the relationship of debt and investment and the second one is the relationship of debt and productivity.

3.1. Debt and Investment

There are two main theories of debt and investment relationship which are widely used by the economists in the literature.

Crowding Out Hypothesis

According to Mankiw, ‘The offset in aggregate demand that results when expansionary fiscal policy raises the interest rate and there by reduces investment spending’. Crowding out effect is the criticism by monetary economists on the expansionary fiscal policy. According to monetary economists expansionary fiscal policy leads government to borrow money by selling government bonds and by this interest rate is increased and this will discourage the private investment and a decrease in private consumption can also be expected.

Crowding out hypothesis theoretically describes the link between debt and investment, this study is going to empirically investigate the relationship of debt and investment, the empirical model is given below is used in this study.

$$\begin{aligned} \text{prinv}_{i,[t,t+4]} = & \alpha_1 \text{debt}_{i,t} + \alpha_2 \text{deficit}_{i,t} + \beta_{inv} \text{capstock}_{i,t} \\ & + \delta W_{i,t} + \varepsilon_{i,t} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (3.1) \end{aligned}$$

Debt Over-hang Hypothesis

A well-known concept for the fall in investment is that where there is a heavy debt burden there is a reduction in the incentive to invest of debtor country; this is known as debt over-hang effect. And this is considered as a moral hazard problem [Hoffman and Reisen (1991)]. As debt reduces the incentive to invest and save eventually the marginal benefit to invest would be for the creditor. According to debt over-hang hypothesis there exist expectation of higher tax rates in future so it leads to lower saving and investment.

3.2. Debt and Productivity

Simple Solow-Swan Model

Let’s consider the simple production function

$$Y(t) = A(t)F(k(t), L(t)) \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (1)$$

$K(t)$ = Capital stock at time t . $L(t)$ = Labour at time t , $A(t)$ = Total factor productivity or Solow residual at time t .

Production function is represented by Cobb-Douglas form, then

$$Y(t) = A(t)K(t)^\psi L(t)^{1-\psi} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (2)$$

Where, $0 < \psi < 1$ is share of capital and $(1 - \psi)$ is labour share.

Intensive form of this Cobb-Douglas function is as

$$y(t) = A(t)k(t)^\psi \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (3)$$

By taking first derivate the equation becomes:

$$f'(k(t)) = A(t)\psi k(t)^{\psi-1} > 0 \quad \text{and} \quad f''(k(t)) = -A(t)\psi(1-\psi)k(t)^{\psi-2} < 0$$

Standard Inada conditions:

$$\lim_{k \rightarrow \infty} f'(k(t)) = 0 \quad \text{and} \quad \lim_{k \rightarrow 0} f'(k(t)) = \infty$$

Implication of these Inada conditions is that the above mentioned Cobb-Douglas production function is satisfying the properties of neo-classical production function.

Equation of motion of capital stock is given as:

$$k(t)^\circ = s.f(k(t)) - (n + \delta).k(t) \quad \dots \quad \dots \quad \dots \quad \dots \quad (4)$$

Substitute $y(t) = f(k(t)) = Ak(t)^\psi$ in Eq. (4), we get

$$k(t)^\circ = s.A(t)k(t)^\psi - (n + \delta).k(t) \quad \dots \quad \dots \quad \dots \quad \dots \quad (5)$$

The term $(n + \delta)$ on the right hand side of the equation can be thought as the effective depreciation rate for capital-labour ratio, $k \equiv K(t)/L(t)$

Rearranging Equation (5) results in

$$k(t)^\circ / k(t) = s.A(t)k(t)^{\psi-1} - (n + \delta) \quad \dots \quad \dots \quad \dots \quad \dots \quad (6)$$

Since we know that

$$y(t) = A(t)k(t)^\psi \quad \text{Or} \quad y(t)^\circ = A(t)\psi k(t)^{\psi-1}$$

By rearranging again the following equation is obtained:

$$y(t)^\circ = A(t)\psi k(t)^{\psi-1} . k(t)^{-1}$$

Or

$$y(t)^\circ / y(t) = \psi [1/k(t)]$$

$$y(t)^\circ / y(t) = s.f'(k(t)) - (n + \delta)\psi$$

Where, $f'(k(t)) = A\psi k(t)^{\psi-1}$

Growth rate of output per capita which depends on the following parameters of the model as:

$$y(t)^\circ / y(t) = g(s, \psi, \delta, A(t), n)$$

It is assumed that $A(t)$ depends negatively on external debt ED.

Therefore, further it is assumed that

$$A(t) = g(ED(t))$$

Therefore

$$y(t)^\circ / y(t) = g(s, \psi, \delta, ED(t))$$

And the final equation is as:

$$y_{it} = \alpha + \beta ED_{it} + \sum_j \omega_j X_{jit} + ky_{it-1} + \varepsilon_{it} \quad \dots \quad \dots \quad \dots \quad (A)$$

From the above given Solow-Swan extended model theoretically, output depends on the capital (K_t), labour (L_t) and productivity (A_t). As we know that productivity is negatively related with external debt and with the output as well. The empirical model given below also shows the link as:

$$\begin{aligned} prodgr_{i,[t,t+4]} &= \varphi_1 debt_{i,t} + \varphi_2 capstock_{i,t} + \varphi_3 educ_{i,t} \\ &+ \beta_{prodgr} gdpw_{i,t} + \theta W_{i,t} + v_{i,t} \quad \dots \quad \dots \quad (3.2) \end{aligned}$$

4. METHODOLOGY AND DATA

This section presents the methodological framework and data. As this study is going to examine the impact of debt on two key determinants of long term growth, first model examines the impact of public debt on investment and second model examines the impact of public debt on productivity.

4.1. Methodological Framework

4.1.1. Effects of Debt on Investment

The following model is used to estimate the effect of debt on investment.

$$privinv_{i,[t,t+4]} = \alpha_1 debt_{i,t} + \beta_{inv} capstock_{i,t} + \delta W_{i,t} + \varepsilon_{i,t} \quad \dots \quad (4.1)$$

For each country i

$Privinv_{[t,t+4]}$ denotes the five year average of real expenditure on investment (gross fixed capital formation of the private sector) between year t and $t+4$, in logarithms, $Debt_t$ is the gross government debt / GDP ratio at the beginning of the five-year period, $Capstock_t$ is the logarithm of the real stock of the capital of the economy, W_t is the vector of control variables, including::the

long term interest rate, trade openness, population growth rate, financial development, inflation rate, $\varepsilon_{i,t}$ is the error term.

4.1.2. Effects of Debt on Productivity

The following model is used to investigate effect of debt on productivity.

$$\begin{aligned} prodgr_{i,[t,t+4]} = & \varphi_1 debt_{i,t} + \varphi_2 capstock_{i,t} + \varphi_3 educ_{i,t} \\ & + \beta_{prodgr} gdppw_{i,t} + \theta W_{i,t} + v_{i,t} \quad \dots \quad \dots \quad (4.2) \end{aligned}$$

For each country i ,

$Prodgr_{[t,t+4]}$ denotes the five-year average of the growth rate of real GDP per hour worked, $Capstock_t$ is the logarithm of the real stock of capital in the economy, $Educ_t$ is human capital (measured by the log of average years of secondary schooling in the population over age 15 in the initial year), $Gdppw_t$ is the logarithm of the real GDP per hour worked, W_t is the same vector of the control variables as in our 1st model.

In further specifications the analysis is done by using deficit and government size in both models of productivity and investment. Moreover in the first model same set of independent variables are used in three different dependent variables including aggregate total investment, aggregate private investment, private per capita investment. In the second model of productivity the analysis has used two different specifications; Labour productivity and total factor productivity growth

4.2. Empirical Methodology

In this study two methodologies are employed that are supported by previous empirical studies. First, is the panel fixed effect on the average of 5-year data on Developing Asian economies and Second is the system GMM on the annual data on the same Developing Asian Economies. 5-year panel fixed effect is a common technique specially in growth literature because taking average of the 5 years data smooth out the short-term business cycle fluctuations in the data but it costs a shorter sample values; and to deal this problem system GMM on annual data is employed.

4.3. Data

In this study sample of developing countries is taken based on data availability, which are Bangladesh, China, India, Malaysia, Pakistan, Philippines and Srilanka. Sample period is taken from 1984 to 2007. And data of the concerned variables is taken from International Financial Statistics (IFS) and World Development Indicators (WDI). The list of variables and their definition s are given in appendix Table A1.

5. EMPIRICAL RESULTS

As the main focus of the present study is to investigate the relationship between debt and investment for seven developing Asian countries by considering three specifications; aggregate investment, aggregate private investment, per capita private investment for estimation. The secondary objective is to further investigate the relationship of debt and productivity for these two specifications: labour productivity and total factor productivity. For this study two estimation techniques are used; the panel fixed effect which is on the 5 year average data to remove the short term business cycle fluctuations and handle the reverse causality issue. But this technique cost in terms of reducing observation, therefore, another approach system GMM is used on the annual data that allows large sample and mitigate the endogeneity problem as well.

The discussion begins with summary statistics of the data presented in appendix Table A2. Then stationarity test is performed and results are reported in Table 5.1.

Table 5.1

Unit Root Test

	Variables Name	Level	Fist Difference	Stationary at
1	DEBT	0.0057		I(0)
2	DEFICIT		0.0000	I(1)
3	PROD	0.0109		I(0)
4	POP GROWTH	0.0000		I(0)
5	TRADE OPP		0.0004	I(1)
6	INTEREST RATE	0.0107		I(0)
7	GOVT SIZE		0.0093	I(1)
8	INV PER CAPITA		0.0010	I(1)
9	HUMAN CAPITAL		0.0010	I(1)
10	REAL CAPITAL STOCK	0.0111		I(0)
11	TFP	0.0001		I(0)
12	GRPPE	0.0000		I(0)
13	INV PRIV		0.0008	I(1)
14	FD		0.0001	I(1)
15	CPI	0.0001		I(0)
16	GDP PC		0.0038	I(1)
17	AGG INVESTMENT		0.0000	I(1)

Note: The above given values are the p-values which shows the level of significance.

In testing of unit root tests IPS is used, the results in case of Developing Asian Economies for DEBT, PROD, POP GROWTH, INTEREST RATE,

REAL CAPITAL STOCK, TFP, GRPPE indicate that CPI are stationary at level where as the remaining all variables (used in our empirical investigation) are stationary at first difference. None of the used variable is stationary at second level.

5.2. Regression Results

The regression results of the debt and investment and debt and productivity are presented below

5.2.1. Debt and Investment

The analysis starts with aggregate investment relationship with debt, deficit and government size

5.2.1.1. Result Using Aggregate Investment

Table 5.2

<i>Results of Aggregate Investment Model</i>				
	5-year FE	Annual GMM	5-year FE	Annual GMM
Debt	-0.839* (3.03)	-0.839* (3.04)	-0.839* (3.03)	-0.839* (3.04)
Deficit	-0.4608* (0.12)	-0.4608* (0.12)		
GE			-0.3567** (0.15)	-0.3567** (0.15)
CS	0.6427 (0.84)	-0.3568** (0.15)	0.6427 (0.84)	-0.3568** (0.15)
LPPE	0.2203* (6.96)	0.2203* (6.96)	0.2203* (6.96)	0.2203* (6.96)
IR	0.9124* (0.14)	0.9124* (0.14)	0.9124* (0.14)	0.9124* (0.14)
TO	0.21* (0.02)	0.2424* (0.10)	0.21* (0.02)	0.2424* (0.10)
PG	0.2043** (1.05)	0.2043** (1.05)	0.2043** (1.05)	0.2043** (1.05)
FD	0.7199 (0.46)	0.7199 (0.46)	0.7199 (0.46)	0.7199 (0.46)
CPI	0.0679 (0.09)	0.0679 (0.09)	0.0679 (0.09)	0.0679 (0.09)

Note: *Represents significance at 1 percent, ** at 5 percent and *** at 10 percent.

In the baseline model where aggregate investment model is used, debt is negative and significant effect on the aggregate investment as expected and highly significant relationship confirms one of the main focus relationships.

With an increase in the level of debt there is a reduction in aggregate investment observed. Results are in line with Nadeem, Qayyum, and Haider (2000) and Salotti and Trecroci (2010). In the alternative specification where deficit to GDP ratio is used instead of debt negative coefficient of deficit confirmed our results. That debt and deficit both if increasing is going to lower the level of aggregate investment and reason behind this is well-known crowding out effect; the crowding out effect explains the reason that when debt is increasing, government has two ways to cover that debt. First is to raise the interest rate and second is to increase the tax rate and both the above discussed methods negatively affect the investment. In another alternative specification where government size is used as independent variable it also shows negative and significant coefficient, results show that as government size increases it is followed by a reduction in the investment.

Results of capital stock are insignificant under all three specifications (debt, deficit and government size) using 5-year panel fixed effect whereas using annual GMM capital stock is negative and significant showing that there exist conditional convergence in case of developing Asian countries.

Results indicate GDP per person employed has a positive and significant relationship with aggregate investment. This suggests that a better economic condition of the economies it is expected an increase in investment. When labour productivity increases it will definitely show a positive effect on the investment. Results are same for 5-year panel fixed effect and annual GMM. Interest rate is positively and significantly related to the aggregate investment in all specifications and under both methodologies (5-year panel fixed effect and annual GMM). Results are in line with Salotti and Trecroci (2012). Trade openness is positively and significantly related to the aggregate investment in all three specifications. These results are in accordance to the economic theories that increase in interest rate always discourage investor to invest so there will be a reduction in the level of investment as suggested by the basic growth theory [Durlauf, *et al.* (2005) and Acemoglu (2009)]. Population growth is also positively related to the aggregate investment as proposed by the literature, and it has a positive and significant relationship with aggregate investment. Financial development is insignificantly and positively related to the aggregate investment. There is a positive relationship between aggregate investment and inflation under both methodologies.

5.2.1.2. Aggregate Private Investment

Using aggregate private investment function of debt and deficit and other variables, the estimated results are reported in Table 3

Private investment is negatively and significantly associated with debt and this result is consistent in all specifications using debt, deficit and government size and under both methodologies (5-year panel fixed effect and

annual GMM). The results indicate that crowding out theory well explains this phenomenon. Capital stock and log per person employed (LPPE) negatively associated with private investment, but GDP per person employed is positively associated using annual GMM. These results are supported by literature such as

Table 5.3

Results of Aggregate Private Investment Model

	5-year FE	Annual GMM	5-year FE	Annual GMM
Debt	-0.2197** (0.849857)	-0.6666** (0.33)	-0.2197** (0.849857)	-0.6666** (0.33)
Deficit	0.0342*** (0.018356)	0.0236* (0.01)		
GE			-0.0352*** (0.018907)	-0.0274** (0.012635)
CS	0.099353 (0.108072)	-0.2223* (0.0751)	0.099353 (0.108072)	-0.2223* (0.0751)
LPPE	0.210806 (0.673333)	-0.2706* (0.053560)	0.210806 (0.673333)	-0.2706* (0.053560)
IR	-0.0298*** (0.014903)	-0.0152** (0.006235)	-0.0298*** (0.014903)	-0.0152** (0.006235)
TO	0.000923 (0.003015)	-0.0035* (0.001268)	0.000923 (0.003015)	-0.0035* (0.001268)
PG	-0.5309* (0.147340)	-0.2706* (0.053560)	-0.5309* (0.147340)	-0.2706* (0.053560)
FD	-0.071204 (0.058339)	0.7492* (0.164363)	-0.071204 (0.058339)	0.7492* (0.164363)
CPI	0.0026 (0.014055)	-0.0424* (0.009955)	0.0026 (0.014055)	-0.0424* (0.009955)

Note: *Represents significance at 1 percent, ** at 5 percent and *** at 10 percent.

Salotti and Trecroci (2010) and Van Biesebroeck (2009). Interest rate is negative and significant relation with private investment using 5-year panel fixed effect and annual GMM. Trade openness and financial development are positively and significantly related to private investment using GMM only. Population growth is negatively related to private investment using 5-year panel fixed effect and annual GMM. These results are also confirmed by Salotti and Trecroci (2010). Financial development and trade openness have an investment enhancing affect. Inflation is negatively related to private investment and this result explains that increase in prices is driving the investment in the opposite direction. These results are supported by Salotti and Trecroci (2010).

5.2.1.3. Private per Capita Investment

Using private per capita investment in the third model as function of debt and deficit and other variables, the estimated results are reported in Table 5.4.

Table 5.4

Results of Private Per Capita Investment Model

	5-year FE	Annual GMM	5-year FE	Annual GMM
Debt	-0.2427* (0.08)	-0.3169* (0.10)	-0.2427* (0.08)	-0.3169* (0.10)
Deficit	-0.0089** (0.00)	-0.0115* (0.10)		
GE			0.0221* (0.00)	0.0122** (0.00465)
CS	0.0948*** (0.05)	0.5163* (0.06)	0.0948*** (0.05)	0.5163* (0.06)
LPPE	1.3783* (0.27)	1.7439* (0.21)	1.3783* (0.27)	1.7439* (0.21)
IR	0.0155* (0.003)	0.0096* (0.01)	0.0155* (0.003)	0.0096* (0.01)
TO	0.0015** (0.00)	-0.000701 (0.00)	0.0015** (0.00)	-0.000701 (0.00)
PG	0.0269 (0.03)	0.0684** (0.03)	0.0269 (0.03)	0.0684** (0.03)
FD	-0.0075 (0.02)	0.0584* (0.01)	-0.0075 (0.02)	0.0584* (0.01)
CPI	-0.0025 (0.00)	0.0013 (0.00)	-0.0025 (0.00)	0.0013 (0.00)

Note: *Represents significance at 1 percent, ** at 5 percent and *** at 10 percent.

Debt and per capita investment are negatively related as expected and as proposed in the literature in all specifications and under both methodologies. Deficit is negatively and significantly affecting per capita investment and results are supported by theory. Capital stock, trade openness and GDP per person employed is positively related to the per capita investment and results are in line with Durlauf, *et al.* (2005): Acemoglu (2009) and Salotti and Trecroci (2010) using both 5-year panel fixed effect and annual GMM. Financial development and population growth is positively related to per capita investment but it is significant using annual GMM only.

5.2.2. Debt and Productivity

Relationship of debt and productivity is measured using two specifications; using labour productivity and total factor productivity. Both specifications are estimated by two techniques; first one is panel fixed effect on the 5-year average data and second using GMM on annual data.

5.2.2.1 Labour Productivity

Table 5.5

<i>Results of Labour Productivity Model</i>				
	5-year FE	Annual GMM	5-year FE	Annual GMM
Debt	-0.7954** (3.91)	-0.2537* (0.44)	-0.7954** (3.91)	-0.2537* (0.44)
Deficit	0.0551 (0.22)	0.0462* (0.02)		
GE			0.3804 (0.25)	-0.0374** (0.018739)
LPPE	-0.135169** (5.95)	-0.3154*** (0.18)	-0.135169** (5.95)	-0.3154*** (0.18)
CS	0.3971 (0.09)	-0.5756* (0.61)	0.3971 (0.09)	-0.5756* (0.61)
HK	0.0494 (0.069003)	-0.0059 (0.01)	0.0494 (0.069003)	-0.0059 (0.01)
IR	-0.3287* (0.099022)	-0.0035 (0.01)	-0.3287* (0.099022)	-0.0035 (0.01)
TO	0.0473*** (0.025501)	0.0122* (0.00)	0.0473*** (0.025501)	0.0122* (0.00)
PG	1.7673 (1.534131)	0.0793 (0.10)	1.7673 (1.534131)	0.0793 (0.10)
FD	1.221* (0.22)	0.6136* (0.07)	1.221* (0.22)	0.6136* (0.07)

Note: *Represents significance at 1 percent, ** at 5 percent and *** at 10 percent.

As expected debt is negatively affecting the labour productivity and the result is significant by both methods. This effect shows that crowding-out effect is in progress. In the alternative specification deficit to GDP ratio is positively affecting productivity measured by the GMM only. Debt and deficit both effect productivity through the investment channel, as we know that when debt or deficit increases government is left with two options; to increase tax rate or to get loans from the banks, when government is borrowing from the banks investor is not entertained by the banks. The increase in interest rate discourages

the investor to invest because future value will be increased and to get loan is not a good option. When investment is discouraged, productivity will decrease ultimately. In the third specification where government size is used instead of deficit, result shows that government size is negatively and significantly related to productivity GMM only.

GDP per person employed is negatively and significantly related to productivity by both methods and results are supported by the literature; (Van Biesebroeck). Capital stock is negatively related to the productivity and this result is significant only by using annual GMM. Human capital and population growth are insignificant in this model under both methodologies. Interest rate variable is negatively and significantly related to productivity by using 5-year panel fixed effect. Financial development and trade openness are positively and significantly related to the productivity in both methodologies. With the increase in financial development an increase in the productivity can be expected.

5.2.2.2. Total Factor Productivity

Table 5.6

<i>Results of Total Factor Productivity</i>				
	5-year FE	Annual GMM	5-year FE	Annual GMM
Debt	-0.1190*** (0.061564)	-0.0857*** (0.050091)	-0.1190*** (0.061564)	-0.0857*** (0.050091)
Deficit	0.0050** (0.002090)	-0.0044 (0.003607)		
GE			0.3804 (0.25)	-0.0374** (0.018739)
LPPE	-0.1617 (0.152607)	-0.1572* (0.046428)	-0.1617 (0.152607)	-0.1572* (0.046428)
CS	0.0542*** (0.026978)	-0.0795* (0.013875)	0.0542*** (0.026978)	-0.0795* (0.013875)
HK	0.0003 (0.001161)	0.0019** (0.000928)	0.0003 (0.001161)	0.0019** (0.000928)
IR	-0.0007 (0.003092)	0.0032*** (0.001759)	-0.0007 (0.003092)	0.0032*** (0.001759)
TO	0.0008** (0.000346)	0.0006** (0.000326)	0.0008** (0.000346)	0.0006** (0.000326)
PG	0.0186 (0.018104)	0.0146 (0.015771)	0.0186 (0.018104)	0.0146 (0.015771)
FD	-0.0056 (0.006445)	0.0023 (0.005896)	-0.0056 (0.006445)	0.0023 (0.005896)

Note: *Represents significance at 1 percent, ** at 5 percent and *** at 10 percent.

Debt is negatively and significantly affecting the total factor productivity and this result is supported by Salotti and Trecroci (2012). In the alternative specification deficit to GDP ratio has positive and significant effect with 5-year panel fixed effect only. In the third specification government size has negative and significant impact on total factor productivity by both methods. GDP per person employed is negatively and significantly related to total factor productivity. Capital stock is negatively related and trade openness is positively related to total factor productivity. Human capital, population growth and financial integration are insignificant in the TFP specification. These results are consistent with our base study Salotti and Trecroci (2012) suggesting that there exists the phenomenon called crowding out hypothesis.

5.3. Non-linear Relationship of Debt

Table 5.7

Non-linearity in Investment and Productivity Models

Variables	Private Investment	TFP	Labour Productivity
Debt	-0.450* (1.407)	0.433 (0.320)	6.025*** (3.542)
Debtsq	3.416* (1.180)	-0.513*** (0.296)	-5.456*** (2.885)
Deficit	0.029* (0.008)	-0.007*** (0.004)	0.008 (0.026)
HK	0.011* (0.003)	0.002** (0.001)	-0.011 (0.022)
Prod		1.759* (0.167)	2.959* (0.367)
FI	0.816* (0.149)	0.029 (0.032)	-0.217** (0.091)
CS	-0.226* (0.074)	-0.066* (0.015)	0.291 (1.179)
PG	-0.235* (0.056)	0.007 (0.017)	0.237 (0.164)
CPI	-0.037* (0.009)		

Note: *Represents significance at 1 percent, ** at 5 percent and *** at 10 percent.

From the above discussed tables we can conclude that there is existence of non-linearity, because our coefficient of debt squared term has showed a significant sign in private investment and in productivity models. So it can be said that in case of Developing Asian countries, non-linearity exists.

6. CONCLUSIONS AND IMPLICATIONS

The present study investigates the relationship of debt with investment and productivity for Developing Asian Economies for the period 1984 to 2007. Two models are estimated with different specifications. As the main interest variables are debt, deficit and government size and for this investigation the panel data estimation technique is applied. The Hausmann test suggests to employ the panel fixed effect moreover by the suggestion of a rich growth literature this study apply panel fixed effect on the 5 year average data. And secondly on the data with annual frequency GMM is used as estimation technique to deal with endogeneity issue. The lag explanatory variables are used as instruments. The results are almost same for both methodologies; 5 years average and annual data smoothens data, however the focus mainly on the results of annual system GMM because with the use of GMM we have an edge of a larger data set so results are more reliable.

Debt is negatively and significantly related to aggregate investment, private investment and private per capita investment and debt coefficient shows a negative and significant result for total factor productivity and labour productivity as well. Deficit is negatively and significantly related to the aggregate investment and private per capita investment whereas deficit shows a positive impact on aggregate private investment. In case of productivity models deficit shows a positive impact on labour productivity and negative and insignificant in case of total factor productivity. With the increase in debt and deficit investment is reduced due to a well-known crowding out effect. According to the crowding out effect with increase in the debt, government is left with two options; to increase tax rate or to get loans from the banks, increase in tax rate will discourage the investor to invest as a larger portion will be taken away by the government. In other case assume that government is not going to increase the tax rate then the only option left is to borrow, when government is borrowing from the banks investor is not entertained by the banks in the way in which he was treated earlier so higher interest rate will discourage the investor to invest because future value will be increased and to get loan is not a good option.

Government size is negatively and significantly affecting both investment and productivity in different specifications. As the sample is consist of the developing Asian countries and these countries are deficit facing economies so to afford a larger government size will be a serious issue for the budget. Increase in government size means more deficit or to take debt to fulfil the needs and that will be a clear reduction in investment because investors are discouraged in such type of situation causes a reduction in productivity as well. Capital stock is

negative in the aggregate private investment model which shows that conditional convergence is in progress in case of the developing Asian countries.

Productivity has positive relationship with investment showing that a better economic conditions of the economies increase investment. Trade openness and population growth are positively related to the productivity models. Financial development variable shows a positive coefficient in investment and productivity models. Financial development is a healthy diet for both investment and productivity, an increase in financial development is a guarantee to secure investment and hence the productivity because in a financially developed atmosphere it is easy and beneficial to invest and under this development investor is encouraged to invest and produce more.

The results highlight some really important points for the sample of Developing Asian Economies. As debt is negatively and significantly related to private investment and productivity, so governing bodies should adopt debt reducing policy. These countries have to face a heavy budget deficit every year and in this situation a larger government size is really an alarming situation for these economies so planning is required to tackle this issue. Deficit should also be reduced to enhance private investment and productivity.

APPENDIX

Table A1

<i>Variable Description</i>		
Notation	Name and Description	Source
Dtgdg	Debt to GDP ratio	WDI
Deftgdg	Deficit to GDP ratio	WDI
GS	Government size	WDI
LPPE	Log of GDP per person employed	WDI
IR	Interest rate	WDI and IFS
CS	Real capital stock	WDI
PG	Population growth	WDI
TO	Trade openness	WDI
FD	Financial development	WDI and IFS
HK	Human capital	Barro and Lee
CPI	CPI inflation	WDI

grPPE	Growth rate of GDP per person employed	WDI
grTFP	Growth rate of total factor productivity	WDI
GFCF	Aggregate investment (log)	WDI
GFCF PS	Aggregate investment private sector (log)	WDI
GFCFPC	Per capita investment (log)	WDI

Table A2

Summary Statistics

	Mean	Median	Maximum	Minimum	Std. Dev.	Sample
DTGDP	0.41883	0.41869	0.944282	0.054453	0.19969	161
DEFTGDP	-2.21849	-1.38914	0.082141	-17.82293	3.18251	161
GS	10.9018	11.4237	16.78491	4.136337	3.21518	161
LPPE	5.00647	4.9943	6.083549	4.224425	0.39822	161
CS	11.303	11.2448	12.9296	9.541454	0.66364	161
HK	53.6296	54.6711	96.45	18.98336	20.5525	161
IR	12.0763	12.06	28.61167	3.41	4.3341	161
PG	1.89725	1.96868	3.37689	-1.609576	0.71406	161
TO	63.5449	43.3279	220.4074	11.52452	51.4487	161
GRTFP	0.09489	0.09242	0.307567	-0.231857	0.08159	161
GRPPE	29.603	3.36099	971.2319	-92.17369	114.801	161
GFCF	24.2047	23.024	43.58616	13.93139	6.71991	161
FD	8.28883	8.39791	13.02347	1.247032	2.38983	161
CPI	6.7737	6.12672	24.23709	-1.407892	4.64968	161
LGFCFPC	2.22939	2.16279	3.207996	1.565717	0.38983	161
LGDFC	2.85806	2.7745	3.69065	2.407116	0.34135	161

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