Amna Sohail Rawat – Lubna Khan

Exploring the Link between Public Investment and Long Run Economic Growth

A Case of a Developing Country

Summary: This paper attempts to investigate the effect of public investment on the economic growth of Pakistan using an annual data series from the period of 1973-2015. An autoregressive distributed lag (ARDL) model is used to estimate the relationship between variables. Moreover, causality analysis and variance decomposition analysis have also been applied. The result of ARDL bound testing confirms the long run association between public investment and economic growth in Pakistan. In addition, the long run and short run estimations reveal that a large amount of public investment reduces the economic growth. However, the larger share of private investment enhances the economic growth. Conversely, an increase in the labor force of Pakistan will decrease the economic growth in the long run. The study evidence presents important policy implications for the government and policy makers to increase economic growth.

Keywords: Public investment, economic growth, private investment, labor force, ARDL
JEL codes: H54, O47, R42, J21
DOI: https://doi.org/10.35551/PFQ_2020_2_1

The growth trajectory of Pakistan's economy is maintained in the fiscal year 2015-16. This sustainable growth is often underpinned to the change in the dynamics of industry, agriculture and services along with the increasing domestic demand. The expansionary monetary policy of the State Bank of the country and the urge of the government for the infrastructure development has given a boost to the business activities. The economic reforms undertaken by the government and the improved security conditions of the country have also contributed towards the sustained economic growth.

With the success of Zarb-e-Azb, and improvement in energy supply along with enabling and conducive environment, the confidence of both foreign and domestic investors is regaining which can be seen with the rise of the stock market, gain in the foreign direct investment and increase in domestic business in Karachi (Pakistan Economic Survey, 2016). Pakistan has also remained focus and committed to the implementation of China-

E-mail address: amnarawat@gmail.com
lubnakhan922@gmail.com

Pakistan Economic Corridor (CPEC) which is a mega project of estimated budget of around US $ 46 billion. It is expected that CPEC will provide major support for the development of infrastructure, communication, formation of economic zones and the development of Gawadar as next international trade harbour.

Investment is one of the most important component of aggregate demand as it increases the productive capacity of the economy. It also creates employment opportunities and causes technological advancement. Volatility is an important characteristic of investment spending. It is dependent on multiple factors and responsible for much fluctuations of the business activities. However, due to effective policies of the government, the situations for investors have quite improved in the country. According to Pakistan Economic Survey 2015-16, total investments in the economy are Rs. 4502 billion as compared to Rs. 4256 billion in the preceding year, i.e., total investments showed a growth of 5.78 percent in fiscal year 2016. Private investment has witnessed a growth of 3.71 percent as compared to previous year. Whereas, public investments grew by 10.63 percent as compared to the preceding year.

Past studies have excessively discussed about the role of private and public investments in the growth process of the country (Khan, Kumar, 1997). It appears to be a general consensus now that these two elements can have a vital impact on the economic growth of the country. However, their relative contribution in the economic growth is of skeptical nature. The extant literature contains two contradictory views about the efficiency of public and private investment; complementary view versus substitution view. The first view states that public investments, if made, in human capital formation and infrastructure development can increase the productivity of private investment. It can also create a countercyclical impact in the economy by reducing output demand and price volatility thereby increasing private investments, (Hatano, 2010; Rahman et al., 2016). However, a number of studies have also concluded that public investment can crowd out private investment from the economy as it consumes the scarce resources. Thus, for the policy making of the developing world, total investment is not the only matter of concern, but, it is also important that how is it divided between public and private investment (Khan, Kumar, 1997, Balassa, 1988). Various studies in the past have proposed that private investments are more impactful than the public investments (see for example, Khan, Reinhart, 1990; Countino, Gallo, 1994; Serven, Solimano, 1992).

The available studies as well as the extensions of endogenous and neo classical growth models have emphasized the importance of public and private investments in the economic growth (for instance, Kormendi, Meguire, 1985; Romer, 1986; Lucas, 1998; Grier, Tullock, 1989 etc.) However, the impact of public investment on economic growth depends on how the government is financing the increased investment (Bukhari etal. , 2007). If public and private investments are perfect substitutes to each other, then an increase in public investment will produce the same effect on the economic growth as the private investment. Both elements of investment facilitate the accumulation of physical capital and helps in sustaining higher level of output (Lachler, Aschauer, 1998). For instance, when public investment is made in infrastructure, it facilitates private investment that consequently increases marginal productivity of private capital and enhances national income (Looney, Frederiksen, 1997; Ansar et al., 2016). Public investments in social sector like health and education also has positive spillover effects and raises economic growth. However, the literature also suggests that public investment may also 'crowd out' private investment as it

attracts scarce resources towards itself through bond floating (Erden, Holcomble, 2005).

Given the vitality of the role of investment in the economic growth of the country, this study tries to establish a causal link between the elements of investment-public and private- and economic growth. The study precisely wants to answer the question that 'What is the role of public and private investment in the growth of Pakistan's economy?' To serve the purpose, the study uses an intensive time series data covering the period from 1973 to 2015. Moreover, the study uses advance econometric techniques to estimate the proposed model. So far, several studies have been conducted which concentrate on the role of public and private investment on the economic growth of Pakistan's economy for instance, *Khan* (1988); *Looney* and *Frederiksen*, (1995); Looney and Frederiksen, (1997) and many more. However, the current study tries to answer the proposed using ARDL co-integration approach.

The study will also help in examining the overall relationship among the focused variables. The findings of the study will help the economic policy makers to design appropriate policy measures for the growth of the economy with regard to public and private investment.

The remaining part of the study is organized as follows. The following part presents a brief sketch of the studies up taken on the same problem. Part 3 discusses the model and methodological framework adopted for the study. Part 4 contains the empirical findings. Part 5 concludes the study with suitable policy recommendations and future line of research.

REVIEW OF RELATED LITERATURE

In the seminal literature, two opposing views exist about the role of public investment on the economic growth. The first proposition states that public investment positively contributes to the economic growth of the country. The studies in support with this proposition argue that when public investments are made on economic infrastructure, it facilitates the private investment plans, creates positive spillover effects and eliminates growth bottlenecks (Barro, 1990; Aschauer, 1989; Afonso, St. Aubyn, 2008, Ansar et al., 2016). The studies also proposed that public investments on social infrastructure such as health, educations, trade harbour, roads etc., create advantageous opportunities for private investments and hence the productivity of private sector increases. Hence, the studies have a consensus on the idea that public investment has positive externalities and it crowds in private investment.

Aschauer (1989) studied the impact of non-military government spending on the overall productivity of the economy. He found out that public investment on infrastructure capital has a positive effect on private investment and it plays an important role in stimulating private investment. He also proposed that public and private investments are complementary in economic nature. *Erenburg* (1993) also presented a positive relationship between public and private investment. According to both studies stated above, private investment stimulates future growth of the economy whereas, effective public investment enhances real economic growth. Following the same notion, Khan and *Reinhart* (1990) claimed that if public investment crowd in private investment, any reduction in public investment will reduce the rate of economic growth. *Calderon* and *Serven* (2010) estimated the same relationship for African countries and found the evidence that African countries can raise their economic growth if the deficits in infrastructure budget are reduced. Thus, discretionary cuts in public investments and giving infrastructure spending a priority restore economic growth in low

income countries. In the same vein, *Ramireez* (2009) estimated if the public provision of infrastructure raises labour productivity and economic growth in Argentina and found that public investment do positively affect labour productivity growth. A recent study in this regard is of *Ntembe et al.*, (2017). The study was conducted in Cameroon. The empirical results found that public and private investment has a significant positive impact on the GDP growth of Cameroon in both short and long run.

The second school of thought proposes that public investments crowd out private investments by diverting scarce resources from their efficient usage. To increase public investments requires increase in tax and non-tax revenue or increase in public demand for funds in the capital markets that ultimately increases the interest rate in the capital market (Aschauer, 1989; Afonso, St. Aubyn, 2008). The interest rate increment reduces the amount of capital available for private investments that ultimately decreases the expected rate of return on private capital and this, consequently crowd outs private investment. *Devrajan et al.*, (1996) claimed that if there is a shift of public investments from current expenditures to capital expenditures keeping the overall government spending constant slows down the rate of economic growth. This finding also gets its support from *Canning and Pedroni* (2008), who suggested that the crowding out phenomenon would occur when the gains from infrastructure investments are lesser than the gains of capital when it is invested in other outlays.

Ashipala and Haimboodi (2008) estimated the impact of public and private investment on growth for South Africa, Bostwana and Namibia. Their study found no evidence of relationship between public investment and economic growth however, private investment was found to have a positive effect on growth in the long run. Similarly, *Warner* (2014) assessed the impact of public investment on the economic growth in case of lower income economies and found insignificant relationship between the variables in long run. However, he put forwarded the argument that such public investment ventures that compromise efficiency and prioritize the actors' benefits rather than the social needs create problems. Poor choice of projects, lack of economic information, serving self-interest of government officials often lowers the efficacy of public investments.

Samake et al. (2013) also examined the relationship between public investment and economic growth for Cameroon and arrived at the conclusion that public investments in Cameroon are not significantly contributing to the accumulation of public capital. According to the study, poor governance and low administrative capacity are responsible for the improper execution of public projects and hence they fail to contribute to the economic growth.

The contemporary literature has extensively discussed the role of public and private investments for economic growth in the context of developing countries. Using VAR approach, *Kollamparambil and Nicolaou,* (2011) contended that public investment does not crowd out or complement private investment in South Africa. Rather, it has an accelerating effect on the private investment. Similarly, To, (2011) found that both private and public investments have a positive effect on the economy's output in the case of Vietnam. *Swaby,* (2007) noted that in Jamaica public investments have a positive but insignificant effect on the economic growth. Further, *Haque,* (2013) confirmed a positive and significant effect of public and private investments on GDP of Bangladesh. The author also showed that investment has an accelerating effect on the growth of the economy.

Looking at the current outlook of Pakistan, we find that the country has been subject to short lived growth cycles because of greater public and private consumption than investment. Consequently, country's aggregate demand increases at a higher pace than the aggregate supply, aggravating the need of imports in the country and making the growth rate unstable. The share of public and private investments in GDP in the country is lower than various countries in the region, (World Bank, 2019). This results in poor quality of education and health sector, lesser development in infrastructure, and lesser supply of energy. Hence, it is quite imperative to assess the role of public and private investment on the economic growth of the country. The findings can affect the government policy decisions for promoting economic growth and selecting right extent of public and private investments.

CONCEPTUAL FRAMEWORK

The neoclassical growth model and its variations have been used extensively in several past studies that tried to assess the impact of public and private investment on the growth of the economy. Following the same approach, we are also using the neoclassical model to examine the relationship between public and private investment and economic growth for Pakistan. Following the theoretical model proposed by *Aschauer,* (1989), *Albala-Bertrand and Mamatzakis,* (2001) and *Ntembe et al.,* (2017), the current study also uses public investment and a set of other variables that can affect output. We present below a modified neoclassical model of the form,

$$RGDP_t = A_t F(LAB_t, GINV_t, PINV) \quad (1)$$

Where *RGDP* measures the real output level, LAB represents the labor force as a percentage of total population, GINV is the public investment and PINV is the private investment. Equation 1 given above can be re-written as a Cobb-Douglas production function as used in Aschauer, (1989), Albala-Bertrand and Mamatzakis, (2001) and Ntembe et al.,(2017) as follows,

$$RGDP_t = A_t (LAB_t)^{\beta}{}_1 (GINV)_t^{\beta}{}_2 (PINV)_t^{\beta}{}_3 \quad (2)$$

Where, *A* is the efficiency parameter that is used to assess the overall efficiency with which the labor force, public investment, and private investment are used in the economy. An important point to note here is that we assume the given model to exhibit increasing returns to scale, meaning that percentage change in all explanatory variables leads to more than proportionate change in the real GDP.

With a log transformation of the proposed model, equation 2 can be presented as,

$$lnRGDP = lnA + \beta_1 lnLAB + \beta_2 lnGINV + \beta_3 lnPINV + \epsilon \quad (3)$$

Since it is a log-log model, the co-efficient βs are the elasticities of real output with respect to each of the type of investment, ϵ is the random error term of the model.

ARDL Co-Integration Approach

Finally, for the estimation of the long run and short run coefficients, we use Autoregressive distributed lag approach (ARDL). Although being new, ARDL co-integration technique provides useful insights into the relationship. The ARDL model is a usual regression model that regresses the dependent variable on both the lags of independent and dependent variables (Pesaran, Shin, 1999). The prominence of the ARDL model has become known with the

work of *Pesaran and Shin,* (1999) and *Pesaran et al.,* (2001)

There are several advantages of the ARDL model over the conventional co-integration technique. First and foremost, this technique also performs well with a smaller sample size. Secondly, the ARDL model does not require the variables to be integrated of the same order in the unit root test. Hence, ARDL model can also be applied even if the variables under consideration are a mixture of the integrated order of zero *I(0)* and one *I (1)* (Pesaran et al., 2001). Thirdly, the ARDL model estimates the long run association using a single reduced form equation.

ARDL model can be written in the following generic form, following Pesaran and Shin (1999) and Pesaran et al., (2001),

$$\Delta ln\ RGDP_t = \alpha_o + \sum_{i=1}^{3} \alpha_{1i} (\Delta ln\ RGDP)_{t-i} + \sum_{i=0}^{4} \alpha_{2i} (\Delta ln\ LAB)_{t-i} + \sum_{i=0}^{4} \alpha_{3i} (\Delta ln\ GINV)_{t-i} + \sum_{i=0}^{5} \alpha_{4i} (\Delta ln\ PINV)_{t-0} + \gamma_1 ln\ (RGDP)_{t-1} + \gamma_2 ln\ (LAB)_{t-1} + \gamma_3 ln\ (GINV)_{t-1} + \gamma_4 ln(PINV)_{t-1} \quad (4)$$

Where, Δ is the difference operator, the coefficients γ_1, γ_2 and γ_3 are the long run parameters and α_{1i}, α_{2i}, α_{3i}, and α_{4i} measure the short-run dynamics of the model. To test whether a co-integrating relationship exists among *RGDP, LAB, GINV*, and *PINV*, we conducted a non-standard *F*-test. The null hypothesis of the test is $\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = 0$ against the alternate i.e., $\gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq 0$.

Data Source

For the current study, all data has been acquired from the Handbook of Statistics, 2016 published by the State Bank of Pakistan. The study has used data of 43 years from 1973 to 2015 to assess the proposed relationship. The *RGDP, PINV,* and *GINV* are taken in real terms and measured in million rupees. Whereas, *LAB* is taken as a percentage of total population.

EMPIRICAL RESULTS

Summary Statistics

Table 1 presents the summary statistics of public investment, private investment, real gross domestic product and labor force of Pakistan from the period of 1973–2015. The average real gross domestic product of Pakistan from the given time period is Rs. 4,958,930 with the standard deviation of 2,784,778. Whereas, the average private investment is calculated as 294,120 with 469,371 value of standard deviation. In addition, the estimated government investment within the selected time period is Rs. 135,466 with the value standard deviation 165,269. Moreover, the average percentage of a total labor force of the country is 30% with the standard deviation of 1.8%.

Stationary Analysis

Augmented Dickey-Fuller Test

Prior to estimating the model, we first check the integration property of the data series. This is important because time series macroeconomic variables used in this study are more likely to contain a trend in their data series, which give spurious results. *Engle and Granger* (1987) stated that regression results will become weak if it applies to the non-stationary data series. Therefore, we used Augmented Dickey-Fuller (ADF) to analyze the stationary property of the variables. Below, *Table 2* reports the results of ADF. The null hypothesis of a unit root against the alternate hypothesis of no unit root is tested. The results suggest that data

Table 1

SUMMARY STATISTICS

	LNRGDP (in Rupees)	LNPINV (in Rupees)	LNGINV (in Rupees)	LF (%)
Mean	4958930	294120.2	135466.1	30.165
Maximum	10644336	1620982.0	632542.0	34.000
Minimum	1401791	1698.0	591.0	27.460
Std. Dev.	2784778	469371.3	165269.9	1.810
Observations	43	43	43	43

Source: Authors' estimation

Table 2

STATIONARY TEST

Augmented Dickey-Fuller (ADF)				
Variables	Level		1st Difference	
	C	*C & T*	*C*	*C & T*
lnRGDP	–2.454	–0.753	–4.605***	–4.893***
lnGINV	–1.630	–1.396	–6.419***	–6.714***
lnPINV	–1.623	–1.053	–6.210***	–6.512***
LF	–1.579	–2.905	–8.724***	–8.921***

Note: t-stats are reported

*** indicates 1% significance level

Source: Authors' estimation

series of all the variables are non-stationary at the level and stationary at first difference. Hence, we can conclude that all the variables are integrated into one *I (1).*

Zivot Andrews Structural Break Unit Root Test

The *Table 3* given above shows the results of Zivot Andrews trended unit root test. The following test is applied in order to check if the variables under study are *I (0)* or *I (1)* or *I(0)/I (1)* in presence of any structural break. Our empirical results have shown that all variables under study are non-stationary at level but have become stationary at the 1st difference and hence, are integrated of *I (1).*

Autoregressive Distributed Lag Approach (ARDL)

After determining that all the variables are integrated at order one *I (1),* we apply ARDL bound testing approach to analyze the long-run relationship between public investment, private investment, labor force, and economic

Table 3

ZIVOT-ANDREWS STRUCTURAL BREAK TRENDED UNIT ROOT TEST

Variable	At Level		At 1st Difference	
	T- Statistics	Time Break	*T*- Statistics	Time Break
lnRGDP	–2.878	2008	–6.550***	2004
lnGINV	–4.935	2005	–7.030***	1999
lnPINV	–6.974	1999	–6.789***	1998
LF	–3.224	2004	–7.550***	2005

Note: t-stats are reported

*** indicates 1% significance level

Source: Authors' estimation

Table 4

BOUND TEST FOR COINTEGRATION RELATIONSHIP

Test Statistics Value	Critical Value Bounds %	I (0)	I (1)
F-statistics= 11.392	10	2.72	3.77
	5	3.23	4.35
	3	3.69	4.89
	1	4.29	5.61

Source: Authors' estimations

growth. *Table 4* presents the results of the bound testing approach. The results imply that all the variables are highly cointegrated with each other because the *F*-statistics value is greater than the upper bound and lower bound critical values, which reject the null hypothesis of no integration and accept the alternate hypothesis of cointegration at 1% significance level. Hence, we conclude that public investment, private investment, and labor force have a long run impact on the economic growth.

Below *Table 5* provides the long and short run estimations of the model. The coefficient of CointEq (–1) is negative and significant, indicating the long-run relationship between all the variables used in the model. Results reveal that government investment has a negative and significant effect on the economic growth of Pakistan in the long-run, while, the effect becomes insignificant in the short-run. However, private investment has a positive and significant effect on the economic growth in both the long and short run. Conversely, the total labor force of Pakistan has a significant and negative relationship with economic growth in the long-run, however, the relationship becomes positive in the short-run.

Table 5

ARDL ESTIMATION WITH LAG LENGTH (3,4,2,2)

Dependent Variable is lnRGDP (1973-2015)			
Variable	**Coefficients**	***t*-statistics**	**Prob.**
Panel *A*: Short-run Estimates			
D(lnGINV)	–0.008	–0.534	0.598
D(lnPINV)	0.003	0.224	0.824
D(LF)	0.005	2.070	0.049
CointEq(–1)	–0.094	–5.453	0.000
Panel *B*: Long-run Estimates			
lnGINV	–0.844	–15.163	0.000
lnPINV	0.772	15.900	0.000
LF	–0.063	–2.975	0.007

Source: Authors' estimations

Causality Analysis

Toda and Yamamoto Modified Wald Test Causality Analysis

To examine the direction of causality between the dependent and independent variables, we used Toda and Yamamoto (1995) Causality Analysis. The following test is based on a modified wald (MWALD) statistics which can be applied irrespective of the order of integration of the studied variables. *Toda and Yamamoto* (1995) based Granger causality analysis employs a Seeming Uncorrelated Regression (SUR) technique by estimating a two-equation system. By employing the Wald statistics, the efficiency of the SUR model is improved, hence the model can be specified as follows,

$$Y_t = \alpha_1 + \sum_{i=1}^{k+d} y_{1i} Y_{t-1} + \sum_{t-1}^{k+d} y_{2i} X_{t-1} + \varepsilon_{yt}$$

$$X_t = \alpha_2 + \sum_{i=1}^{k+d} \delta_{1i} Y_{t-1} + \sum_{t-1}^{k+d} \delta_{2i} X_{t-1} + \varepsilon_{xt}$$

Where k is the optimal lag order, d denotes the maximum order of integration in the system and ε_{yt} and ε_{xt} are white noise error terms. The usual Wald test are then applied on the first k coefficients matrices by employing the standard x^2-statistics. The empirical results of Toda and Yamamoto, (1995) method based on the granger causality test are reported in *Table 6* below. The results indicate evidence of bi-directional causality between public and private investments and unidirectional causality running from public investment to real GDP.

Variance Decomposition Analysis:

The generalized forecast error variance decomposition (VD) method following the vector autoregressive (VAR) system has been used also to check the strength of the causal relationship between real GDP, public investment, private investment, and labor force. It is a method that provides series' predicted error variance accounted for changes in each independent variable over different time periods. Various past studies,

Table 6

TODA AND YAMAMOTO, (1995) BASED ON GRANGER CAUSALITY RESULTS

Dependent Variable	Independent Variables			
	Modified Wald Statistics (*p*-value)			
	lnRGDP	*lnGINV*	*lnPINV*	*LF*
lnRGDP	—	4.793 (0.020)**	1.371 (0.241)	1.8380 (0.175)
lnGINV	0.100 (0.751)	—	5.666 (0.017)***	1.5230 (0.217)
lnPINV	0.844 (0.358)	3.109 (0.077)*	—	0.0779 (0.780)
LF	2.448 (0.117)	0.004 (0.945)	0.426 (0.513)	—

Note: *** and ** denotes significant at 1% and 5% significance level, respectively. The figure in the parenthesis (…) denotes *p*-value. The lag length is 1 based on the Schwartz Information Criterion.

Source: Authors' Estimation

for instance, *Wong,* (2010), *Hye,* (2012), *Shahbaz et al,* (2012), *Raza and Jawaid,* (2013), Jawaid and Raza, (2013) etc, have used this approach in order to check causality among the variables. *Table 7* given below provides the results of variance decomposition analysis. The results from the VD analysis for real GDP, presented in panel A of table 7 shows that in the first round, 100% change in real GDP is explained by its own innovations, whereas, in the second round, 92.02% change in real GDP is explained by its own innovations, 7.03% by public investments, 0.156% by private investments and 0.782% by the labor force. In the fifth round, 40.045% change in the real GDP is caused by its own innovations, 38.934% change is caused by the innovations in public investments, 20.645% innovations are caused by private investments and 0.373% innovations in real GDP are caused by the labor force. Whereas in the tenth round, 10.391% innovations in the real GDP are caused by itself, 46.664% changes in the real GDP are being caused by the public investments, 42.23% by the private investments and 0.706% by the labor force.

Panel *B* of the table 7 represents the results of VD analysis for public investments. The results show that in the first round, 99.79% innovations in the public investments are caused by the public investment itself and 0.204% by the real GDP. In the second round, 97.036% changes in the public investments are caused by public investments itself, 2.050% changes are explained by the real GDP, 0.846% is explained by private investments and 0.066% are explained by the labor force.

Panel *C* of the table 7 represents results of variance decomposition analysis for the private investments. It shows that only 21.11% changes in the private investments are explained by the private investments itself in the first round, whereas, 76.262% variation in the private investments are explained by the public investment, and 2.617% variation is explained by the real GDP. However, in the tenth round, 3.57% innovation in the private investments is explained by its own self whereas, 93.67% innovations are explained by the public investments, 2.371% variations in private investments are explained by the real GDP and 0.418% variation in the private investments are explained by the labor force.

Panel *D* of the table 7 explains the VD analysis result of the labour force. The results showed that in the first round, labor force explained 67.80% variation of its own, while rea GDP caused 16.077% changes in the labour force and public investment caused 0.597% change in the labour force. Whereas in the last round, 40.329% innovation in the labour force was caused by labour force, 53.39% innovation in the labour force was caused by the real GDP, 2.062% changes in the labour force were caused by public investments and, 4.216% innovations in the labour force were caused by the private investments.

The results of the VD analysis have shown that a feedback mechanism exists among the variables under study and all of them are exhibiting a causal relationship.

Table 7

VARIANCE DECOMPOSITION ANALYSIS

Panel *A*: Variance Decomposition of lnRGDP:				
Period	***lnRGDP***	***lnGINV***	***lnPINV***	***LF***
1	100.00	0.000	0.000	0.000
2	92.021	7.039	0.156	0.782
3	76.668	18.845	3.832	0.653
4	57.077	30.972	11.496	0.452
5	40.045	38.934	20.645	0.373
6	28.202	43.409	27.991	0.396
7	20.519	45.530	33.481	0.468
8	15.629	46.438	37.379	0.552
9	12.472	46.704	40.189	0.633
10	10.391	46.664	42.237	0.706
Panel *B*: Variance Decomposition of lnGINV:				
Period	***lnRGDP***	***lnGINV***	***lnPINV***	***LF***
1	0.204	99.795	0.000	0.000
2	2.050	97.036	0.846	0.066
3	3.614	95.546	0.786	0.052
4	3.792	95.489	0.671	0.046
5	3.609	95.693	0.631	0.064
6	3.299	95.792	0.806	0.101
7	2.995	95.597	1.250	0.156
8	2.734	95.156	1.884	0.223
9	2.526	94.493	2.680	0.299
10	2.371	93.674	3.574	0.379

Panel *C*: Variance Decomposition of lnPINV:				
Period	***lnRGDP***	***lnGINV***	***lnPINV***	***LF***
1	2.617	76.262	21.120	0.000
2	2.175	84.274	13.498	0.051
3	1.461	84.671	13.750	0.116
4	1.346	84.897	13.640	0.115
5	1.377	83.227	15.239	0.155
6	1.651	81.268	16.883	0.196
7	1.993	78.894	18.859	0.251
8	2.409	76.517	20.766	0.307
9	2.837	74.161	22.637	0.363
10	3.270	71.929	24.381	0.418
Panel *D*: Variance Decomposition of LF:				
Period	***lnRGDP***	***lnGINV***	***lnPINV***	***LF***
1	16.077	0.529	15.587	67.805
2	29.634	0.318	16.327	53.719
3	35.447	0.277	12.494	51.780
4	40.010	0.459	10.401	49.128
5	43.428	0.671	8.594	47.304
6	46.248	0.954	7.257	45.540
7	48.538	1.239	6.206	44.016
8	50.449	1.527	5.385	42.637
9	52.043	1.802	4.736	41.417
10	53.392	2.062	4.216	40.329

Source: Authors' estimation

DISCUSSION

The result of the ARDL model shows that government investment reduces the economic growth in both the long run and short run period. A possible reason might be the inefficient execution of investment by the state, which is not translated into productive projects. Moreover, most of the developing states are struggling with weak institutions, bad governance, law and order situation, corruption, etc like Pakistan. Despite the strong connection between government investment and economic growth, these prevailing issues turn the positive impact of government investment into negative on the economic growth of Pakistan. This empirical finding is consistent with the findings of *Gauthier and Zeufack* (2011), they also pointed out that misallocation of government

investment and bad governance may reduce the economic growth. Further, *Tabova and Baker* (2011) and *Gupta et al.* (2014) support our estimated results by stating that due to the lack of strong institutions, the government fails to allocate resources efficiently and undermines the economic growth. Similarly, Khan and Reinhart (1990) revealed that the impact of private investment has larger than the impact of public investment on economic growth. If the share of public investment is greater, it might crowd out the private investment by increasing interest rates. On the other hand, the estimated results suggest that private investment has a positive and significant relationship with the economic growth. The estimated result is consistent with the results of Erenburg (1993) and Ashipala and Haimboodi (2008), who found a strong positive and significant relation between private investment and economic growth. The author stated that private investment boosts the future income of the country. However, Ramireez (2009) argued that public and private investment both influence the economic growth, whereas, the author also argued that public investment enhances the efficiency of the private investment and thus both have a strong and positive relationship with economic growth. Furthermore, the study also found an inverse but significant relationship between labor force and economic growth. Though, the results are not consistent with the findings of Ramireez (2009), conclude that the labor force has a positive and significant impact on the economic growth. However, a possible explanation within the context of Pakistan might be the large proportion of unskilled labor. Due to the weak academic institutions and low literacy rate, Pakistan has a larger share of unskilled labor in total, which in the long run reducing the productivity of the country. While the short run coefficients are positive and significant. Therefore, we can justify this long run inverse relationship between labor force and economic growth by stating that an increase in unskilled labor population will increase the illiteracy rate and in subsequent reduces growth.

CONCLUSION

This study investigated the impact of public investment on the economic growth of Pakistan during the period 1973–2015. Prior to testing the model, we have ensured the stationary status of the time series data of all the variables by using augmented dickey fuller (ADF) test and Zivot and Andrews structural break unit root test. The results of the ARDL bound testing approach suggest that public investment and economic growth are highly cointegrated with each other in the long run. Moreover, the long run and short estimations of ARDL model suggest that public investment has an inverse but significant impact on the economic growth of Pakistan. This empirical result is consistent with few past studies findings (Gauthier and Zeufack, 2011; Tabova and Baker, 2011; Gupta et al., 2014; Ramireez, 2009), concluding that inefficient pubic investments, weak institutions, and bad governance diverge the resources from productive use and crowd out private investment, resulting in a reduction of economic growth. However, the impact of private investment on the economic growth is positive and significant. Past studies support the findings (Erenburg, 1993; Khan and Reinhart, 1990 among others) that private investment boost the real income of the economy. Contrary to that, the labor force of Pakistan has a significantly negative relationship with the economic growth. An increase in unskilled labor substantially reduces the economic growth of the country in the long run.

The empirical results presented in this study can draw several important policy implications. An evidence of a negative relationship between public investment and economic growth suggests the state authorities of Pakistan design and implement such policies that aimed to enhance the efficiency of government investments. The government of Pakistan should invest public money in education, infrastructure, communication, and transport to bolster the efficacy of private investment and subsequently improve the economic performance of the country. The government should focus on the proper allocation of government investment in productive projects and this should be stressed because many past studies have shown that bad governance and poor quality of institutions misallocate the government investments. The allocated amount should be fully spent on a project that contributes to the economy and improves performance. The state of Pakistan should mobilize their resources to the sectors like textile, infrastructure, education, health and others that create positive externality and help to boost the private investment. Hence, the public money invests in the relevant area can more likely to crowd in the private investments and thus spur economic growth. Despite the strong policy implications, this study has some limitations which open up new avenues for future studies. This study primarily investigated the effect of public investments on the economic growth of Pakistan. This relationship can further be tested by future researchers at different regional level. Further, more control variables such as governance indicator, political stability, school enrollments, and many others can also be added to the model that affect economic growth.

References

Afonso, A., St Aubyn, M. (2008). Macroeconomic Rates of Return of Public and Private Investment: Crowding-in and Crowding out Effects. *The Manchester School*, *77*, pp. 21-39, https://doi.org/10.1111/j.1467-9957.2009.02117.x

Albala-Bertrand, J. M., Mamatzakis, E. C. (2001). Is public infrastructure productive? Evidence from Chile. *Applied Economics Letters*, *8*(3), pp. 195-198, https://doi.org/10.1080/13504850150504595

Ansar, A., Flyvbjerg, B., Budzier, A., Lunn, D. (2016). Does infrastructure investment lead to economic growth or economic fragility? Evidence from China. *Oxford Review of Economic Policy, 32*(3), 360-390, https://doi.org/10.1093/oxrep/grw022

Aschauer, D. A. (1989). Is public expenditure productive? *Journal of Monetary Economics*, *23*(2), pp. 177-200, https://doi.org/10.1016/0304-3932(89)90047-0

Ashipala J, Haimbodi N. (2003) The impact of public investment on economic growth in Namibia. *NEPRU Working Paper* No. 88. Retrieved from https://www.ean.org.na:8080/xmlui/bitstream/handle/123456789/1562/NPB05%20The%20Impact%20og%20Public%20Investment%20on%20GDP%20in%20Namibia%20%20Oct.%202003.pdf?sequence=1&isAllowed=y

Barro, R. J. (1990). Government spending in a simple model of endogenous growth. *Journal of Political Economy*, *98*(5, Part 2), pp. 103-s125, https://doi.org/10.3386/w2588

Bukhari, S. A. H. A. S., Ali, L., Saddaqat, M. (2007). Public investment and Economic Growth in the three little dragons: Evidence from heterogeneous dynamic panel data. *International Journal of Business and Information.* 2(1), pp. 57-79

Canning, D., Pedroni, P. (2008). Infrastructure, long-run economic growth and causality tests for cointegrated panels. *The Manchester School*, *76*(5), pp. 504-527, https://doi.org/10.1111/j.1467-9957.2008.01073.x

Calderón, C., Servén, L. (2010). Infrastructure and economic development in Sub-Saharan Africa. *Journal of African Economies*, *19*(suppl_1), pp. 13-87, https://doi.org/10.1093/jae/ejp022

Coutinho, R., Gallo, G. (1991). Do Public and Private Investment Stand in Each Other's Way. *World Development Report Background Paper*. World Bank,. Washington DC., Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.40.9910&rep=rep1&type=pdf

Devarajan, S., Swaroop, V., Zou, H. F. (1996). The composition of public expenditure and economic growth. *Journal of Monetary Economics*, *37*(2), pp. 313-344, https://doi.org/10.1016/S0304-3932(96)90039-2

Erden, L., Holcombe, R. G. (2005). The effects of public investment on private investment in developing economies. *Public Finance Review*, *33*(5), pp. 575-602, https://doi.org/10.1177/1091142105277627

Erenburg, S. J. (1993). The real effects of public investment on private investment. *Applied Economics*, *25*(6), pp. 831-837, https://doi.org/10.1080/00036849300000137

Engle, R. F., Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: Journal of the Econometric Society*, 55(2), pp. 251-276, https://www.jstor.org/stable/1913236 https://doi.org/10.2307/1913236

Gauthier, B., Zeufack, A. (2011). *Governance and oil revenues in Cameroon*. Palgrave Macmillan: Basingstoke, pp. 27-78,

Ukgrier, K. B., Tullock, G. (1989). An empirical analysis of cross-national economic growth, 1951–1980. *Journal of Monetary Economics*, *24*(2), pp. 259-276, https://doi.org/10.1016/0304-3932(89)90006-8

Gupta, S., Kanpur, A., Papageorgiou, C., Wane, A. (2014). Efficiency-adjusted public capital and growth. *World Development,* 57, pp. 164-178 https://doi.org/10.1016/j.worlddev.2013.11.012

Hatano, T. (2010). Crowding-in effect of public investment on private investment. *Public Policy Review, 6*(1), pp. 105-120

Hye, Q. A. M., (2012). Long term effect of trade openness on economic growth in case of Pakistan. *Quality and Quantity* 46 (4), pp. 1137–1149 https://doi.org/10.1007/s11135-011-9612-0

Haque, S. (2013). Effect of public and private investment on economic growth in Bangladesh: an econometric analysis. *Research Study Series,* No-FDRS 05/2013, pp. 105-136

Jawaid, S. T., Raza, S. A. (2013). Effects of terms of trade on growth performance of India. *Economic Modelling*, 33, pp. 940-946 https://doi.org/10.1016/j.econmod.2013.04.043

Khan, M. S., Kumar, M. S. (1997). Public and private investment and the growth process in developing countries. *Oxford Bulletin of Economics and Statistics*, *59*(1), pp. 69-88, https://doi.org/10.1111/1468-0084.00050

Khan, M. S., Reinhart, C. M. (1990). Private investment and economic growth in developing countries. *World Development*, *18*(1), pp. 19-27, https://doi.org/10.1016/0305-750X(90)90100-C

Khan, A. H. (1988). Macroeconomic policy and private investment in Pakistan. *The Pakistan Development Review*, 27 (3), pp. 277-291, Retrieved from https://www.jstor.org/stable/41259048?seq=1

Kormendi, R. C., Meguire, P. G. (1985). Macroeconomic determinants of growth: cross-country evidence. *Journal of Monetary Economics*, *16*(2), pp. 141-163, https://doi.org/10.1016/0304-3932(85)90027-3

Kollamparambil, U., Nicolaou, M. (2011). Nature and association of public and private investment: Public policy implications for South Africa. *Journal of Economics and International Finance,* 3(2), pp. 98

Lachler, U., Aschauer, D. A. (1998). *Public investment and economic growth in Mexico* (No. 1964). Policy Research Working Paper Series 1964, The World Bank, Washington DC., Retrieved from http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/1998/11/17/000009265_3981005112610/Rendered/PDF/multi0page.pdf

Looney, R. E., Frederiksen, P. C. (1995). Privatization of Public Sector Enterprises in Pakistan: Prospects for Reducing Regional Imbalances. *Review of Urban & Regional Development Studies*, *7*(2), pp. 143-152, https://doi.org/10.1111/j.1467-940X.1995.tb00067.x

Looney, R. E., Frederiiksen, P. C. (1997). Government Investment and Follow-on Private Sector Investment in Pakistan. *Journal of Economic Development* 22 (1), pp. 91-100, Retrieved from http://faculty.nps.edu/relooney/RelPcfJED.pdf

Lucas, R. E. (1998). On the mechanics of economic development. *Econometric Society Monographs*, *29*, pp. 61-70, https://doi.org/10.1016/0304-3932(88)90168-7

Ntembe, A., Amin, A. A., Tawah, R. (2017). Analysis of public investments and economic growth in Cameroon. *Journal of Economics and Finance*, 42, 1-24. https://doi.org/10.1007/s12197-017-9411-0

Pesaran, M. H., Shin, Y. (1999). An autoregressive distributed Lag-Modelling approaches to Cointegration analysis. *Econometrics and economic theory in the 20th century: the Ragnar Frisch centennial symposium.* Strom S. Cambridge University Press, Cambridge

Pesaran, M. H., Shin, Y., Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), pp. 289-326, https://doi.org/10.1002/jae.616

Rahman, M., Islam, A. M., Banerjee, P. K. (2016). Public versus private investment in economic growth of Bangladesh: an econometric analysis. *International Journal of Trade and Global Markets, 9*(3), pp. 228-248, https://doi.org/10.1504/ijtgm.2016.077851

Ramireez M. D. (2009). Does public investment enhance labor productivity growth in Argentina? A Cointegration analysis. *Economics Department Working Paper,* No. 57, Yale University, Retrieved from http://economics.yale.edu/sites/default/files/files/Working-Papers/wp000/ddp0057.pdf

Raza, S. A., Jawaid, S. T. (2013). Terrorism and tourism: a conjunction and ramification in Pakistan. *Economic Modelling,* 33, pp. 65–70, https://doi.org/10.1016/j.econmod.2013.03.008

Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, *94*(5), pp. 1002-1037, https://doi.org/10.1086/261420

Samaké, I., Muthoora, M. P. S., Versailles, M. B. (2013). Fiscal Sustainability, Public Investment, and Growth in Natural Resource-Rich, Low-Income Countries: The Case of Cameroon, WP/13/144, International Monetary Fund

Shahbaz, M., Islam, F., Aamir, N., (2012). Is devaluation contractionary? Empirical evidence for Pakistan. *Economic Change and Restructuring,* 45, pp. 299–316, https://doi.org/10.1007/s10644-011-9119-7

Serven, L., Solimano, A. (1992). Private investment and macroeconomic adjustment: A survey. *The World Bank Research Observer*, *7*(1), pp. 95-114, https://doi.org/10.1093/wbro/7.1.95

Swaby, R. (2007). *Public investment and growth in Jamaica*, Fiscal and Economic Programme Monitoring Department, Bank of Jamaica

Tabova, A., Baker, C. (2011). Determinants of non-oil growth in the FRA-zone oil producing countries: how do they differ? *IMF Working Paper-African Department,* Washington DC.

Toda, H. Y., Yamamoto, T., (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics* 66, pp. 225–250, https://doi.org/10.1016/0304-4076(94)01616-8

To, T. T. (2011). Public investment "crowds out" private investment? A look from experimental model of VECM. *Magazine of Finance*, 6(560), pp. 49-62

Warner A (2014). Public investment as an engine of growth. *International Monetary Fund Working Papers*, 14(148). International Monetary Fund, Washington DC.

Wong, H. T., (2010). Terms of trade and economic growth in Japan and Korea: an empirical analysis. *Empirical Economics* 38, pp. 139–158, https://doi.org/10.1007/s00181-009-0259-9

Ministry of Finance (2016). *Pakistan Economic Survey 2016-17*, Ministry of Finance, Government of Pakistan. Retrieved from http://www.finance.gov.pk/survey_1617.html