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Research Article

Pakistan's Infrastructure Capital-Growth Analysis

Muhammad Ahmad Mazher [1*], Jauhari Dahalan [2]

[1,2] Business School, University Kuala Lumpur, Malaysia
* Corresponding author: muhammad.mazher@s.unikl.edu.my

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Abstract

Purpose- This empirical study facet at Pakistan for the period between 1960 and 2017 in the connection between public investment, public capital stock, private investment, private capital stock, and real GDP.

Design/Methodology- Using theoretical and empirical literature assessment, to measure the impact of private investment, private capital stock, government investment, and government capital stock on Pakistan's real gross domestic product, we involved the ARDL Bound tests.

Findings- A positive and significant connection was revealed between government investment, a private capital stock with real GDP. Private investment showed a substantial but negative impact in the short run, despite capital stocks indicating a positive and insignificant relationship with Pakistan's RGDP. The long-term consequences showed that the government's capital stocks, public investment, private capital stocks, and RGDP from Pakistan are linked positively and significantly. Private investment, however, has shown harmful and detrimental or insignificant relations with Pakistan's RGDP.

Practical Implications- Our study may benefit the Pakistani economy, particularly while useful for academics and researchers to understand the basic concept of 'capital-growth' philosophy.

Introduction

The economy of Pakistan is inadequate for long periods to enable faster and high economic growth rates. The economy is experiencing a payment balance problem every few years, though continuing to expand rapidly. This is different from several influential peer countries that evolve for an extended timeframe at higher rates. This inability to sustain growth had been encouraged for Pakistan's aspirations to convert into such a middle-income economy. Why is Pakistan experiencing this boom and busts phenomenon very often? This short-term rise is expected to continue as it is influenced not by increasing consumption spending but by private and public investment.

Consequently, demand in this country grows much more quickly than its availability of products and services, leading to a need for more unsustainable imports. Successive governments have attempted to accelerate prosperity, but they have all ended up with a payment balance crisis. Pakistan is insufficiently growing, and its investment share in GDP is one of the world's weakest at 15%, approximately half of Southern Asia's 30% share. This means insufficient housing, lack of access to enough water and electricity, low quality of schools and hospitals.

Private investment has declined as a share of GDP and is below 10% in Financial Year 2018. The low investment trap and deteriorating productivity of labor also restricted Pakistan's capacity for expansion and prosperity. The reduction in the economic growth capacity is particularly meaningful because it indicates that the economy cannot grow at higher rates enough to generate employment. Pakistan required many changes in several ways to improve labor efficiency and capital accumulation to overcome these problems. The aim is to sustain macroeconomic stability in Pakistan. Persistent macroeconomic stability has hindered the country's savings and private investment, contributing to low output levels and fluctuating productivity. The fact that the country has a weak and diminishing share in the overall global investment stream remains a primary cause for low foreign investment in Pakistan. Fiscal fluctuations and quasi-fixed exchange-rate regimes have caused substantial economic disruption (Waheed & Ghumman, 2019).

However, empirical studies on economic growth and related factors are carried out far earlier aggressively; attention is given later to the infrastructure's influence on economic growth. The survey related to these challenges, however, rapidly becomes a different category. Instinctively, infrastructure is essential for economic development; a lot of effort is dedicated to this dilemma, although few have sought to establish its theoretical context. Since the 1980s, the relationship between infrastructure and economic growth was being studied extensively. After multiple reports and contextual-studies, the scene appears unclear. This is partially attributed to the apparent complexity of the studies undertaken thus far: infrastructure and development were measured in many ways; they focused on various phases and geographic regions and used differentiated econometric methods. However, such apparent inconsistencies do not reflect the heterogeneity of all empirical results. Previous research has shown very contradictory interpretations. As a result, some observers conclude that every infrastructure project is intrinsically different and that it becomes difficult to forecast the overall growth effect.

Many have already argued that pivot study results in macro-econometric infrastructure and development, but their reliability in decision-making is relatively low, not only because they require evidence. The term "infrastructure" derives from the Latin terms "infra" under, and "struktura" means a structured mechanism (that may also indicate under-structure either background). In the early 20th century, the term 'infrastructure' described the framework of structures that supported the armed forces movement beyond the front-line of battle (substances, weapons depots, military bases, polygons, units that demolished barriers and constructed bridges as the leading army moved). This terminology became popular during the 1940s in Western economics and subsequently on in much other literature and suggested areas of the economy supporting agriculture and industry (Ragnar, 1961). Instituting colleges, hospitals, accessible housing, and other social infrastructures

encourages public involvement in providing essential government infrastructure. The provision of economic infrastructure structures (e.g., airports, seaports, telecommunications, transport, and power generation and transmission systems) also connects individuals and companies to economic infrastructure resources. The provision of social and economic infrastructure would serve as a significant catalyst for sustainable growth. The significant positive relationship between investing in high-quality public infrastructure and development across the economy is demonstrated by a broad range of analytical and empirical methods. Based on the advanced economies' sample, IMF projections in October 2014 will raise investment output by 1 % of GDP by about 0.4% in the same year and by 1.5% in the coming four years (Queyranne et al., 2019). There are two dimensions of infrastructure comprise of "capitalness" and "publicness" according to (Fourie, 2006).

Therefore, it refers to assets that have an important but not strictly social value. It categorized the valuation degree infrastructure intensity and social significance. Therefore, infrastructure can include capital-intensive facilities, not of public interest. Even so, most of the infrastructure is being used by the public voluntarily. Economists refer to physical frameworks or infrastructure capital. Academic evidence analyses the role of infrastructure through physical infrastructure capital services. For all household and sustainable development levels, infrastructure resources such as electricity, transportation, telecommunications, water supply, sanitation, and waste disposal are essential. It is also recognize that infrastructure is a long-term, partially attached, capital-intensive assets with such a long lifespan (Prud'homme, 2005) and (Baldwin & Dixon, 2008). The investment return time might be somewhat consistent with a "market collapse" (a situation under which the economic climate crashes and economic efficiency is not achieved).

An awareness of the impact of government investment on growth is necessary for at least three dimensions. First, strict budgets have been proposed for decreasing public investment instead of current expenditure, as it is easier to eliminate the former ones for political and other concerns (Roy et al., 2006). Since the 1990s, the search has led to a remedy of the public investment tendencies, especially in infrastructure, and 'fiscal zones' to fund such spending (Heller, 2005). Belief inefficient public investment underlies this presumption. Second, it was stated in a very similar way that foreign borrowing constraints prevented governments from making significant investments with major "infrastructure gaps." While debt-funded government spending commitments to growth and exportation are often of considerable significance in foreign borrowing constraints since a country's borrowing capacity depends mainly on its macroeconomic policy, tax revenues, and the efficacy of its public finance, and debt management. Finally, as noted by the recent financial crisis, fiscal policy plays a counter-cyclical part in strengthening balanced growth and development. In several countries, fiscal stimulus initiatives have produced a significant portion of public investment spending, intended to be safer and more effective for continued development.

Economic growth has increased in South Asia over the last decade. Meanwhile, it has also built its infrastructure. Approximately one-fourth of the global population lives in South Asia, where too many people already live below the poverty line. Even so, income inequality in South Asia has increased significantly since the 1990s. Pakistan is a crucial country in the South Asian region, which is serving abundant problems. However, our analysis is intended to address the question: What effect does the infrastructure stock have on Pakistan's economic growth?

The current study is intended to evaluate infrastructure capital's function in economic growth in various institutional efficiency levels. In that sense, structural performance may be treated as a soft component of influencing growth trends, while infrastructural capital is perceived as a physical core. Therefore, the study's initial contribution is to reform through a new database that includes numerous alternative indicators such as general government investment, general government capital stock, private investment, and private capital stock for both dimensions, the collective impact of capital infrastructure organizational performance. In the era 1960–2017, we use a balanced data-set of the Pakistan economy.

Literature Review

Gross fixed capital investments and capital transfer is actively engaged in government investment. It mostly concerns road infrastructure and infrastructure, including buildings for offices, houses, hospitals, and schools. Transfers of capital are government-paying investment grants and other transfers of capital. Total investment contributes to a holistic economy's investment expenditure, comprising government, financial companies, businesses, and nonprofit organizations (OECD, 2011). Public capital is the collective asset grouping of government resources used as a catalyst for economic growth (Aschauer, 1990). Such assets include a vast array of services, including roads, airports, bridges, trains, and transport systems; local and regional elements, including public education, public hospitals, police, and fire safety, jail and court of justice; and critical components, including water and sanitation, gas and power supplies and mobile telecommunications (Tatam, 1993). The government's initial investments and expenditures, resources, and infrastructure terms are most often defined as a physical stock of public capital. One of the most traditional macroeconomic research initiatives is the implications of available capital investment on sustainable economic growth. While numerous researchers explore this feasibility, it has also been observed that the relationship between infrastructure investment and economic growth was already statistically positive (Aschauer, 1990).

The economist David Alan Aschauer from the Federal Reserve said that an increase of 1% in public capital stock leads to an increase of 0.4% in the overall factor productivity (Haan et al., 2007). Review of the real GDP growth rates of the OECD and non-OECD economies, with explanatory variable government capital from 1960 to 2000 (not using public investment), rises in government capital stocks were related to improvements in growth (Arslanalp et al., 2010). Consequently, this connection is focused on the initial levels of government capital and income in the country. In the short term, the OECD countries have a stronger positive relationship, while non-OECD countries have a stronger positive relationship in the longer term. To endowment high-prospect investment in public capital, developing countries can advantage even from non-concessional public debt (Arslanalp et al., 2010). Private investment, macro-economically speaking, is a purchase from a financial facility to produce income, accumulate value, or generate and appreciate revenue. A property is a capital asset that is not quickly sold and usually acquired by an investor for profit – for instance, land, buildings, equipment, and machinery are capital assets.

Private capital is money provided as debt or capital investment by an external source such as a bank, a governmental entity, or stock sales on an exchange. Nevertheless, in a cluster of 30 countries in the Latin American Caribbean, the relationship between government capital stock, private capital stock, and economic progress was attributed from 1970 through 2014 (Santiago et al., 2020). Researchers estimate that both public and private capital stock positively impact our reporting countries' long-term economic development. However, the findings also show that short-term private capital continues to dominate public capital, which is one reason why government capital stocks are harming growth.

The study focused on Pakistan's overall and sectorial-level link between infrastructure investment and economic growth from 1972 to 2015. The study's main finding is that both government and private infrastructure investments have a positive but distinct economic development effect (Javid, 2019). This means that the marginal efficiency of private and public investment in all economic sectors varies. In most cases, public infrastructure investments have more impact than private infrastructure investments on economic growth. The research examines two significant consequences: (1) the policymakers can quantify the effect of policies targeted at the sector by using various elasticity estimates and, (2) the government intends to establish a political culture that can systemically encourage private investment. The framework of the private sector in infrastructure provision will lead to a difficult fiscal situation.

However, there is mixed empirical evidence of the impacts of public investment on growth. Preliminary findings have not documented clear findings regarding public investment growth factors (IMF, 2005b, 2004). There have also been claims that public investment is not successful. Some even concluded that the total factor productivity is required to understand growth variations instead of capital accumulation (Easterly et al., 2001). At around the same time, more the study concluded that there were significant growth outcomes for general public investment and infrastructure, education, and health expenses in particular (World Bank, 2007). The (Commission on Growth and Development, 2008) has sought to provide a much broader view of how massive public investment - 7% or more of GDP in fast-growing countries is possible. Other authors comprise Perotti & Roberto (2005) and Zand & Mark (2008) also claim that multipliers of fiscal expenses are significantly greater than multipliers of public expenditure or tax reductions.

According to Mohmand et al. (2017), there seems to be no systematic analysis of the contributions to economic growth in the existing literature of infrastructure investment. Current studies are associated with particular aspects of transport infrastructure. A limited number of physical infrastructure measurement metrics have been included in many other analyses, e.g., electricity use, paved roads, telecommunications networks, rail coverage, air transport, etc., especially in transport, energy and ICT sectors, while other infrastructure aspects were neglected and policy concerns have not been specific (Sahoo & Dash, 2009, 2012). In addition, the infrastructure component is primarily driven by quality of road, rail infrastructure, airport infrastructure, supply of electricity and institutional growth which is greater than the recorded national competition (Palei, 2015). The principal structural trap that restricts national economic growth has been revealed. These findings help us understand critical factors that affect economic growth, identify what infrastructure factors allow income levels to increase, and provide a valuable way for policymakers and managers to introduce better economic initiatives and structural reforms. Researchers examine the mutual effects of infrastructure capital and institutional efficiency on economic growth in a huge panel of data from 99 countries over 1980–2015. The effects of the relationship between capital and institutional quality suggest that economic growth has a positive and significant impression. These results are stable in numerous alternative strategies and institutional quality controls. Consequently, observations indicate that it is essential to enhance institutional efficiency to maximize infrastructure capital returns (Zergawu et al., 2020).

To accurate imperfections in the previous study, the recent analysis considers a more robust infrastructure framework consisting of 30 indicators for transport, electricity, ICT, and finance infrastructure. The method also uses the recently developed PMG (Pooled Mean Group) method, which could provide a detailed overview of the expansion hypothesis powered by infrastructure. The phenomenon of infrastructure-led growth is, however, tested by scholars using infrastructure sub-indications. The PMG projections are higher than the Fixed Effect (FE) results because they are strongly endogenous (Menegaki, 2019). South Asia is one of the fastest-growing regions worldwide owing to growth in recent years. In South Asian countries, policy reforms have given economic growth an impetus. In India, Nepal, Sri Lanka, and Bangladesh throughout the 1990s, the structural reforms brought economic growth. But Pakistan does not achieve the desired growth goals because of political complexities, socio-economic turmoil, and political unrest (Rehman et al., 2020).

Infrastructure has been demonstrated in various ways to impact a country's economic output. The multi-factor efficiency and penetration of income sustained development and economic growth in any economy (Calderon & Serven, 2008; Esfahani & Ramirez, 2003; Mas et al., 1996; Paul, 2003; Pereira & Andraz, 2013). Economic infrastructure contributes to economic potential and prosperity.

Research Methodology

To analyze the influence of infrastructure capital on Pakistan's economic growth, we comprehensively comprise government general public investment, government general capital stock, private investment, and private capital

stock. The data collected from the International Monetary Fund (IMF) Fiscal Affairs Department over the period 1960-2017. In the neoclassical growth model, empirical studies use the mainstream function of Cobb-Douglas output as a source of input. Input infrastructure promotes labor and resources in the manufacturing process. We use augmented Cobb-Douglas production features for this purpose. Cobb-Douglas has two proposed factors, comprise labor and capital, used in production and growth purposes. Accumulation infrastructure in the Cobb-Douglas production feature will boost all economic activities. Performance and productivity can be increased by having adequate public infrastructure. Therefore, with adequate infrastructure, productivity, or efficiency increases. The above function has different interpretations and perspectives. From the neoclassical growth model's perspective, as Solow (1956) in his model claimed, there is a constant return to scale. He concludes that infrastructure shocks demonstrate exogenous and short-run economic growth shocks. Long-term influence, however, is only due to technology. Infrastructure investment has a short-term impact on aggregated demand and a long-term impact on the aggregate supply of accumulated capital, while Infrastructure investment is like all investments. Standardized aggregate growth can be described as concentrating on the long-term impact;

$Y = f(A, L, K)$ ……..(i)

Y represents aggregate output, L and K representing labor and capital, respectively, and A showing total factor productivity. When the infrastructure is deliberated as a distinctive production input in a Cobb-Douglas aggregate production meaning and GI represents government investment, GCS as government capital stock, PI as private investment, and PCS as the private capital stock, we get:

$$Y = A\,(GI)^{\emptyset}\,(GCS)^{\varphi}(PI)^{\psi}(PCS)^{\pi} \quad \text{……(ii)}$$

Where Y representing the country growth (GDP), Ø, φ, **ψ**, and **π** representing the efficiencies of government investment, government capital stock, private investment, and private capital stock correspondingly. By taking the natural log of the equation, we get;

$$\ln Y = a + \emptyset\, ln\,(GI) + \varphi\, ln\,(GCS) + \psi\, ln\,(PI) + \pi\, ln\,(PCS) + \varepsilon \quad \text{…….(iii)}$$

Where 'ε' is error-term.

Estimations and Results Discussions

The unit root test is used to evaluate time-series hypotheses in a time series integrative of order one, as mentioned by (Phillips & Perron, 1988). It was established on the null hypothesis of the Dickey-Fuller test $\rho = 1$ in $\Delta y_t = (\rho - 1)y_{t-1} + \mu_t$ where Δ signifies the 1st difference operative.

Table 1 - Unit-root Results by Phillips-Perron Test

Variable	I(0)	I(1)
Govt. Capital Stock	0.0196	-
Govt. Investment	0.5002	0.0000
Private Capital Stock	0.0115	-
Private Investment	0.2850	0.0000
Real Gross Domestic Product	0.0000	-

An econometric technique developed by (Pesaran et al., 2001) for evaluating long-term relationships between variables is ARDL bound testing technique. This approach has many benefits over conventional research for cointegration, a relatively new method. First of all, I(0) or I(1) is used in the sequence. Second, a linear transition will lead to the unrestricted error correction model (UECM) from the ARDL boundary test. This model has

short- and long-term consequences. Third, observational findings suggest the method is superior, producing reliable results for small samples. The sequence of ARDL measures is continuing to investigate: (a) stationary, (b) cointegration/test bound test, (c) error-correction model and bound test, and last but not least (c) long-run relationship, and (d) diagnostic tests comprise normality, autocorrelation, heterosexuality, CUSUM and CUSUM square test. There are other ways to continue with the statistical inference except for the first two stages, but this is achieved under other analytical frameworks.

Table 2 - Lag-length Criteria and Johanson Cointegration Conclusions

Lag	AIC	SC
0	-19.52120	-19.33703
1	-41.60698	-40.50199
2	-43.26320	-41.23739
3	-43.30134	-40.35470
4	-43.50507	-39.63760
Johansen Cointegration Test Results		
Three Cointegration equations are demonstrated in the Trace test.		
The Max-eigenvalue analysis of three cointegration equations.		

Table 2 describing the results of lag length criteria through AIC and SC methods. SC method leads to lag-length as 2 while AIC exposing 4 as lag length criteria. In cooperation, 'Trace' and 'Max-eigenvalue' systems for the Johansen cointegration test revealing three vital cointegration equations at a 5% level of significance.

Table 3 - ECM and Bound Test

ECM Regression Results			
Variable	Coefficient	t-statistics	Prob.
CointEq(-1)	-0.131776	-19.49076	0.0000
F-Bound Test			
Test Statistics	Value	Level of Sign.	I(0) / I(1)
F-statistics	57.55903	5%	2.56/3.49

Negative but significant coefficient value (-0.131776) of CointEq(-1) in Table 3 leading that the economy of Pakistan moving toward the equilibrium position. In contrast, the F-statistic value 57.55903 more than the upper and lower limits at 5% level of significance snapshot that very strong cointegration exists among the variables.

Table 4 - ARDL Long-run and Short-run

ARDL Short-run and Long-run Results			
Variable	Co-efficient	t-statistics	Prob.
Govt. Capital Stock	0.081946	1.970972	0.0543
Govt. Investment	0.010033	2.472913	0.0168
Private capital Stock	0.133773	2.824829	0.0068
Private investment	-0.053149	-2.284921	0.0266
ARDL Short-run and Long-run Results			
Variable	Co-efficient	t-statistics	Prob.
Govt. Capital Stock	0.621853	2.218332	0.0311
Govt. Investment	0.076137	2.492970	0.0160
Private capital Stock	1.015154	4.651551	0.0000
Private investment	-0.403326	-1.727762	0.0902

According to table 4, under the short-run period, government investments and private capital stocks showing a positive and significant while private investment revealed a negative but significant relationship with the RGDP of Pakistan. The government capital stock has a positive but insignificant relationship with RGDP in Pakistan over 1960-2017. Under the long-run period, government capital stock, government investment, and private capital stock revealed a positive and significant impact on the RGDP of Pakistan. In contrast, private investment revealed a negative and insignificant relationship with the RGDP of Pakistan. The estimated equation of our model can be written as;

$$RGDP = 0.5788+0.076(GI)+0.6218(GCS)-0.4033(PI)+1.0151(PCS)+Error\ term$$

Table 5 - Serial Correlation LM and Heteroscedasticity Results

Serial Correlation LM Results – Breusch Goldfrey Method	
Obs-R^2	Prob. Chi-sq
6.766212	0.1488
Heteroscedasticity Test – Harvey Method	
Obs-R^2	Prob. Chi-sq
3.8429	0.6979

The estimated Serial correlation LM value of probability (0.1488) is more than 5% leads that there is no serial correlation problem in our analysis. While the probability value (0.6979) is also more than 5% for Heteroscedasticity, revealing the absence of a hetero problem in our studied data.

Diagram 'A' showing the graph of a histogram in which probability value 0.8311 is more than a 5% level of significance leads to fulfilling the condition of normality. Hence, our data is usually distributed.

Diagram 'B' showing the model fitness. If the estimated line (blue line) remains inside the upper and lower limits (red line), direct and verify that the estimated model is fit and robust.

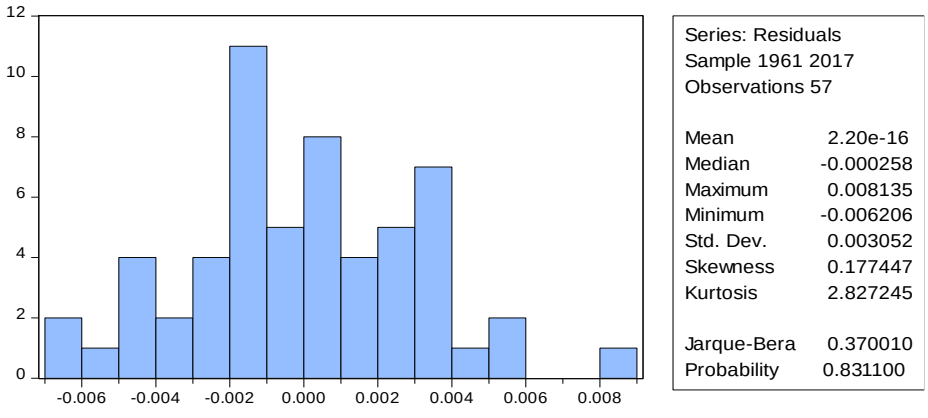

Figure 1 - Diagram –A (Normality test)

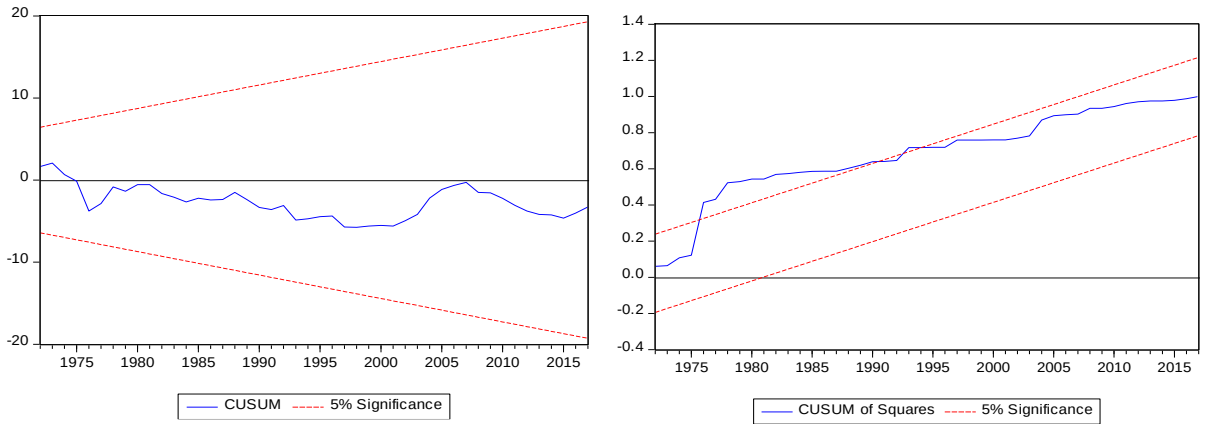

Figure 2 - Diagram –B (CUSUM and CUSUM Square Tests)

This research aimed to analyze empirical relationships for Pakistan's economy from 1960 to 2017 between government investment, government capital stocks, private investments, private capital stocks, and real gross domestic product. This study revealed the infrastructure capital relationship with RGDP of the economy, with a significant contribution to the new economic variables such as private and government capital stock and investment concerning Pakistan's real gross domestic product with a large sample size of 58 years' annual time-series data. The empirical consequences snapshot the two states comprise the short-run and long-run. Under the short-run period, government investments and private capital stocks showing a positive and significant while private investment revealed a negative but significant relationship with the RGDP of Pakistan. The government capital stock has a positive but insignificant relationship with RGDP in Pakistan over 1960-2017. On the other side, under the long-run period, government capital stock, government investment, and private capital stock revealed a positive and significant impact on the RGDP of Pakistan. In contrast, private investment revealed a negative and insignificant relationship with the RGDP of Pakistan. Hence, based on empirical consequences, when we increase by 1% in government capital stock, government investments, and private capital stock, Pakistan's real GDP will grow by 62.18%, 7.6%, and 101.51%, respectively.

Conclusion

The infrastructure of any country plays a vital role in its economic growth. The fundamental constituent which may participate comprises government investment, government capital stock, private investment, and private capital stock. The government and private sector conjointly accelerate the speed of growth. To analyze the impact and connection composed for the Pakistan economy, we combined both (government and private) sector's capital stocks and investments as self-determining variables. The result of government capital investment on sustainable growth is one of the most conventional macroeconomic research initiatives. Although some researchers examine the impacts of infrastructure investment and economic development, there are positive and statistically relevant correlations. Though numerous scholars have expressed the significance of this, reports have suggested that statistically positive connections between infrastructure investment and economic growth (Aschauer, 1990). The Federal Reserve economist David Alan Aschauer stated that a 1% rise in the public capital stock would increase 0.4% in total factor productivity (Haan et al., 2007). Arslanalp et al. (2010) indicate that available capital stock increases are connected with growth increases. According to Santiago et al. (2020), the relationship between public capital stock, private capital stock, and economic growth has become evident. The estimates indicate that both public and private capital stock positively affect long-term economic growth in our country surveyed. Empirical evidence on public investment's impacts on development,

however, is mixed. Initial studies on public investment's influence on growth have not reported consistent findings (IMF, 2005b, 2004). Some also argued that public investment is not efficient. Around the same period, the World Bank (2007) concluded that public investment in general and infrastructure, education, and health expenditures, in particular, have substantial growth results. The Commission on Growth and Development (2008) contributed to a much broader interpretation by stating that high public investment, identified as 7 % of GDP or more, is a popular component in fast-growing countries.

Our empirical consequences revealed a positive and significant relationship between government investment, private capital stock, and RGDP. Simultaneously, private investment showed a significant and negative, and capital stock exposed a positive and insignificant connection with RGDP in Pakistan under a short-run period. In the long-run period, government capital stock, government investment, and private capital stock revealed a positive and significant impact on the RGDP of Pakistan. In contrast, private investment revealed a negative and insignificant relationship with the RGDP of Pakistan. Hence, based on empirical consequences, when we increase by 1% in government capital stock, government investments, and private capital stock, Pakistan's real GDP will grow by 62.18%, 7.6%, and 101.51%, respectively. It is suggested that Pakistan's government must need to increase its capital stock both for public and private sectors while investing at the government level to enhance the RGDP of Pakistan. Private investment also needs to stimulate to attain the targeted motives of the economic growth of Pakistan.

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