Article

Impact of Road Transport Infrastructure on Economic Growth: Evidence from Afghanistan

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Mohibur-Rahman Mohib

Abstract

Infrastructure investment has long been held as an accelerator of the economy. Internationally, Afghanistan ranks poorly with infrastructure performance and ranks in the lower percentile for both infrastructure investment and GDP growth rate. The current study examines the impact of road transport infrastructure on economic growth and sectoral bias in the public expenditure in the provision of social services in Afghanistan. The ordinary least square regression method is employed by using time series data from 2005-2019. The results of the study are mixed. The association between road transport infrastructure and economic growth is robust, except for agriculture, energy, and health, due to the government's sectoral bias in public expenditure and allocation of the insufficient budget. Thus, it is inferred that road transport infrastructure investment leads to economic growth in Afghanistan. The study recommends a balanced budget to sectors related to economic growth and policy for public-private partnerships.

Keywords: *Afghanistan, Road Transport Infrastructure, Economic Growth, Public Expenditure*

Introduction

Infrastructure encompasses large investment-oriented natural monopolies. Natural monopolies can be separated into transport facilities and roads, water, sewer, and communication infrastructures (Gramlich., 1994). Infrastructure provides the support and services crucial for effective functioning and growth of society, community, organization, and country (Beeferman and Wain, 2013). Investment in Infrastructure and its development alleviates poverty (Haimin., 2010), denotes human development (Letsara and Saidi., 2013), and generates employment (Haimi., 2010). In addition, investment in infrastructure and its development produces regional competitiveness (Letsara and Saidi., 2013).

Many of the previous literature demonstrates that investment in infrastructure and expansion has positive, negative, and no relationship with economic growth. Several studies deliver evidence that investment in infrastructure has a significant and positive connection with economic growth (Aschauer, 1989, Calderon and Servén, 2004, Canning, 1998, Lau and Sin, 1997, Munnell., 1992). However, numerous studies

indicate an insignificant effect of infrastructure investment on economic growth (Holtz-Eakin and Schwartz, 1995; Garcia- Mila et al., 1996). Few studies question the strength and uniformity of the connection between infrastructure and economic growth (Gramlich.,1994, Fedderke and Bogetic, 2006). Few studies also find a bidirectional association between infrastructure and economic growth (Canning and Pedroni., 1999, and Perkins et al., 2005). We get the motivation to study the impact of infrastructure on economic growth as former studies' results were inconsistent regarding the impact of infrastructure on economic growth, and the results are not robust. We perceive the need to examine this relationship in Afghanistan at the individual country level by applying the time-series ordinary least square regression method.

It is noticed that few studies question the robustness and uniformity of the connection between investment in road infrastructure and economic growth. This study struggles to examine the impact of road infrastructure investment on economic growth in Afghanistan. Further to add, the study further introspects the existence of sectoral bias in the public spending between road transport infrastructure and the delivery of other social services in Afghanistan. No Past literature has analysed the effect of road infrastructure investment on economic growth in Afghanistan. Therefore, this study is novel and covers data from 2005-2019. The study uses time-series regression analysis to test the association between road infrastructure investment and economic growth.

2.Literature Review

2.1 Road Infrastructure Scenario of Afghanistan

Afghanistan is a landlocked country relying on ground transportation, thus reflecting its vitality and contribution to economic growth. Road infrastructure is the only transport mode across the country, serving 90 percent of Afghanistan’s travel and trade demand. Presupposing the only alternative to enhancing connectivity within the nation and neighbouring countries strongly contributes to regional integration. The four decades of civil war in Afghanistan have destroyed infrastructures in particularly the road transport infrastructure. Investment in road transport infrastructure is regarded as the foundation for economic growth. Road infrastructure is crucial for every country to enhance its economic growth. Modern and well-organized infrastructure sectors such as transport infrastructure (road, railway, and ports) are significant contributors to the contemporary economy’s success. An efficient transportation system can lead to more economic and social benefits to the emerging and advanced economies, improving market linkages, expand trade and regional integration, and providing the labor force with

employment and labor mobility. The road transport infrastructure provides agriculture products access to zonal and regional markets and connects the consumers' production source. The agriculture product producers' high demand is to have proper access to markets with less time and low transportation costs. Therefore, the road transport development programs aim to improve access to zonal, regional and international markets, expand trade, and create employment opportunities.

Since the establishment of the interim government of Afghanistan, many international donors invested in the transportation sectors of Afghanistan, for instance, USAID, World Bank, ADB, European Commission, Japan, Iran, India, and Pakistan. Since 2002, Afghanistan has initiated a significant program for developing its road infrastructure. Afghanistan's Road Network includes 3,300 km of regional highways, about 4,800 km of National Highways, 9,600 km of Provincial Roads, and 17,000 km of rural roads.

Regional highways foster regional trade and economic linkages between Afghanistan and neighbouring countries, Iran, Pakistan, Tajikistan, Uzbekistan, and Turkmenistan (ATSMP, 2017-2036). Unfortunately, the persistent conflict essentially destroyed the road network. Road transport infrastructure development affects time and safe transportation of goods and services to local, regional, and international markets. Additionally, it involves falling the transportation cost of local products to the mentioned markets, and reducing transportation means maintenance cost. Also, road transport infrastructure facilitates physical, social, and economic mobility among the economic zones. Based on this research, transportation infrastructure development is vital for Afghanistan's economic growth. The agriculture sector contributes 24 percent of Afghanistan's GDP, which is a significant portion compared to other industries, and exports these products.

Moreover, 76.5 per cent of the Afghanistan population lives in rural areas; agriculture provides 41 percent of employment for the labor force (ATSMP, 2017-2036). However, enhancements and linking rural products to the Afghanistan National Development Strategy (2013). Therefore, road transport infrastructure development positively impacts and strongly recommends rural product promotion and improvement.

In Afghanistan, many rural and remote areas are laid off from markets and public services. Thus, there are economic opportunities, which lock many Afghan households in low-productivity activities and poverty. Investment in primary and secondary rural roads positively affects private sector productivity, poverty reduction, school enrolment, access

to health services, and economic growth (ALCS.2016-2017). Since 2003, approximately 20,000 km of rural access roads, village-to-village, village-to-district centres have been constructed (ANDS, 2008-2013). The World Bank and Asian Development Bank suggested that road transport infrastructure development has a significant role in Afghanistan's economic growth by linking rural to regional and international markets, expanding trade and regional integration, and creating employment opportunities.

2.2 Road Transport and its Impact

Kalan (2017) a well-organized transportation scheme can achieve economic and social benefits to developing and developed economies. It improves market accessibility, increases production efficiency, and provides balanced regional economic growth. A well-equipped and interlink road transport network is a catalyst for national output growth, poverty alleviation in rural areas. Road connectivity has multiple positive effects on the overall economy, including international trunk roads and national, urban, and rural roads (Moyaki., 2015). The paved roads linking the country's point to point and connects city to city of the neighboring countries (JABU., 2015).

Nagi (2019) Road infrastructure development is positively connected with economic growth. It lowers the physical barrier by stimulating people and goods and services and advancing access to markets by reducing times and costs. It provides connectivity and facilitates market activities within the different economic hubs (Khumalo., 2018). The increase and decrease in transportation networks affect social and economic activities. It is understood in transportation, geography, and urban economy (Zepeda-Ortega., 2019). It is the mover of economic activities and determines the mobility of products and elements in geographical space by reducing transportation costs and the accessibility of the markets (Tong., 2019).

Road infrastructure is a substantial component of empowering the environment for economic growth. The enterprises need sound transport systems of rural roads to access markets for their goods and services (Lidri.,2015). Rural development is depending on secondary and territory roads development. Construction of a network of national roads to link rural districts with the provincial centres of economic growth. Afghanistan government and donors realized that rural road development is vital for access to markets (Assess, Transform & Reach Consulting., 2016). The ADB concentrated on improving rural roads and logistics centres for more producers and consumers to participate in national, regional, and global markets (ADB Annual Report, 2018).

Afghanistan government and donors realized that rural road development unwavering support is vital for enhanced job opportunities, health, and education services (Assess, Transform & Reach Consulting., 2016). Spending on road infrastructure reinforced multiple effects, economic aggregation, knowledge sharing, access to more suppliers, and larger labor markets (Tripathi et al., 2010). Road infrastructure assists production function by reducing production costs and expanding labor and capital productivity (Badada et al.,2019).

Road Transport infrastructure offers access to goods, services, and employment opportunities in the regions through the multiplier effect (Mohmand et al., 2017). It enhances adjacent areas' economic growth through the spill over effect conceded by urbanization, labor force, and regional openness (Hu et al.,2017). Furthermore, improved transport infrastructure results in easy labor and capital movement facilitation across regions through agglomeration effects (Shabani et al., 2018). Road network counts for more than 90 percent of the movement of people, goods, and services. It provides for a more enhanced labor division, increased productivity, structural change, greater competitiveness, growth in incomes, and higher employment (Oladipo., 2015). It facilitates labor and capital movement from underdeveloped to developed areas through agglomeration effects (Shabani et al., 2018).

Road infrastructure such as expressways can upsurge the speed and imrove domestic and international trade efficiency by lowering the transportation times and costs (Ng.,2019). It can link unconnected regions to trade and investment frameworks and access goods (Tripathi et al., 2010). It contributes to product improvement, attracts investment in the private, and enhances e-commerce (Badada et al.,2019).

Proper transportation infrastructure is the primary precondition for expanding trade. In Turkey, a transport policy primarily focused on road transportation, and the newly constructed railways' length decreased an average of 16 km per year (Badalyan et al.,2014). The transport and supporting infrastructure network is an engine for economic growth. The efficient transport system leads to an increase in international trade and stimulates economic growth. It shares approximately 6 per cent to 12 per cent of GDP (Lenz et al.,2019).

Transportation is essential for international trade and countries' development. In Europe, the most crucial mode of transportation was sea transport because of inadequate and non-existing land transportation infrastructures. According to the European Commission, road transportation became the primary transportation mode; it accounts for 45.3 per cent, according to European Commission (Andreev., 2015). Road transport infrastructure's sufficiency determines a country's

success, diversifies production, expands trade, reduces poverty, and improves environmental conditions. It bridges the gap and economic growth step by step with the road's capacity (Peter., 2015).

The BRI (Belt and Road Initiative) is a comprehensive development strategy, including coordination, policy, unimpeded trade, facilitate connectivity, and financial integration. Its primary goals are to encourage and enhancing regional and interregional connectivity and intranational trade. The transport infrastructure is a leading economic facilitator (Wang.,2020). Transportation infrastructure not only improves accessibility but also increases trade and investment opportunities to the unconnected regions (Mohmand et al.,2017).

The miracle growth of China is associated with the development of transportation infrastructure. In the last 40 years, China has practiced rapid economic growth and expanded its transport infrastructure network of roadways, expressways, railways, and high-speed rail. The highways and civil aviation promote trade and increase growth (Ke et al., 2020). Road transport infrastructure contributes to the economic growth of the region. It is the catalyst for regional economic growth and effects on the economy by enhancing trade and industrial expansion (Kauzen et al., 2020).

2.3 Effect of Road Infrastructure Investment on Economic Growth

The study applies a model from a pioneer study by Aschauer (1989) involving cumulative production technology to scrutinize the association between infrastructure and economic growth. Many studies test the connection between investment in infrastructure development and economic growth. Many literature reviews find a significant and positive link between infrastructure investment and economic growth. Aschauer (1989) claims that public infrastructure capital significantly influences cumulative total factor productivity. Munnell (1992) suggests that infrastructure investment has a positive and significant effect on output and growth. A similar study by Lau and Sin (1997) perceives that investment in infrastructure significantly influences output. Canning (1998) inspects 152 countries and takes a yearly compilation of physical infrastructure stocks from 1950 to 1995. He calculates that a considerable quantity of telephone mainlines per capita has a significant and positive impact on economic growth. Demetriades and Mamuneas (2000) find that infrastructure stimulates long-run growth. Calderon and Servén (2004) also indicate that infrastructure assets positively influence growth. Corong et al. (2013) analyse the impact of investment in public infrastructure on economic growth for the Philippines. The results demonstrate that a higher investment in public infrastructure positively and significantly affects real GDP. Brons et al. (2014), Canning and

Pedroni (2004), Leduc and Wilson (2012) suggest that there is a significant positive relationship between investment in road transport infrastructure and economic growth. Demetriades and Mamuneas (2000) indicate that infrastructure fosters long-term growth.

A Few studies perceive an insignificant association between transport infrastructure and economic growth. Holtz-Eakin and Schwartz (1995) analyse investment in transport infrastructure for the period of 1971 to 1986. The result shows that an increase in infrastructure investment rate has an insignificant influence on annual productivity growth. Garcia-Mila et al. (1996) noticed no indication of a significant and positive association between private output and public capital. Gramlich (1994) queries the strength of the relationship between investment in transport infrastructure and economic growth. He shows that the connection between investment in transport infrastructure and economic growth is negative and positive, contingent upon a case-to-case basis. Fedderke and Bogetic (2006) perceive that the association between transport infrastructure and growth is not solid and uncertain. Few of the studies examine the bidirectional relationship between infrastructure and economic growth. Canning and Pedroni (1999) take 67 countries from 1960 to 1990 and perform a Granger Causality Test (GCT). Their results show bidirectional causality among three different infrastructure variables and GDP by taking one variable at a time. Perkins et al. (2005) find a bidirectional association between investment in infrastructure and economic growth.

Table 1: Comparative Gap Analysis

Author and year	Variables used
Kalan. (2017)	Labor force, private capital stock, public capital stock, and highway capital stock
Tripathi et al. (2010)	GDP, labor force, gross private capital formation (GPTCF) and gross public capital formation, Length of all roads network
Badada et al. (2019)	Paved and unpaved road density (RD) measured in (km/1000 population), spending on road infrastructure, and GDP
Badalyan et al. (2014)	Investments in economic infrastructure (kilometres of paved road), roads and rail goods transported (million ton-km), roads and rail passengers carried (million passenger-km), roads and rail network length (km), and gross domestic capital formation (GCF)
Lenz et al. (2019)	Economic Growth (EG), Population Growth (POP), Infrastructure Investment (GFCF), Trade Openness (OPEN), and real GDP
Hu et al. (2017).	Capital investment, labor force, capital investment, urbanization, regional openness, Road mileage, and GDP
Moyaki (2015).	Public spending on road infrastructure, Private spending on road infrastructure, Labour force, Agriculture public expenditure, Education public expenditure, Energy public expenditure, Health public expenditure, Structural & institutional dummies, and GDP
Andreev (2015)	Length of the highways, FDI inflows, Tax rate, Trade openness, and Corruption
Peter et al. (2015)	Capital utilization (CUR), Government expenditure on road transportation (GENOT) and Exchange Rate (EXCHR).

Shabani et al. (2018)	Transportation capital stock, Transportation investment, Density of railway and highway, Networks and Road and railway lengths
Wang et al. (2020)	Economic growth, Transport infrastructure (Road and Rail), Labor force, Urbanization level, Trade openness, and Physical capital.
Zepeda et al. (2019)	Geographical density interactive, Interactive dummy, Length and type of road (Toll and Toll-free), Business Entities, Road Density, Physical Investment, Length, and the number lanes, Capital stock, Employed workforce, Investment, and fixed assets, Gross production and GDP per capita

Source: Author's Compilation

Table 2.1 denotes that various researcher use different variables in their model. In the majority of the studies, few of the variables are common. The proposed model in this study derives from the variables applied by previous researchers. The proposed model is exclusive; the variables used in the model (trade openness and public expenditure on social services) are rarely used in past literature. As figured out in Table 2.1, it is noticed that the majority of the studies apply GDP, Real GDP, and GDP growth rate as a proxy for economic growth (Tripathi et al. 2010, Badada et al. 2019, Lenz et al. 2019, Hu et al. 2017, Moyaki., 2015, and Zepeda et al.,2019). Few studies use tax rate, corruption, FDI, Exchange rate, and Physical capital. (Zepeda et al. 2019, Wang et al.2020, and Peter et al., 2015). Several studies use the labor force as an independent variable (Kalan. 2017, Tripathi et al. 2010, Hu et al. 2017, Moyaki.2015, and Wang et al., 2020). Few of the studies introduce private capital stock, public capital stock, and highway capital stocks (Kalan. 2017, and Tripathi et al.,2010) as independent variables. In comparison, some of the studies use urbanization level as an independent variable (Hu et al. 2017, and Wang et al.,2020). It is also noticed that some researchers apply public spending on road infrastructure as a proxy for transportation infrastructure investment (Badalyan et al. 2014, Badada et al. 2019, and Moyaki. ,2015). Lenz et al. (2019) use population growth as a control variable.

3. Theoretical Framework and Methodology

The foundation is based on Solow's neoclassical growth model of economic growth. The model outlines a connection between the country's total output and its aggregate inputs of production factors. Solow's model is based on the assumptions of constant capital-output ratio, no government intervention, full-employment at all times, regular labor force growth rate, and technology.

Solow's model assumes physical capital as the ideal measure of the capital in the economy. From the economic definition perspective, the road network is a capital good because it produces other goods and services by imposing mobility of goods and services within the economy. Therefore, given this scenario, the amount of capital stock within the economy will affect the economic growth rate. The road infrastructure

network is the part of the physical capital that affects economic growth. Therefore, this is the link between road infrastructure and economic growth portrayed by Solow's economic growth model.

3.1. Methodology

The overall objective of the study is to test the association between road infrastructure investment and economic growth. The study considers explanatory variables namely public spending on road infrastructure, labor force, agriculture public expenditure, public education expenditure, public energy expenditure, health public expenditure, trade openness, urbanization, and road usage. The variables used are secondary data. The dependent variable and independent variables used are taken from the World Bank database. Table 2 shows various indicators representing independent variables and the dependent variable in the model. Furthermore, this study uses ordinary least square (OLS) method to draw the analysis and estimation.

3.2. Variables, data, sample and empirical model

A model is having a unique set of the dependent variable and independent variables and also a unique set of indicators representing the dependent variable and independent variables. These dependent variables and independent variables and indicators for the dependent variable and independent variables are derived from previous literature. The scope of the study is limited to Afghanistan taking data for 16 years (2005–2019). Time series analysis is used to test the association between road infrastructure investment and economic growth. Time series analysis is applied to test the relationship. The study uses a unique indicator for the majority of variables (public spending on road infrastructure, labor force, agriculture public expenditure, public education expenditure, public energy expenditure, health public expenditure, trade openness, urbanization, and road usage). To Solow's model, we endogenize some variables that the model assumes to be exogenous. In this case, we use the physical capital and endogenize the human capital development, which is core in skills enhancement, increasing productivity. The linkage between various indicators is shown in equation (1):

Table 2: Variables and Indicators

Variables	Indicator's description	Indicators (Short form)
Economic growth	Gross domestic product current US$	GDP
Road Infrastructure	Government's spending on road infrastructure.	RDI
Labour force	Economy's labor force, number of employees at the year-end.	LF

Expenditure on the agriculture	This is the public sector expenditure on the agricultural sector.	AGR
Expenditure on the provision of primary social services	This is the public sector expenditure on the provision of other primary social services	OSS
Trade Openness	This is the trade openness among the regions, proportion of real import and export total to real GDP as a trade openness alternative variable	TOP
Urbanization Level	Level of urbanization growth. It is the proportion of urban population to total population indicates the level of urbanization.	UL
Road Length	This is the road networks length	RN
Expenditure education	This is the public sector expenditure on the education sector	EDU
Expenditure energy sector	This is the public sector expenditure on the energy sector	ENE
Expenditure health sector	This is the public sector expenditure on the health sector	HEL

Source: World Bank Data

$$\text{Economic growth} = \alpha + \beta_1\, \text{roadInfrastructure}_{ps} + \beta_2 \text{laborforce} + \beta_3 \text{agricultureexpenditure}_{ps} + \beta_4\, \text{primarysocialservices}_{ps} + \beta_5 \text{tradeopeness} + \beta_6 \text{urbanisationlevel} + \beta_7 \text{roadlength} + \varepsilon t \quad \ldots\ldots\ldots\ldots (1)$$

Various indicators are taken for the dependent variable and independent variables [Equation (2) and (4)]. A broad description of variables and indicators is given in Table 2:

$$GDP = \alpha + \beta_1 RDI_{ps} + \beta_2 LF + \beta_3 AGR_{ps} + \beta_4 OSS_{ps} + \beta_5 TOP + \beta_6 UL + \beta_7 RN + \varepsilon t \ldots (2)$$

To further understand the effect of the expenditure on providing other primary social services, we decompose the social services into the main services, education, energy, and health sector expenditure. We further note that the expenditure figures used are the annual capital expenditures and not the recurrent spending. We, therefore, have the extended version of model 1 that contains the decomposed social services and the structural and institutional dummies and presented in model 2.

$$\text{Economic growth} = \alpha + \beta_1\, \text{roadInfrastructure}_{ps} + \beta_2 \text{laborforce} + \beta_3 \text{agricultureexpenditure}_{ps} + \beta_4\, \text{expenditureeducation}_{ps} + \beta_5\, \text{expenditureenergysector} + \beta_6 \text{expenditurehealthsector} + \beta_5 \text{tradeopeness} + \beta_6 \text{urbanisationlevel} + \beta_7 \text{roadlength} + \varepsilon t \quad \ldots\ldots\ldots\ldots (3)$$

$$GDP = \alpha + \beta_1 RDI_{ps} + \beta_2 LF + \beta_3 AGR_{ps} + \beta_4 EDU_{ps} + \beta_5 ENE_{ps} + \beta_6 HELps + \beta_7 TOP + \beta_8 UL + \beta_9 RN + \varepsilon t \ldots\ldots (4)$$

Regarding equations (3) and (4), it is observed that α is constant. ß1, ß2, ß3, ß4, ß5, ß6, ß7, ß8 and ß9 are coefficients of independent variables. Various indicators are used for representing variables. ε_t is an error term.

3.3. Operationalisation of Variables

Table 3: Instrumentation and Operationalisation of Variables

Variable	Definition	Measurement	Adapted from	Expected Sign
GDP	This is the total market value of all goods and services produced in an economy for a period of one year.	*GDP* *GDP = C + G + I + NX* C=consumption G=government spending; I=investment; and NX=net exports	Moyaki (2015), Wang, et al (2020), and *Lenz et al (2019)*	
RDI	This is the government's spending on road infrastructure. It is mainly the annual budgetary allocation by the government, which goes into the provision of road infrastructure.	Total government expenditure (US Dollar) on Road transport Infrastructure at the end of fiscal year	Moyaki (2015), Badada et al. (2019), Khumalo (2018) and Peter et al. (2015).	Positive
LF	It is the economy's labor force. We measure this by the working-age population, which will be a proxy of the labor force/input.	Number of employees at the year-end	Hu et al., & Luo., 2017, and Wang., et al. 2020.	Positive
AGR	This is the public sector expenditure on the agricultural sector, which is considered the largest component of Afghanistan's economy.	Total government Spending (US Dollar) on Agriculture sector at the end of fiscal year	Moyaki (2015)	Positive
OSS	This is the public sector expenditure on the provision of other major social services.	Total government Spending (US Dollar) on social services (education, health, and energy) sector at the end of fiscal year	Moyaki (2015)	Positive/Negative

4. Empirical Results

In this section, we report the empirical results based on time series data for Afghanistan over the period 2005-2019. Normality test is conducted to verify if the error term is normally distributed. The variables are tested for unit root to see stationarity and non-stationarity. The unit root test is executed to determine the level at which each variable is stationary or determine the integration order. The Augmented Dickey-Fuller (ADF) test is used to test for the existence or absence of a unit root. A co-integration test is carried out in case of non-stationary of the series to derive long-run relationships. The test for unit root and differencing is performed to avoid spurious and consistent regression results. Regressors are confirmed for problems of multicollinearity, evidenced by a very high coefficient of determination (R^2) on estimating the model. Thus, before evaluating the empirical model, performing a correlation matrix among all variables of the model.

A high correlation coefficient between any two variables was enough to conclude that the two variables are highly correlated, thus justifying the elimination of one of the two variables out of the model. The estimation technique used in this research is the Ordinary Least Squares (OLS); performed with the help of EViews package. It is applied to the time-series or annual data to estimate the regression line. The study used both the error correction model (ECM) and co-integration to identify the long-run and short-run equilibrium relationship. In addition, a causality test was conducted, among other tests such as heteroskedasticity and normality tests that catered for proper model specification and reliability of the results. For objective one, the empirical model was regressed, and the respective coefficients were discussed and after this, tested the hypotheses on the significance of the specific objectives to find out whether the individual independent variables are significant in determining growth or not. In addition, the joint test for all the variables was carried out to determine whether all the variables jointly influence economic growth or not. For the second objective, a constructed a correlation matrix for all the variables of the model. In addition, the correlation coefficient among these variables was conducted to determine their correlation. The quantitative method is adopted to investigate the long-run relationship between road transport infrastructure development and economic growth. The OLS model states that economic growth is a function of road transportation in GDP, market linkage, trade expansion, and employment opportunities. The secondary data is used on public spending on road infrastructure, Labor force, agriculture public expenditure, public education expenditure, public energy expenditure, health public expenditure, trade openness, urbanization level, road density, and road networks.

4.1. Pre- estimation Tests

Table 4.1 represents the descriptive statistics for the variables. It includes the mean values, maximum and minimum values, variance and standard deviation values, skewness, and kurtosis values of the variables.

Table 4.1 Descriptive Statistics

	GDP	RDIps	AGRps	EDUps	ENRps	HELps	RN	LF	UL	TO
Mean	1.56	2.61	6819	7.17	1.53	1.66	2.62	1.25	7.65	5.31
Median	1.80	2.63	4515	7.22	9.63	1.41	2.21	1.23	7.54	4.97
Maximum	2.06	3.94	1.43	1.57	3.39	2.63	4.93	1.53	9.81	8.73
Minimum	6.21	1.98	2283	2.14	5.22	9.84	0.05	1.05	5.82	3.05
Std. Dev.	5.11	0.50	4235	4.03	1.15	5.20	1.46	1.64	1.30	1.81
Skewness	-0.76	1.21	0.89	0.39	0.84	0.74	0.32	0.28	0.19	0.80
Kurtosis	2.01	4.45	2.15	2.36	1.94	2.31	1.55	1.66	1.72	2.44
Jarque-Bera	2.05	4.98	2.45	0.64	2.46	1.66	1.56	1.30	1.10	1.81
Probability	0.35	0.08	0.29	0.72	0.29	0.43	0.45	0.51	0.57	0.40

Sum	2.35	3.91	1.02	1.08	2.29	2.49	0.39	1.85	1.15	7.97
Sum Sq. Dev.	3.66	3.55	2.51	2.28	1.87	3.79	3.02	3.77	2.39	4.58
Observations	15	15	15	15	15	15	15	15	15	15

Source: Calculation through EViews 8.0

It deduces from the descriptive statistic model that trade openness has the highest mean value, followed by public expenditure on the road, public expenditure on health, public expenditure on energy, education, and agriculture, on the measure of dispersion as evidenced by standard deviation. GDP has the highest variation from the mean value, followed by trade openness, expenditure on energy, health, road length, agriculture expenditure, education expenditure, labor force, and urbanization. The distribution parameter notices that GDP, education, health, trade openness, road network, urbanization, and labor force variables are negatively skewed. In contrast, road investment and energy variables are positively skewed. The kurtosis values deduce that all variables have non-normal distribution as the kurtosis values are far from 3.0.Furthermore, this study applied Jarque-Bera Test to test normality. The Jarque-Bera is 0.93, and the P-value is significant than 0.05, denoting residuals as normally distributed. In the residual diagnostic test through actual fitted residuals, the asterisks were randomly dispersed; hence, the linear regression model is preferred for this data set. Correlation analysis is conducted to estimate the correlation coefficients to understand the correlation among the variables in the model. The results for the correlation matrix are represented in table 4.3.

Table 4.3 Correlation Matrix

	GDP	**RDIps**	**AGRps**	**EDUps**	**ENRps**	**HELps**	**RN**	**LF**	**UL**	**TO**
GDP	1.00									
RDIps	-0.01	1.00								
AGRps	-0.43	-0.41	1.00							
EDUps	0.45	0.08	0.30	1.00						
ENRps	-0.46	0.10	-0.51	-0.47	1.00					
HELps	0.51	-0.55	0.40	0.39	-0.45	1.00				
RN	0.35	-0.4	0.46	0.45	-0.47	0.90**	1.00			
LF	0.37	-0.37	0.44	0.42	-0.48	0.89**	0.48	1.00		
UL	0.40	-0.35	0.33	0.47	-0.49	0.87**	0.49	0.49	1.00	
TO	0.42	-0.42	0.48	0.37	-0.5	0.92**	0.50	0.39	0.29	1.00

Source: Calculation through EViews 8.0

From the correlation matrix table 4.2 results, the calculated values of variables have a positive and negative moderate and weak correlation. However, expenditure on health is strongly correlated with road network, labor force, urbanization level, and trade openness. Therefore, these warrants dropping expenditure on health out of the regression equation since their strong correlation with other variables would lead to

multicollinearity problems upon regression of the empirical model. From the correlation coefficients, it is deduced that there is a sectorial bias among public expenditures. Because the correlation coefficients across all the expenditures are negative and positive, the expenditures are mutually exclusive rather than mutually exhaustive. It is deduced from the correlation coefficients that there is a sectorial bias among government expenditures.

Unit root test is crucial to determine the order of integration of variables before the empirical model estimations. For this purpose, the Dicky Fuller test is applied to test the absence of unit root among the variables.

Table 4.4 Unit Root Test Results

	At level				At First Difference				Order of Integration
	t-statistics	Critical values			t-statistics	Critical values			
		1%	5%	10%		1%	5%	10%	
GDP	-2.45	-4.06	-3.12	2.70	-2.18	-4.06	-3.12	-2.70	I (1)
RDIps	-2.34	-4.00	-3.10	2.69	-4.00	-4.06	-3.12	-2.70	I (1)
AGRps	-0.33	-4.06	-3.12	2.70	-5.67	-4.06	-3.12	-2.70	I (1)
EDUps	-1.77	-4.00	-3.10	2.69	-5.57	-4.06	-3.12	-2.70	I (1)
ENRps	-1.57	-4.06	-3.12	2.70	-2.11	-4.12	-3.14	-2.71	I (1)
HELps	1.69	-4.12	-3.14	2.71	-5.24	-4.06	-3.12	-2.70	I (1)
RN	1.28	-4.00	-3.10	2.69	-2.03	-4.06	-3.12	-2.70	I (1)
LF	-0.83	-4.20	-3.18	2.73	-0.97	-4.06	-3.12	-2.70	I (1)
UL	0.57	-4.06	-3.12	2.70	-2.41	-4.12	-3.14	-2.71	I (1)
TO	-0.16	-4.00	-3.10	2.69	-3.30	-4.06	-3.12	-2.70	I (1)

Source: Calculation through EViews 8.0

The unit root test results show that at level t-statistics, variables are stationary and don't have unit-roots. The t-statistics are lower than the critical values at; one percent, five percent, and ten percent significance levels.

In the running of regression, test for the serial correlation in the residuals of the model. It is essential for the determination, whether the estimated model best fit the data. In this study, the Breusch-Pagan-Godfrey test for serial correlation was used. The results of heteroskedasticity are figured out below.

Table 4.5 Breusch-Pagan-Godfrey Heteroscedasticity Test

F-statistic	0.637644	Prob. F (9,5)		0.7376
Obs*R-squared	8.015976	Prob. Chi-Square (9)		0.5325
Scaled explained SS	0.757641	Prob. Chi-Square (9)		0.9998
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-7.76E+19	8.96E+19	-0.866239	0.4260
RDI_{PS}	-3.12E+10	2.09E+10	-1.488044	0.1969
AGR_{PS}	1.74E+08	2.90E+10	0.006020	0.9954
EDU_{PS}	2.89E+10	4.15E+10	0.696898	0.5169
ENR_{PS}	-1.59E+10	2.29E+10	-0.692016	0.5197
HEL_{PS}	-3.46E+10	4.13E+10	-0.835988	0.4413
RN	-8.62E+14	9.99E+14	-0.862820	0.4277
LF	-1.53E+13	1.87E+13	-0.819453	0.4498

UL	1.79E+13	1.89E+13	0.944752	0.3882
TO	1.33E+10	2.45E+10	0.544235	0.6097
R-squared	0.534398	Mean dependent var		9.76E+17
Adjusted R-squared	-0.303684	S.D. dependent var		1.32E+18
SE of regression	1.50E+18	Akaike info criterion		86.78320
Sum squared resid	1.13E+37	Schwarz criterion		87.25523
Log likelihood	-640.8740	Hannan-Quinn criter.		86.77817
F-statistic	0.637644	Durbin-Watson stat		2.606546
Prob(F-statistic)	0.737580			

Source: Calculation through EViews 8.0

The test was applied for all the explanatory variables. It is a chi-square test with a value of 0.53. Thus, to decide whether to accept or reject the null hypothesis, check the chi-square p-value. Looking at the p-value, which is more significant than 0.05, accept the null hypothesis. Therefore, indicating homoscedasticity. Furthermore, it suggests that the variance of the model residues is constant across the residuals.

Table 4.6 Breusch-Godfrey Serial Correlation Auto Correlation LM Test

F-statistic	1.496101	Prob. F(2,3)		0.3542
Obs*R-squared	7.490240	Prob. Chi-Square (2)		0.0236
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RDI_{PS}	14.93337	34.83053	0.428744	0.6970
AGR_{PS}	-17.24985	32.60347	-0.529080	0.6334
EDU_{PS}	-24.41895	68.29286	-0.357562	0.7443
ENR_{PS}	19.05549	37.60274	0.506758	0.6472
HEL_{PS}	-10.70141	46.80929	-0.228617	0.8339
RN	954761.3	2006583.	0.475814	0.6667
LF	14597.46	37177.51	0.392642	0.7208
UL	-16129.84	40084.43	-0.402397	0.7143
TO	-16.28419	42.35442	-0.384474	0.7263
C	7.28E+10	1.84E+11	0.395066	0.7192
RESID(-1)	-0.368578	0.712868	-0.517036	0.6408
RESID(-2)	-1.016837	0.696222	-1.460508	0.2403
R-squared	0.499349	Mean dependent var		3.56E-06
Adjusted R-squared	-1.336370	S.D. dependent var		1.02E+09
S.E. of regression	1.56E+09	Akaike info criterion		45.16854
Sum squared resid	7.33E+18	Schwarz criterion		45.73498
Log likelihood	-326.7641	Hannan-Quinn criter.		45.16251
F-statistic	0.272018	Durbin-Watson stat		2.708176
Prob(F-statistic)	0.953022			

Source: Calculation through EViews 8.0

As figured out in Table 4.6, the Durbin-Watson stat value= 2.708176 indicates negative autocorrelation between GDP and other explanatory variables.

4.2 Regression and Hypothesis Results

Upon testing for the unit root among variables, it is found that all variables have the same order of integration. Whether to estimate the model using the variables at their level point or after the first difference yields unbiased estimators and no spurious regression since all variables are integrated in the same order. The results of the estimated model are figured out in below table 4.7.

Table 4.7 Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RDI_{PS}	11.15927	23.81742	0.468534	0.6591
AGR_{PS}	-14.01427	32.93145	-1.336542	0.2390
EDU_{PS}	3.785739	47.19235	0.080219	0.9392
ENR_{PS}	-6.480156	26.06871	-0.248580	0.8136
HEL_{PS}	-22.36533	47.00243	-0.475834	0.6543
RN	29.4180	1135453.	0.259087	0.8059
LF	16.835.17	21213.51	0.793606	0.4634
UL	11.540.18	21548.47	-0.535545	0.6152
TO	7.352855	27.82934	-0.264212	0.8022
C	3.27E+10	1.02E+11	0.321194	0.7611
		Mean dependent		
R-squared	0.959999	var	1.56E+10	
Adjusted R-squared	0.887996	S.D. dependent var	5.11E+09	
SE of regression	1.71E+09	Akaike info criterion	45.59372	
Sum squared resid	1.46E+19	Schwarz criterion	46.06576	
		Hannan-Quinn		
Log likelihood	-331.9529	criter.	45.58869	
F-statistic	13.33286	Durbin-Watson stat	2.412166	
Prob(F-statistic)	0.005387			

Source: Calculation through EViews 8.0

The empirical model stated in the research methodology sates regressing the public investment on the road, agriculture, energy, education, health, road network, urbanization, labor force, and trade openness. The p-value of all variables from the regression results is insignificant in determining the economic growth at a 10 percent significance level in the economy. On the other hand, the respective p-values are more than 10 percent significance level. Explicitly, it deduces from the regression results those explanatory variables are insignificant in determining the economic growth in the economy at a 10 percent significance level. Looking into interpretation, it deduces that road transport infrastructure increases by one US Dollar, then GDP increases by 11.16 US Dollars keeping other factors remain constant. Thus, public investment in road transport infrastructure shocks economic growth positively. However, expenditure on the different social services shows that spending on education one US Dollar GDP increases by 3.78 US Dollars. On the other sectors, expenditures, agriculture, energy, and health got negative values due to the bias in the government expenditures.

The joint test statistics indicate that the F-statistics is equal to 13.33 with a p-value of 0.005, which means all factors are significant in jointly explaining the investment. The determination coefficient (R^2) of 95.99 percent, indicating that 95.99 percent of the total changes in economic growth are described by changes in all explanatory variables of the model, with only 4.01 percent changes in the economic growth determined by other factors outside the model. Upon accounting for the degree of freedom, the adjusted determination coefficient is 88.79 percent indicating that 88.79 percent of the total changes in economic

growth are described by changes in all explanatory variables of the model, with only 11.21 percent changes in the economic growth determined by other factors outside the model.

4.3 Discussion

This study aimed to test a model to understand whether the road transport infrastructure impact on economic growth in Afghanistan. The results supported the hypothesis that investment in road infrastructure increases the GDP and positively shocks the overall economic growth. It is consistent with the previous studies in other contexts; results have been made that road infrastructure development positively impact economic growth (Moyaki., 2015). Several authors (Badada et al.,2019, Lenzet et al., 2019, Ng.,2019 and Law et al., 2019) revealed the positive nexus of road infrastructure with economic growth. The results confirmed in Central and Eastern European Member States (CEE) align with our findings as the road network has positive effects of population growth, gross fixed capital formation, trade openness, and road infrastructure on economic growth. The results indicated road infrastructure development is associated positively with economic growth.

5.Conclusion

The present study extends earlier studies on the effects of infrastructure investment on economic growth. The study examines the relationship for Afghanistan. The time series analysis technique is used by taking 15 years from 2005 to 2019. As per previous literature, it is observed that few indicators are having a positive relationship with economic growth, whereas few other indicators are having a negative association with economic growth. Few of the variables are having no statistically significant association with the dependent variable (economic growth).

Economic growth has been a foremost concern for researchers around the globe. The literature on road infrastructure or transportation infrastructure demonstrated that the developed countries have well-equipped and quality transportation infrastructures. While developing countries such as African and Asian countries have given considerable attention to road transport infrastructure development, and investment achieved a higher growth rate. Furthermore, connecting regions and countries with quality road infrastructure attract more people, and companies enable agglomeration and clustering, which increases the economic growth rate (Andreev.,2015). Also, in the economy, the capital stock will strengthen the economic growth rate indicating road infrastructure network being part of the physical capital impacts the economic growth (Moyaki., 2015).

This study analysed the impacts of road transport infrastructure and economic growth in Afghanistan. The study encompassed the annual data from 2005-2019 and was influenced by confirming that road transport infrastructure is essential for economic growth. Moreover, it plays a central role in enhancing market linkages, facilitating trade and region integration, and creating job opportunities. Also, road transport infrastructure opens isolated regions to trade, investment and expands access to goods, services, and employment opportunities. Road transport infrastructure leads to sustainable economic growth due to the multiplier impacts of public expenditure on infrastructure in the economy. The study attempted to address and answer the questions on the impacts of road transport infrastructure on economic growth in Afghanistan and the existence of sectorial bias in government expenditure between road transport infrastructure and agriculture, education, energy, and health sectors in Afghanistan. Currently, limited literature exists on road infrastructure but not the relationship of road transport infrastructure and economic growth in general. Therefore, the significance of the research problem is to examine the fundamental issues about the impacts of road transport infrastructure and economic growth in Afghanistan.

5.1 Policy Recommendations

Based on the model results, it is clear that road transportation has positive value and a solid contribution to GDP in Afghanistan and substantially impacts economic growth. It implies that increases in public spending on road transport infrastructure in Afghanistan increase economic growth. On the other hand, a reduction in public expenditure on road transport infrastructure leads to decreased economic growth in Afghanistan. As per the collected data, over the years, government spending on the road transport infrastructure is insufficient to achieve the goal of the construction of the remaining 475Km ring road, which connects Pakistan and Iran to the middle Asian countries to promote trade, and regional integration. Expansion of 3,300 km national and provincial road network and Operation and Maintenance (O&M) of 2,500 km roads (ATSMP, 2017-2036).

Similarly, external funding sources such as WB and ADB for road transport infrastructure play a vital role in complementing the government 20-year Transport Sector Master Plan. The ring and connector roads are the top priories of the master plan. Therefore, external financing can further improve the economic growth in the country if the external funding well integrates into the transport master plan. Future studies can also focus on the efficiency and quality of the road transport infrastructure, rather than its quantity since many

developed countries improve the existing road infrastructures instead of expanding them.

The study recommends that the Afghanistan government should allocate a sufficient budget in its fiscal budget for the road transport sector, including all road transport infrastructure development (national highways, regional highways, provincial roads, and rural roads) to balance economic growth. The government should include sustainability of road transport infrastructure in the sector strategy and policy and allocate the budget for maintenance of these structures. The government should develop a balanced budget for all sectors in the fiscal budget and policy and avoid any bias in the expenditure among the sectors. In the fiscal budget, the allocation of budget for each sector should align with its contribution to the GDP growth. It will support the government to achieve its economic growth and welfare. The government should develop sustainable and implementable road transportation infrastructure development and maintenance policies to ensure reasonable access and good traffic flow on roads across the nation. The government should develop a proper road transportation toll and revenue management system, which will support further development and maintenance of road transport infrastructure. Which, boldly stipulated in Afghanistan Transport Sector Master Plan (2017-2036). Government should develop a policy for PPP. It is necessary to increase and encourage the participation of private investment in the provision of public transport services. The Ministry of Transport and Civil Aviation (MoTCA) should install a computerized system for all national and regional highways to control the speed and cargo of vehicles and trucks to prevent the destruction of the road infrastructure

5.2 Implications of the study

The study analyses the impact of road infrastructure investment on economic growth. It determines whether infrastructure investment has a positive, negative, or insignificant impact on economic growth. The study can help arrive at the optimal level of investment, as; road infrastructure investment may be oversupplied, undersupplied, or optimally supplied at various countries as per previous literature. The present study can help do a comparative analysis within SAARC countries relating to road infrastructure investment. The study is also helpful in conducting comparative research of the subsectors of infrastructure.

5.3 Future research

Future studies can extend the sample to include more countries. The period of study can be extended for more than 15 years. Larger the sample size and number of observations improve the quality and robustness of results. Country-wise analysis can be done within SAARC

countries to test the effect of infrastructure investment on economic growth (positive, negative, or insignificant effect) and test whether infrastructure investment is supplied at the optimal level.

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About the Authors

Mr. Mohibur-Rahman Mohib, Member of Research Society, Kardan University, Kabul Afghanistan. < zohrazaka79@gmail.com>. <rahman.mohib@gmail.com>