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The Effect of Infrastructure Development on Economic Growth in the United States of America

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Abstract: This study examines the relationship between infrastructure development and economic growth in the United States from 1990 to 2021, focusing on gross fixed capital formation (GFCF), transportation infrastructure, electricity coverage (EI), and population growth (POP). Using empirical analysis and statistical techniques, the study found that infrastructure development, as measured by GFCF, exhibited a significant and positive relationship with economic growth. Increased investment in physical capital contributed to higher productivity and output, fostering economic growth in the United States. Conversely, a negative relationship was found between transportation infrastructure and economic growth, implying that inadequate or inefficient transportation networks may hinder economic progress. The study also examined the impact of electricity coverage and population growth on economic growth. The results indicated a negative but statistically insignificant relationship between electricity coverage and economic growth, suggesting that while access to electricity is essential, other factors may play a more significant role in driving economic growth. Additionally, no significant relationship was found between population growth and economic growth, implying that population growth alone does not strongly determine economic performance. Other factors, such as technological progress, human capital development, and institutional quality, may exert more influence on economic growth dynamics. These findings highlight the positive impact of infrastructure development on economic growth and emphasize the need for continued investment in infrastructure to support productivity gains and sustained economic expansion. Moreover, the study underscores the importance of addressing deficiencies in transportation infrastructure to unlock its potential as a driver of economic growth. This study contributes to the understanding of the relationship between infrastructure development and economic growth in the United States.

Keywords: Infrastructure Development; Economic Growth; The United States of America

Introduction

Infrastructure development is the foundation for economic growth and advancement, encompassing areas such as transportation, energy, communication, and public amenities, all essential for a flourishing economy (Ilori, 2004). The quality and sufficiency of infrastructure directly impact the productivity, efficiency, and competitiveness of a country's industries, enterprises, and individuals (Ismail & Mahyideen, 2015). Infrastructure spans multiple sectors, providing interdependencies and opportunities for synergy, and acts as the foundation for economic activity and general growth (Oyediran, 2016). For instance, transportation infrastructure connects producers and consumers, promotes the flow of goods and services, and boosts trade (Rodrigue & Notteboom, 2013). Energy infrastructure supports industrial processes, enables enterprises, and propels innovation (Eberhard et al., 2020). Communication infrastructure facilitates the exchange of information, boosts productivity, and improves connectivity (Cascio & Montealegre, 2016). Social infrastructure, including schools, hospitals, and public utilities, contributes to individual well-being, improves human capital, and fosters a healthy workforce (More & Aye, 2017).

Recognizing the interconnection and relevance of infrastructure across multiple sectors is crucial for understanding its role in generating economic growth and promoting a sustainable society. Recently, the United States has experienced a significant decline in infrastructure investment, falling behind other industrialized countries (ASCE, 2021). Despite the recognized necessity of infrastructure development, the U.S. has failed to sustain adequate investment to meet the needs of its growing population and economy (Congressional Budget Office, 2020). This has led to deteriorating infrastructure, including decaying roads, obsolete bridges, and overburdened public transportation systems, impeding the efficient movement of goods and people and raising transportation costs. Much research has focused on the impact of infrastructure development on economic growth in developing and emerging nations. For example, Kumo (2012) found a strong causal relationship between infrastructure investment and GDP growth in South Africa. Ota (2020) indicated that public investment in technology, education, and power positively correlates with the economy, while investment in transportation shows a negative relationship. Chijioke and Amadi (2020) found that government investment in transportation, communication, education, and health infrastructure significantly impacts Nigerian economic growth. Most studies in developing nations have focused on single variables, such as rail expansion (Fosu, 2021), access to transportation (Banerjee, Duflo, & Qian, 2020), and telephone penetration (Sridhar & Sridhar, 2007).

This study aims to close the gap by boosting infrastructure measures and analyzing their impact on economic growth in the United States using an Autoregressive Distributed Lag (ARDL) model. The goal is to provide a comprehensive look at U.S. infrastructure investment and offer policymakers suggestions for infrastructure development. The study follows a structured methodology: Section 2 reviews related literature and hypothesis development; Section 3 outlines the research methodology; Section 4 presents data analysis and discussion; and Section 5 concludes and provides recommendations.

Review of Related Literature and Hypothesis Development

Conceptual Review

Economic growth

Todaro and Smith (2003) define economic growth as an increase in an economy's capacity to produce goods and services from one period to the next, or a positive change in a country's level of production of goods and services over time, as well as an increase in living standards and an improvement in societal wellbeing. According to Ivic (2015), Economic growth includes increases in material output over a very short period of time, generally one year. According to Jhingan (2022), economic growth is defined as a persistent increase in a country's per capital production or income, which is accompanied by an increase in labor force, consumption, and trade volume. He defines growth factors as structural and technical developments. According to Alhaji (2019) defines economic growth as increased production without a change in technological and institutional arrangements. This technological and institutional setup refers to the method employed to boost output. According to Acemoglu (2009), economic growth sometimes grows pollution or raises individual goals to the point where the same bundle of consumption may no longer satisfy an individual, and on the contrary, economic expansion shows striking differences in the quality of life, standards of living, and health.

Economic growth has a very unique relationship with economic development. Economic growth can occur without economic development (Ivic, 2015) because economic development is a rise in material output, coupled with improvement in all other socioeconomic processes and changes brought about by economic and non-economic forces. Haller (2012) concluded that economic growth is the process of increasing the sizes of national economies, the macro-economic indications, especially the GDP per capita, in an ascendant but not necessarily linear direction, with positive effects on the economic-social sector, while development shows us how growth impacts on the society by increasing the standard of life. According to Solow, economic growth is driven by the accumulation of physical capital, human capital, and technological progress (Solow, 1956). Economic growth could be negative, zero, or positive depending on the population growth. According to Egbetunde (2012), when population is growing faster than the economy is, economic growth is negative, when the economy is growing faster than the population growth, then economic growth is positive, however when the two variable is on par, then economic growth is zero.

Infrastructure Development

Infrastructure development plays a vital role in economic growth, social progress, and sustainable development. This conceptual review aims to explore the multifaceted aspects of infrastructure development, with a focus on transportation, buildings, energy, and health. Transportation infrastructure serves as the backbone of economic activity, facilitating the movement of goods, services, and people (Ejiogu et al., 2000). Efficient transportation networks, including roads, railways, airports, and ports, are essential for promoting trade, regional integration, and economic competitiveness. Buildings infrastructure, including residential, commercial, and public structures, plays a crucial role in shaping the quality of life and supporting economic activities (Sui Pheng et al., 2019). Well-designed and functional buildings contribute to a safe and productive environment, accommodating businesses, educational institutions, and public services. Energy infrastructure, encompassing power generation, transmission, and distribution, is fundamental for economic activities and societal well-being (Oyedepo, 2012). Reliable and affordable access to electricity is essential for powering industries, enabling technological advancements, and improving living standards (Awe & Agbaka, 2019). Health infrastructure, including hospitals, clinics, and healthcare facilities, is essential for promoting public health and well-being (Varkey et al., 2020).

Effective infrastructure development requires careful consideration of various factors, including financing, planning, implementation, and maintenance. Public and private investments, along with sound governance and transparent regulations, are essential for funding and managing infrastructure projects (Zahra et al., 2020). Moreover, technological advancements and innovation play a transformative role in infrastructure development (Caliskan, 2015) The integration of digital technologies, smart systems, and data analytics can enhance the efficiency, safety, and sustainability of infrastructure networks. Embracing emerging trends, such as smart cities and intelligent transportation systems, can further optimize infrastructure performance and enhance overall quality of life.

Theoretical Review

Neoclassical growth theory

Neoclassical growth theory, as established by economists such as Robert Solow and Trevor Swan, has had a considerable influence on our understanding of economic growth (Dimand & Spencer, 2009). This theory, sometimes known as the Solow-Swan growth model, lays emphasis on the role of capital accumulation in promoting long-term economic growth. At the basis of neoclassical growth theory is the assumption that growing the stock of physical capital, such as machinery, infrastructure, and equipment, leads to greater levels of productivity and output. According to the theory, investment in physical capital allows for more efficient production processes, which in turn leads to economic growth (Jones, 2002). This connection is commonly expressed in the production function, where increases in capital inputs lead to greater levels of output. One of the main ideas of neoclassical growth theory is the concept of decreasing returns to capital (Prescott, 1988). As an economy collects more capital, the incremental gains to production shrink with time. This finding reflects the assumption that the early investments in capital tend to provide bigger productivity benefits compared to later investments (Dimand & Spencer, 2009). This conclusion has crucial consequences for policymakers, since it implies that sustained economic growth cannot exclusively depend on capital accumulation, but must also account for other variables. Neoclassical growth theory also admits the reality of technical development however it regards it as exogenous, or external to the model (Solow, 1956). Technological advancement is regarded a residual component that is not clearly described within the scope of the theory. This component has been subject to criticism, since it does not adequately convey the significance of innovation and technical breakthroughs in generating economic growth (Ozdemir, 2017).

Endogenous Growth Theory

Endogenous growth theory, spearheaded by economists such as Paul Romer and Robert Lucas, represents a significant advancement in our understanding of economic growth (Jones, 2019). This theory builds upon the neoclassical growth model by incorporating the role of technological progress as an endogenous factor. One of the key insights of endogenous growth theory is the recognition that technological progress is not solely a result of external forces but can be influenced by deliberate actions and policies (Jones, 2019). Unlike the exogenous technological progress assumption in neoclassical growth theory, endogenous growth theory argues that investment in research and development (R&D), human capital, and innovation can actively drive sustained increases in productivity and economic growth (Schilirò, 2019). By focusing on the accumulation of knowledge and ideas, Romer (1990) highlights the importance of investments in human capital. Education, training, and skill development are seen as crucial drivers of innovation and productivity growth. A more educated and skilled workforce can generate and absorb new knowledge, leading to advancements in technology and higher economic output (Schilirò, 2019). Moreover, Romer (1990) stresses the role of research and development activities in fostering technological progress. Investment in R&D not only leads to the creation of new knowledge and technologies but also enhances the productivity of existing factors of production. It highlights the positive spillover effects of innovation, whereby new ideas and technologies benefit not only the innovator but also other firms and sectors within the economy (Jones, 2019).

Empirical Review
Aschauer (1989) conducted the ground-breaking research investigating the influence of infrastructure investment on output and productivity growth. His study revealed that the relatively slower growth in public capital accumulation in the United States during the 1970s and 80s played a significant role in the productivity slowdown experienced in the private sector. Notably, he discovered that the private output elasticity concerning public capital was approximately 0.42, indicating a substantial level of sensitivity to changes in public capital investment. Aschauer (1990) conducted research examining the impacts of transportation infrastructure by analyzing road density indicators across 48 U.S. states during the time frame of 1960 to 1985. The results indicated a positive effect of highways on economic growth.

Syadullah & Setyawan (2020) analzyed the impact of infrastructure spending on economic growth in Indonesia using investment in road, port and irrigation infrastructure as proxies. The study covered a period from 2011-2018 across 29 provinces using a growth model and a panel analysis. They found that economic growth is positively influenced by government investment in road, port and irrigation infrastructure. In a study conducted by Donaldson and Hornbeck (2016), they explored the influence of railroads on market accessibility in the United States. Their research revealed a significant effect of railroads on the agricultural sector in 1890. They observed that in the absence of railroads, agricultural land decreased by 63.5%, resulting in a 3.4% decline in GNP. In their study, Canning and Pedroni (1999) performed a Granger causality test to examine the relationship between investments in three types of economic infrastructure: kilometers of paved road, kilowatts of electricity generating capacity, and the number of telephones. They utilized a panel dataset comprising 67 countries over the period from 1960 to 1990. The results of their analysis provided compelling evidence of causality running in both directions between each of the three infrastructure variables and GDP in a significant number of the countries investigated. In their study, Seethepalli et al. (2008) discovered a positive impact of all dimensions of infrastructure stocks on economic growth. They employed standard growth regressions in a panel consisting of 16 East Asian countries, analyzing the data at 5-year intervals. Another study conducted by Banerjee et al. (2020) aimed to assess the effects of transportation network accessibility on regional economic outcomes in China. The authors discovered that access to transportation networks had a moderate and positive impact on the level of real GDP per capita across various sectors. However, they did not find any significant effect on the growth of real GDP per capita in China. In a similar vein, Esfahani and Ramırez (2003) employed a cross-country analysis to examine the contribution of infrastructure services to GDP compared to the associated costs. Their findings revealed that the benefits of infrastructure services to GDP far outweighed the costs of providing those services. Using a meta-analysis, Elburz et al. (2017) conclude that there exists no relationship between infrastructure investment and economic output.

Czernich et al. (2011) conducted a panel analysis to investigate the effects of broadband infrastructure on economic growth in OECD countries between 1996 and 2007. Their study indicated that a 10% increase in broadband infrastructure led to an annual GDP per capita growth of 0.9%–1.5%. Yoshino and Abidhadjaev (2017) utilized the difference-in-difference approach to analyze the impact of a high-speed rail line on tax revenues and the economy of affected regions in Japan. Their study demonstrated a significant positive effect on the region's tax revenue following the connection of the Kyushu rapid train with major cities such as Osaka and Tokyo. In a study conducted by Okoro (2013), the impact of government spending on Nigerian economic growth was investigated for the period from 1980 to 2011.The study revealed the presence of a long-run equilibrium relationship between government spending and economic growth in Nigeria. The impact of railroads on market access was carried out by Donaldson and Hornbeck (2016). They found a positive significant effect of railroads on the agricultural sector in 1890. Deng et al. (2013) found that port infrastructure has a positive impact on the growth of the economy by examining value added in Chinese ports and regional economic development. In similar research, Yochum & Agarwal (1987) carried out a study on the impact of port development on growth. They concluded that port shortages lead to losses for companies thereby leading to slower economic growth. The impact of government spending on economic growth in Nigeria was investigated by Okoro (2013). He found that there is a long run relationship between government spending and economic growth in Nigeria.

Research carried out by Cockburn et al. (2013) studied three Asian countries; China, Pakistan, and the Philippines and found that the effects of infrastructure investments on economic growth can differ between countries, however, the consensus is that infrastructure investment reduces poverty and promotes economic growth. This conclusion was supported by Straub and Terada-Hagiwara (2010) who found that developing countries in Asia have been increasing their infrastructure spending and significant correlation was found in the performance of economic growth in those countries. The impact of government expenditure on infrastructure in Nigeria was investigated by Edame and Fonta (2014) using co-integration and error correction specification. However, the study did not provide an interpretation of the results, which is crucial for policy formulation and decision-making. In contrast, the present study not only analyzes the research findings but also discusses their implications for policy-making. Mitchell (2005) focused on examining the impact of government spending on economic growth in the United States, neglecting developing economies like Nigeria, where such studies are scarce. This study addresses this research gap by specifically covering Nigeria as a developing economy. While Iheanacho (2016) explored the relationship between government expenditure and economic growth from 1986 to 2014, the study lacked a description of the variables and failed to establish a connection between its findings and the relevant theoretical framework. In contrast, the current study describes the research variables and further argues the findings based on applicable theories. Previous studies by Nurdeen and Usman (2010), Fasoranti (2012), and Chingoiro and Mbulawa (2016) utilized secondary data from different time periods. However, since then, there have been notable developments in macroeconomic issues. The present study is unique as it utilizes current data, covering the years 1980 to 2016, thus examining both pre- and post-millennium periods. Additionally, this study innovatively combines primary and secondary data to provide a more robust interpretation of the findings.

The empirical review reveals a broad consensus on the positive impact of infrastructure investment on economic growth, with variations in the extent and nature of this impact. Despite these findings, gaps remain in understanding the specific effects of different types of infrastructure and their interplay with other economic variables in a comprehensive manner. The current study aims to bridge this gap by focusing on the United States from 1990 to 2021, examining the distinct roles of gross fixed capital formation, transportation infrastructure, electricity coverage, and population growth on economic growth, thereby offering nuanced insights for policy and investment decisions.

Hypothesis Development

The study adopts the following hypotheses:

H_0: Infrastructure development is not related to economic growth in the United States of America.

Methodology

This study aims to investigate the effect of infrastructure development on economic growth in the United States, employing a simple regression approach. The study follows a quantitative research design, utilizing secondary data analysis to examine the relationship between infrastructure development and economic growth indicators. Various publicly available datasets from government sources, research institutes, and economic databases will be employed as primary sources of data.

Data collection and variable measurement

The research focuses on a specific timeframe, specifically 1990 to 2020, to capture recent trends and developments in infrastructure development and economic growth in the US. The primary variables of interest include the dependent variable, economic growth, measured by indicators such as GDP growth rate, and the independent variable, gross fixed capital formation. Population growth and infrastructure spending in infrastructure spending in transportation and energy was used as control variable to account for potential confounding factors. Data collection involve identifying and gathering data for the dependent, independent, and control variables from reliable sources. Ensuring the consistency and accuracy of the collected data is crucial, and efforts was be made to verify compatibility and reconcile any disparities across different data sources. The collected data was subjected to descriptive analysis to identify trends, patterns, and correlations between infrastructure development and economic growth variables.

Model specification

A functional relationship exists between infrastructure development and economic growth.

$$Economic\ growth = f(Insfrastural\ development)$$

This relationship is then expanded to include the independent and dependent variables. The dependent variable is Real GDP growth while the main independent variable is gross fixed capital formation. Control variables include transportation infrastructure spending, energy infrastructure spending, and population growth.

$$RGDPG = f(GFCF, TIS, EIS, POPG)$$

Where; RGDP = Real GDP growth, GFCF = Gross fixed capital formation, TIS = Transportation infrastructure spending, EIS = Energy infrastructure spending, and POPG = Population growth.

Based on this relationship, an linear log econometric model was written by adding coefficients for each independent variable and a constant term.

$$RGDPG = \beta_0 + \beta_1 LOG\_GFCF + \beta_2 LOG_{TIS} + \beta_3 LOG\_EIS + \beta_4 POPG + \mu_1$$

Where; β_0 = Constant; β_1 - β_4 = Estimation parameters; μ_1= Stochastic element

Empirical Analysis

Descriptive statistics

Table 1

Summary statistics

	RGDPD	LOG_GFCF	LOG_TIS	LOG_EI	POPG
Mean	2.296532	12.463	10.97516	8.466826	0.951535
Median	2.684217	12.47775	11.00408	8.470582	0.945865
Maximum	4.794499	12.63546	11.21056	8.520485	1.386886
Minimum	-2.7678	12.21383	10.819	8.397285	0.455381
Std. Dev.	1.77607	0.123225	0.099637	0.03705	0.239983
Skewness	-1.31149	-0.62651	-0.02589	-0.29615	-0.07154
Kurtosis	4.880009	2.326715	2.221691	1.89083	2.249455
Jarque-Bera	13.45198	2.613518	0.785909	2.042237	0.754062
Probability	0.001199	0.270696	0.675059	0.360192	0.685895
Sum	71.19248	386.3531	340.2298	262.4716	29.49758
Sum Sq. Dev.	94.63274	0.45553	0.297826	0.041181	1.727752
Observations	31	31	31	31	31

According to Antonio & Cruz (2008), the mean of a series is the average value obtained by dividing the total value of the series by the number of observations. From Table 1, It is obvious that the mean values for the variables in the equation are positive. The dependent variable's mean value (RGDPD) is 2.296532, while the mean values for LOG_GFCF, LOG_TIS, LOG_EI, and POPG are 12.463, 10.97516, 8.466826, and 0.951535 respectively. The maximum values indicate the highest point of the variables throughout the study period while the minimum values indicated the lowest values for each variable throughout the study period. The maximum value for RGDPD is 4.794499 and the maximum values for LOG_GFCF, LOG_TIS, LOG_EI, and POPG are 12.63546, 11.21056, 8.520485, and 1.386886 respectively. The minimum value for RGDPD is -2.7678, while the minimum values for LOG_GFCF, LOG_TIS, LOG_EI, and POPG are 12.21383, 10.819, 8.397285, and 0.455381 respectively.

A standard deviation is a measure of how dispersed the data is in relation to the mean. From Table 1, the standard deviation for RGDPD is 1.77607, while standard deviation for LOG_GFCF, LOG_TIS, LOG_EI, and POPG are 0.123225, 0.099637, 0.03705, and 0.239983 respectively. Skewness is a measure of asymmetry of the distribution of the series around its mean. A normally distributed dataset will have a skewness value of 0. A dataset with a positive skewness value shows that the This indicates that the majority of the data points are concentrated on the left side of the distribution, and the right tail is stretched out. A dataset with a negatively skewness value implies that the majority of the data points are concentrated on the right side of the distribution, and the left tail is stretched out. All the variables in this analysis are skewed to the left. Kurtosis is a statistical measure that describes the peakiness or flatness of a probability distribution or dataset. Kurtosis can be either mesokurtic, platykurtic, or leptokurtic. A dataset is mesokurtic when it has a kurtosis value of 3 implying that the distribution is neither too peaked nor too flat compared to a normal distribution. If the distribution is less than 3 it is platykurtic, if it is above 3 it is leptokurtic. RDGPD is Leptokurtic, while the other variables are platykurtic. Jarque-bera is a test statistic to test for normal distribution of the series. It measures how different the data is from the skewness and kurtosis value of a normal distribution. The Jarque Bera values for RGDPD is 13.45198 while the value for LOG_GFCF, LOG_TIS, LOG_EI, and POPG are 2.613518, 0.785909, 2.042237, and 0.754062 respectively.

Table 2

Variables	ADF Test statistic	Critical Value at 5%	Remarks	Order of Integration
RGDPD	-6.22875	-2.96777	S	I(1)
LOG_GFCF	-4.19035	-2.96777	S	I(1)
LOG_TIS	-3.88915	-2.97185	S	I(1)
LOG_EI	-13.3085	-2.96397	S	I(0)
POPG	-3.20923	-2.97626	S	I(1)

When using the Augmented Dickey Fuller Test (ADF test), the expectation is that a variable is stationary when the value of the ADF test statistics is less than the critical value at 5%. RGDPD, LOG_GFCF, LOG_TIS, and POPG met this criterion at first difference while LOG_EI met the criterion at level.

Regression testing

Table 3

Regression Analysis Results

Dependent Variable: RGDPD		
Method: Least Squares		
Date: 06/07/23 Time: 06:30		

Sample: 1990 2020				
Included observations: 31				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG_GFCF	17.42341	6.485886	2.686357	0.0124
LOG_TIS	-16.7728	6.831377	-2.45526	0.0211
LOG_EI	-42.9259	36.57117	-1.17376	0.2511
POPG	-2.31143	2.46814	-0.93651	0.3576
C	334.878	204.053	1.641132	0.1128
R-squared	0.522767	Mean dependent var		2.296532
Adjusted R-squared	0.449346	S.D. dependent var		1.77607
S.E. of regression	1.317951	Akaike info criterion		3.536724
Sum squared resid	45.16189	Schwarz criterion		3.768012
Log likelihood	-49.8192	Hannan-Quinn criter.		3.612118
F-statistic	7.120175	Durbin-Watson stat		1.412147
Prob(F-statistic)	0.000519			

Table 3 shows the result of the regression analysis using an Ordinary Least Squares regression method. The estimated model in the table above is:

$$RGDP = 334 + 17.423_{InGFCF} - 16.773_{InTIS} - 42.923_{InEI} - 2.3114_{POPG}$$

The result indicates that the Gross Capital Formation are positively affects the GDP of the United States of America while the transportation infrastructure, electricity coverage, and population growth are negatively related to GDP in United states. This is indicated by the parameters of the coefficient of each independent variable. The result is consistent with the expectation that infrastructure development as measured by gross fixed capital formation is positively related to the economic growth of United States of America. From the table, it is seen that GFCF is positive and the relation between the dependent and independent variables is a log-linear relationship. This indicates that a 1% percentage change in the value of the GFCF will spur a 0.17-unit change in real GDP growth in the United States of America. The probability of the t-statistics in 0.0124 which is below the significance level of 0.05 and indicates that GFCF is significant in relation to the overall model estimation. Like GFCF, Transportation Infrastructure (TIS) and the dependent variable also have a linear log relationship indicating that a 1 % increase in transportation infrastructure will lead to a decrease in economic growth (RGDPD) by 0.16 units. The probability of the t-statistics is 0.0211 which is below the significance level of 0.05 and indicates that TIS is significant in relation to the overall model estimation.

Electricity Coverage (EI) also have a linear log relationship with the dependent variable. This revealed that for every 1% increase in electricity coverage, economic growth as measured by RGDPD is likely to fall by 0.429 units. However, the probability of the t-statistics is 0.2511 which is above the significance level of 0.05 and indicates that the relationship between electricity coverage and economic growth in the United States of America is not statistically significant. The adjusted R^2 which is the coefficient of determination is 0.52. This suggests that 52% variation in Real GDP growth can be explained by gross fixed capital formation, transportation infrastructure, electricity infrastructure and population growth while the remaining is caused by other variables not captured in the model. This is a fair model fit, implying evidence of causality. At the 5% level of significance, the F-statistics is 7.120 and p-value is 0.000 which is less than 0.05 level of significance used for this study. This implies that null hypothesis one which posits that infrastructure development does not have significant effect on Gross Domestic Product is rejected. Therefore, we accept the alternative hypothesis that infrastructure development has a significant effect on economic growth in United States of America.

Discussion of findings

The results indicate that the relationship between Gross Fixed Capital formation which captures the overall infrastructure investment in the United States and real GDP growth is positive and significant. This result conforms with several literatures reviewed in this study including Syadullah & Setyawan (2020), Esfahani and Ramırez (2003), Aschauer (1989) and others. However, the study finds that transportation infrastructure has a negative, significant relationship with real GDP growth in the United States. This is in direct contrast with the findings in pervious literature which agreed that transportation infrastructure have a positive relationship with economic growth (Banerjee et al., 2020, Canning and Pedroni, 1999, Donaldson and Hornbeck, 2016). The relationship between electricity coverage and Population growth in relation to real GDP growth in United States of America is negative and insignificant.

Implication of findings

The finding of this study has several implications, especially for policy makers:

i. Governments should diversify infrastructure investments beyond transportation, as current transportation investments negatively impact real GDP growth.
ii. Efficient transportation planning is crucial to avoid congestion and optimize logistics, rather than merely expanding infrastructure.
iii. The study finds a negative but statistically insignificant relationship between electricity coverage, population growth, and real GDP growth, suggesting other factors like education and innovation are crucial.
iv. Integrated infrastructure planning is essential, considering the interdependence of various sectors to maximize positive effects on real GDP growth.

Conclusion and Recommendations

The findings of this study shed insight on the relationship between infrastructure development and economic growth in the United States. The results demonstrate a positive and strong link between infrastructure, as measured by gross fixed capital formation (GFCF), and economic growth. This underlines the significance of ongoing investment in physical capital to achieve productivity improvements and maintain economic prosperity. However, the analysis also shows a negative relationship between transportation infrastructure and economic growth, underlining the necessity for focused changes in transportation systems to promote economic performance. Additionally, the analysis reveals no significant relationship between electricity coverage and economic growth, suggesting that other factors may exercise a bigger impact on economic dynamics in the United States. Similarly, population growth alone does not serve as a key predictor of economic growth, stressing the relevance of other variables such as technical progress, human capital development, and institutional quality.

Based on the findings of this study, the following are recommended to policy makers:

i. Authorities should prioritize and expand investments in infrastructure projects to support economic activity and boost productivity by updating existing infrastructure and establishing new projects.
ii. Policymakers should address transportation infrastructure deficiencies by investing in updates, reducing congestion, enhancing connectivity, and improving logistics efficiency to foster smoother trade flows and market access.
iii. Authorities should foster innovation and technical progress through increased expenditures in R&D, promotion of entrepreneurship, and support for knowledge-intensive companies to boost productivity and long-term economic growth.

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