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Bridging the Infrastructure Gap: Assessing the Impact of Critical Infrastructure Investments on Economic Growth in the United States and Emerging Markets

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Abstract
Infrastructure is an important driver in economic development, promoting trade, increasing access to basic services, and enabling productivity, however, the infrastructure gap that many nations are facing has become detrimental, threatening their long-term economic growth and competitiveness. While emerging markets contend with deficient infrastructure systems that impede industrialization and social development, industrialized economies such as the United States suffer from inefficiencies triggered by deteriorating infrastructure and periods of underinvestment. The purpose of this review is to assess the impact of critical infrastructure investments on economic growth in the United States and emerging markets. The study revealed that infrastructure investment significantly boosts economic development. Modernizing infrastructure in the United States enhances productivity and competitiveness globally, especially across sectors. Therefore, bridging the infrastructure gap is essential for promoting economic development and sustaining long-term growth.

Keywords: Infrastructure, Sustainable development, Investment, Economic growth, policy

1. Introduction

Infrastructure is the foundation of economic growth and advancement because it offers the systems and services required for society to operate efficiently. Apart from being necessary for everyday existence, infrastructure such as roads, bridges, electrical grids, water systems, and communication networks also have a vital function in fostering businesses, production, and innovation (Weijnen & Correljé, 2021).
Generally, one of the most important factors influencing the economic performance of a nation is its infrastructure, which affects its capacity for generating investments, competing in the global market, and improving the living conditions of its people. Investing in infrastructure increases productivity and the economy's competitiveness while also lowering production costs, increasing labour efficiency, and creating jobs (Du et al., 2022; (Nchake & Shuaibu, 2022). According to previous research, every $1 spent on infrastructure in the United States adds about $3 to GDP growth, with the impact being greater during recessions (Business Roundtable, 2015). On the other hand, poor infrastructure places a heavy financial burden on the economy and lowers personal income, unemployment, and the nation's global

competitiveness (Foster et al., 2023). However, there are large differences in the level of infrastructure development around the world, and many nations are experiencing an infrastructure gap that is growing and impeding their ability to advance economically.

Despite significant global advances in infrastructure spending, there remains an infrastructure gap. In the United States, the infrastructure gap is evident in practically every economic area. The majority of United States roads, bridges, and dams have a D+ rating because public infrastructure expenditure is at a 20-year low (American Society of Civil Engineers (ASCE), 2021). The Congressional Budget Office (2021) revealed that from 3.0% in 1959 to 2.3% in 2017, the total amount spent on infrastructure as a percentage of GDP has decreased. For instance, the Congressional Budget Office (2020) stated that public spending on highways as a share of GDP decreased from 1.58% in 1958 to 0.92% in 2017. According to ASCE research report from 2021, an additional $632 billion will need to be invested over the next ten years in irrigation, wastewater treatment, and drinking water infrastructure. Countries like China spent 8.3% of their GDP on public infrastructure between 2010 and 2015, while the United States spent 2.3% of GDP on the same project (Congressional Budget Office, 2021). Therefore, the economic crisis brought on by the coronavirus epidemic and the nation's downward trend in infrastructure investment necessitates an empirical analysis of the relationship between infrastructure and economic growth in the United States imperative.

Bridging the infrastructure gap is important for achieving sustainable economic development, especially in nations where development is impeded by antiquated or insufficient infrastructure. Most of the infrastructure in developed nations was constructed decades ago, and possible underfunding has caused vital systems like energy grids, bridges, and highways to deteriorate (Gurara et al., 2017). The inefficiencies brought forth by this underinvestment lower global competitiveness, raise production and transportation costs and prevent innovation (Calderón & Servén, 2004; Zhang & Cheng, 2023). Creative policy frameworks that place a priority on long-term sustainability, climate change resilience, and equal access to services are needed to address the infrastructure gap.

Although the United States economy is among the most developed in the world, concerns have been expressed regarding the country's capacity to maintain long-term development due to deteriorating infrastructure and underinvestment in important areas. The transportation, electricity, and water systems urgently need to be improved, and trillions of dollars are needed to overcome the infrastructure deficit (Zhao et al., 2019). Since it affects social fairness, public safety, environmental sustainability, and economic efficiency, the deteriorating status of American infrastructure has gained significant governmental attention.

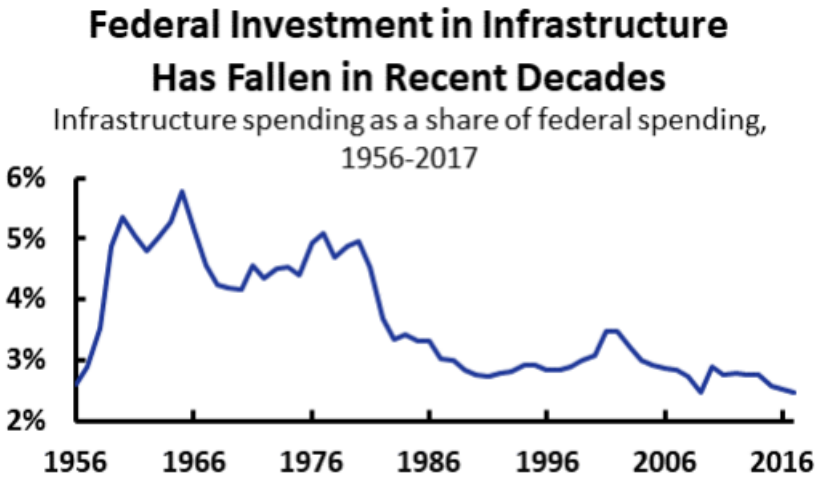
Conversely, emerging markets encounter distinct obstacles. Although the urbanization and industrialization of many of these economies are rapidly occurring, the development of their infrastructure may be substandard (Bodo, 2019). In this regard, growth may be hindered by inadequate transportation networks, erratic electricity sources, and restricted access to sanitary facilities and clean water (Hassan & Nor, 2017). In developing markets, where infrastructure investments are critical to increasing productivity, lowering poverty, and fostering sustainable development, closing these infrastructure gaps is imperative to attaining the full potential of these markets. The purpose of this study is to assess the impact of critical infrastructure investments on economic growth in the United States and emerging markets**.** The study will also investigate the prospects linked to narrowing the infrastructure disparity in nations, providing valuable perspectives on policy approaches that may promote sustainable economic growth.

2. Overview of Infrastructure and Economic Development

The correlation between infrastructure and economic development is widely recognized, as nations possessing strong infrastructure systems typically witness more economic activity, heightened global competitiveness, and better living standards. An overview of the critical role infrastructure plays in promoting economic development is explored in this section, along with an emphasis on the direct and indirect effects it has on investment, productivity, and human capital in various locations and industries.

2.1 Infrastructure and Economic Growth

The relationship between infrastructure and economic growth has been the subject of numerous studies, all of which have consistently found a beneficial association between infrastructure investment and GDP growth. Studies show that faster, more effective movement of products, services, and information is made possible by advancements in the transportation and communication infrastructure, which typically has the biggest effect on productivity (Oladimeji et al., 2023; Javaid et al., 2024). As instance, the World Bank discovered that in low-income nations, a 10% increase in infrastructure investment might result in a 1% increase in GDP.



Congressional Budget Office, data from the Office of Management and Budget and the Census Bureau (2018)

Comparable results have been documented in several areas and industries, bolstering the theory that infrastructure spending is a major force behind economic growth (Du et al., 2022; Stupak, 2018). Research conducted on established economies, including the United States and Western Europe, demonstrates that investments in infrastructure enhance the productivity of existing companies and encourage the emergence of new ones, so promoting long-term economic growth (Bennett, 2019; Zenghelis et al., 2024). The effect is particularly noticeable in developing economies since these nations frequently begin with less developed infrastructure. It has been demonstrated that infrastructure investments in emerging countries lower production costs, increase market accessibility, and create a large number of job opportunities all of which help to lower poverty and improve standards of living.

2.2 The Role of Infrastructure in Economic Development

Due to the direct and indirect implications that infrastructure has on development, it is frequently referred to as the foundation of an economy (Macdonald, 2008; Palei, 2015). It first supplies the fundamental physical capital required for production procedures. Across all industries, efficient transportation networks lessen production and transaction costs by reducing the cost and duration of transportation and goods

(Zhang & Cheng, 2023). A consistent supply of electricity is ensured by a reliable energy infrastructure, and this is essential for industrial and technical activities. In addition, adequate water and sanitation systems are essential for worker productivity, public health, and general community well-being.

Infrastructure has a crucial role in promoting economic expansion by enhancing the investment culture. Given that it lowers the risks and expenses of operating an enterprise there, a region's well-developed infrastructure increases its appeal to both domestic and foreign investors (Du et al., 2022). Investors are more willing to place money in areas with dependable and effective energy, communication, and transportation infrastructure (Zhao et al., 2022). As a result, infrastructure not only attracts capital but also stimulates innovation and competition by enabling companies to operate more efficiently.

Additionally, infrastructure supports social development, which is directly related to advancements in the economy. Considerably, the human capital of a nation is increased when it has access to contemporary infrastructure, such as power and transportation, which also makes it easier to obtain healthcare, work opportunities, and education (Kruk et al., 2019; Barrett, 2019). A workforce that is better educated and in better health is produced by infrastructure that supports health and education services, which raises economic production and productivity (Luxon, 2015). In this way, investing in infrastructure benefits physical production directly as well as indirectly through raising human capital.

3. Previous Studies

Public infrastructure's role in economic growth is examined in several early studies (Cook & Munnell 1990; Rives & Heaney 1995; Wylie, 1996). Specifically, Cook and Munnell (1990) discovered that public capital significantly and favourably affects output using state-level data from the United States. Similarly, Garcia-Milà and McGuire (1992) discovered a significant correlation between public education, highway infrastructure, and gross state products using data from 48 United States from 1969 to 1983. However, the investigations by Rives and Heaney (1995) demonstrate that the local economy is more affected by infrastructure than the national economy. According to Wylie (1996), infrastructure investment in Canada has better production elasticities than in the United States. Despite this, these studies have several methodological flaws, including measurement errors, data availability, reverse causality where the causal relationship extends from the economic measures to public infrastructure investment, and endogeneity between the public capital stock and economic performance. Therefore, Subsequent research has addressed a few of these issues. In the United States, there is either no relationship or a fragile one between infrastructure investment and economic growth. The meta-analysis by Elburz et al., (2017) revealed that there is no connection between infrastructure investment and economic production. Whereas, the study by Timilsina et al., (2020), does to corroborate previous research regarding the connection between infrastructure and economic expansion.

Several studies substitute the stocks of physical infrastructures (such as the number of phones, length of roads, and energy generation capacity) for governmental investments in infrastructure. Two indices; one measuring infrastructure quantity and the other measuring infrastructure quality were used by Calderon and Serven (2010) to combine diverse infrastructure assets. In this instance, the non-overlapping five-year average GDP growth rates for 1960–2005 are their dependent variable. Utilizing both internal and exterior instrumental variables (demographic variables), they applied the system generalized method of moments (GMM) created by Arellano & Bond (1991) and Arellano & Bover (1995) to a dynamic panel to address the reverse causality problem. According to their findings, infrastructure development had a positive and statistically significant impact on economic growth for both infrastructure indices. From 1991 to 1995, the

worldwide growth rate increased by 1.6% points year due to infrastructure development. The study by Kodongo and Ojah (2016) and Chakamera and Alagidede (2018) employed the system GMM to assess the link between changes in an infrastructure index and economic growth in sub-Saharan Africa, adopting the methodology of Calderón and Servén. Granger causality was also discovered by Chakamera and Alagidede (2018) from infrastructure to growth. Therefore, Bun and Windmeijer (2010); Bazzi and Clemens (2013) concluded that it should be highlighted that poor internal instruments might lead to issues with the difference and system generalized method of moments (GMM) approaches.

Furthermore, the dynamic panel analysis by Calderón et al., (2015) used a synthetic infrastructure index that was created by principal component analysis of the number of fixed telephone lines, total road length, and electricity generation capacity for a sample of 88 countries between 1960 and 2000. They estimated the model focusing on a long-run production function link between infrastructure variables, other manufactured capital, human capital, and GDP using the pooled mean group estimator (Pesaran et al., 1999). From the findings, infrastructure was observed to have a considerable and positive long-term impact on GDP, with an elasticity ranging from 0.07 to 0.1 depending on the specification. In addition, the findings revealed macro-level evidence that infrastructure capital can yield economic dividends; the authors were unable to reject the null hypothesis that infrastructure is weakly exogenous, which helps mitigate concerns about reverse causality. However, evidence that the effects of infrastructure on GDP vary amongst nations at different stages of development was not identified.

Furthermore, numerous studies at the micro level have also examined the consequences of expanding access to infrastructure, such as power. A review of studies on power access was presented by Lee, Miguel, and Wolfram (2020), while studies on transportation have been reviewed by Faber (2014) and Donaldson & Hornbeck (2016). More recent quasi-experimental techniques, like randomized controlled trials, generally find a smaller impact on electricity than earlier studies, even though microeconomic studies generally suggest positive impacts of electrification on income and other development outcomes Lee et al., (2020). Therefore, the infrastructure gap is exacerbated by rapid urbanization and population growth, limiting access to markets and industrial capacity. Bridging this gap is crucial for productivity improvements, job creation, and poverty reduction. Governments must collaborate with private sector and multilateral organizations to leverage innovative technologies and drive long-term economic development.

4. Impact of improved Infrastructure Investment on Economic Growth Quality

A unity of quantity and quality is referred to as economic growth (Barro, 2002). An advanced level and ideal state of economic development are referred to as high-quality development. It has been associated with the quality of economic growth at the macroeconomic level (Li et al., 2019). When evaluating the benefits of economic growth, early research mainly considered economic growth quality. Therefore, further research has adopted a more comprehensive interpretation of economic growth, encompassing various facets of economic and social development. This includes the integration of concerns like income inequality, social welfare, resource depletion, and environmental contamination into the growth quality framework as highlighted by Barro (2002). Process elements like structure and stability as well as condition dimensions like innovativeness and coordination have steadily been added to the notion (Kong et al., 2021; Ru et al., 2020). The intricate notion of economic growth quality, in general, encompasses normative value assessments on the nature, trajectory, and outcomes of economic growth. Therefore, enhancing the conditions, procedures, and outcomes at the same time is necessary to improve economic

growth quality and quantitatively expand it to a specific stage.

Conventional infrastructure such as transportation, is a key component that ensures social advantages and economic growth, and it is the fundamental force behind many of the Sustainable Development Goals (Prus & Sikora, 2021). The positive impact of new infrastructure on economic growth and regional sustainable development is consistent with transport infrastructure since new infrastructure involves supporting the transformation and upgrading of existing infrastructure (Raicu et al., 2021). Long-term sustainable growth requires new infrastructure investment due to the desire for an intelligent society and digital economy. New infrastructure investment delivers more economic and social benefits and a stronger market focus than traditional infrastructure investment (Wensi, 2020). Conversely, it possesses the qualities of high technology content, high industry penetration rate, significant impact, and a positive feedback mechanism with quality economic growth through its effects on productivity, industrial structure, and technical innovation in terms of the circumstances, means, and outcomes of economic growth.

Moody's Analytics by Zandi & Yaros, (2021) revealed that the present administration and congressional Democrats are collaborating on a $1 trillion budget that includes a $1.75 trillion package of social spending and tax reductions for lower- and middle-class households, as well as a bipartisan infrastructure agreement. The measure seeks to support long-term economic growth and assist lower- and middle-class Americans, much like the United States government's Build Back Better initiative. It is anticipated that the strategy will guarantee the economy's recovery to full employment following the pandemic recession. With support from both parties, the Infrastructure Investment and Jobs Act allocated over $1 trillion in additional funding for transportation and other physical infrastructure over the 2022–2031 period, with the majority of the increase going towards roads and bridges, power systems, rail, broadband, water systems, and public transit (Zhang & Batjargal, 2022). Therefore, the legislation aims to address unemployment by reducing spending on income support programs like unemployment insurance. It includes delaying drug rebates and extending mortgage guarantee fees. This modestly contributes to budget deficits over a 10-year horizon. The report also suggested that investing more in infrastructure provides major macroeconomic advantages. In the immediate future, it has a sizable "multiplier," or the growth in GDP per dollar increase in investment. Hence, it remains among the highest compared to other federal government spending and taxation forms. In the long run, economic studies strongly concur that public infrastructure offers a notably favourable impact on employment and GDP. It reduces expenses for businesses, therefore increasing productivity and competitiveness, and permits employees to reside nearer to their work, which cuts down on commute times, increases employment, and decreases carbon emissions.

5. United States Infrastructure Investments: Future Economic Impacts

According to the report by the American Society of Civil Engineers (ASCE 2016), the United States surface transportation infrastructure is facing a significant investment gap, with an average annual increase of $110 billion by 2025 and $173 billion by 2040. This deterioration, affecting critical highways, bridges, commuter rail, and transit systems, is causing a significant burden on the economy. This deterioration is particularly pronounced in regions with high urban concentrations, as these areas are experiencing faster rates of deterioration due to increased congestion.

In addition, the ASCE (2016) revealed that the United States' ageing water and wastewater systems face a funding gap of $105 billion by 2025, with the gap expected to escalate to $152 billion by 2040. The

current investment rate is $150 billion, and the gap is expected to increase to $204 billion by 2040. This shortfall in funding will result in nearly 500,000 job losses by 2025 and a $508 billion GDP loss by 2040. Similarly, the United States electric system faces a significant investment gap, with the average annual gap expected to decrease from $21 billion to $18 billion by 2025. This gap is expected to increase to $565 billion by 2040, with a cumulative gap of $177 billion through 2025 and $388 billion from 2026 through 2040. The system consists of three elements: generation facilities, high-voltage transmission lines, and local distribution systems. The complicated and inefficient regulations and policies contribute to uncertainty for infrastructure owners in investing in the larger energy network. By 2040, the cumulative gap will reach $565 billion, primarily due to projected shortfalls in generating capacity.

Furthermore, the ASCE (2016) report highlighted that investments in aviation are expected to grow at an average annual rate of 2.2% through 2036, with 30 core airports serving 70% of commercial passengers. Air and ground congestion at major airports is a significant economic threat, with an annual capital gap of about $2.1 billion through 2025 and $1.6 billion annually from 2026 to 2040. Although, estimates suggest that NextGen, a satellite-based system expected to transform the operation and management of the air transportation system is expected to require $19.9 billion in investment through 2025 and $38.2 billion through 2040. However, the future economic impacts of failing to invest in infrastructure may lead to shortfalls of nearly 257,000 jobs in 2025 and over $337 billion in GDP loss by 2040. Therefore, these concerns necessitate appropriate attention.

6. Policy Recommendations

In order to create a coordinated approach to investment in infrastructure, federal investments should be paired with state and local contributions. Intervention programs which finance road and bridge projects should be expanded and modernized to meet current needs. Targeted investments in critical infrastructure sectors, such as renewable energy, can help drive growth in emerging industries while addressing sustainability concerns. The federal government must play a larger role in financing infrastructure development.

Public-private partnerships (PPPs), which allow the private sector to invest in and manage infrastructure projects in exchange for money from user fees, tolls, or long-term contracts, should be expanded in light of the fiscal constraints on public budgets. Successful PPP models have been implemented in other countries; bringing this strategy to the United States could help close the funding gap, improve project delivery efficiency, and introduce innovative management practices. To enhance private sector participation, clear regulatory frameworks and risk-sharing mechanisms must be established.

Reducing regional disparities and enhancing access to energy, water, and transportation systems in rural and low-income areas should be the main goals of infrastructure investments. Subsequent plans and other initiatives that address historical inequities in infrastructure investments should be expanded to ensure that infrastructure benefits are shared widely across all communities. Bridging the infrastructure gap should also prioritize equity and inclusivity, guaranteeing that marginalized and underserved communities have access to essential infrastructure services.

7. Conclusion

Bridging the infrastructure gap is crucial for both developed economies such as the United States and emerging markets striving towards improving their economy. Overall, infrastructure remains the basis for commercial development through enhancing productivity, innovation and connectivity across the various

sectors. Specifically in the United States addressing the issues surrounding dilapidated infrastructure and underinvestment is vital for maintaining long-term economic sustainability and global competitiveness. Ultimately for emerging markets, expanding and upgrading infrastructure is important for harnessing growth potential, reducing poverty, and improving the standard of living for their populations.

In addition, infrastructure planning must prioritize sustainability and resilience to manage the increasing risks associated with climate change and guarantee that these investments yield long-term returns. In the end, narrowing the infrastructure gap offers a route to inclusive, sustainable development in a variety of economic environments in addition to economic growth.

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