

The Economic Impact of Infrastructure Investment on Regional Development: Evidence from ASEAN Countries

by

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Abstract

This study investigates the economic effects of infrastructure investment on regional development within ASEAN member states. It has focused on how infrastructure investment affects GDP growth, regional inequality, and sustainable development. The study has considered panel data collected over almost 20 years from six ASEAN nations. The study has shown that infrastructure spending has a major impact on economic growth. The research findings indicate that although infrastructure expenditures exhibit a positive correlation with GDP growth, their effects are contingent upon regional differences and sustainability issues. More specifically, the analysis has demonstrated that gains in accessibility to basic services, like clean cooking fuels, do not always result in immediate economic gains and may instead be a sign of underlying systemic problems. Furthermore, there is a need for efficient implementation of sustainable practices because the sustainability of infrastructure projects, as determined by environmental policy scores, has not shown a substantial direct impact on GDP growth. The study has emphasised how critical it is to combine infrastructure expenditures with more comprehensive regional integration policies, pointing out that the stability and collaboration of the regional economy depend heavily on having high-quality infrastructure. It has also highlighted difficulties that impede the efficient use of infrastructure resources, such as budgetary limitations and governance problems. To maximise the benefits of infrastructure for fair and sustainable economic growth in ASEAN countries, research has generally argued for a balanced approach to infrastructure investment that tackles regional inequities, emphasises sustainability, and supports regional integration.

Keywords: *Infrastructure investment, Regional Development, ASEAN Countries*

Introduction

The primary driver of international commercial integration is high-quality infrastructure. Effective infrastructure networks facilitate involvement in international production networks and

strengthen national ties to global supply chains. In addition, reducing marginal costs increases economic growth and reduces transaction costs (Vidya and Taghizadeh-Hesari, 2021). Investment in infrastructure, especially in developing countries, is a key driver of regional development and economic growth. The world economy has experienced tremendous economic growth due to increased investment in infrastructure, especially due to capital accumulation. There is no economy in the world that can grow without continuous growth in infrastructure investment because infrastructure growth is such an important part of economic growth. The economic growth of any economy in the short and long run is greatly influenced by investment in infrastructure (Ayub et al., 2021).

The ten member states of the Association of Southeast Asian Nations (ASEAN), with different economic policies and stages of development, have recognized the value of infrastructure in terms of trade, regional integration and raising living standards in the general direction. One typical regional international organization that is essential for international cooperation in the Southeast Asian region is the Association of Southeast Asian Nations (ASEAN). This chapter examines ASEAN's foundations, initiatives, policies and attitudes, focusing on issues related to regional security management (Valuch and Hamulák, 2022). Although many ASEAN countries have committed large sums of money to infrastructure development, more research is still needed to determine how these expenditures lead to real economic gains for the region. The administration needs to review a number of national strategic initiatives and select infrastructure projects more carefully due to limited resources and capacity (W. Salim and Negara, 2018). The effectiveness of these investments is challenged by differences in development outcomes among ASEAN member states. This calls into question how effectively public infrastructure investments are being used (Giang and Pheng, 2015). There is a lack of thorough analysis that takes into account various aspects, including governance, regional inequalities and sustainability, and captures the comprehensive impacts of infrastructure investment on regional economic development. The failure to create and implement infrastructure strategies that maximize growth and equitable development across the region has been hampered by this information gap.

The main objective of this study was to assess the financial impacts of infrastructure spending on regional development in ASEAN countries, with particular emphasis on the ways in

which these investments affect regional disparities and economic growth. To this end, the study examined the relationship between GDP growth and infrastructure investment, assessed the impact of such investment on regional inequalities, examined the role such investment can play in promoting regional integration through increased connectivity and trade facilitation, and identified the opportunities and challenges posed by infrastructure projects. The ultimate goal of the study was to offer practical policy suggestions for maximizing the benefits of infrastructure investment for equitable and sustainable regional development.

Literature Review

Infrastructure Investment and Economic Growth

Research on infrastructure issues only addresses a small portion of publicly owned capital. It is challenging to distinguish the influence of private infrastructure investment on industrial growth from that of public infrastructure, even in situations when it is possible to assess it (Palei, 2015). It is commonly acknowledged that investing in infrastructure is a key factor in economic expansion. Saidi *et al.* (2020) claimed that in an intense competition, emerging nations have been courting foreign direct investments (FDI), which would provide large finance capital to provide favourable externalities. C T and Taghizadeh-Hesary (2021) argue that superior infrastructure networks reduce marginal costs and transaction costs, making it easier for people to join international production networks and fortify ties to global supply chains. They looked into the relationship between infrastructure and the level of interdependence in regional trade among the Association of Southeast Asian Nations (ASEAN). Increased economies of scale and general economic efficiency are the outcomes of this.

Taghizadeh-Hesary *et al.* (2021) added that the largest major variable is the quality of infrastructure, which greatly lowers damage over time. It has also been demonstrated that lower levels of corruption and greater development indicators—as indicated by GDP per capita—reduce the harm caused by natural disasters. Ayub *et al.* (2021) underscored the importance of infrastructure investment for economic progress, especially in developing nations, since it fosters both immediate and sustained growth. Their investigation also sought to determine the connections between infrastructure spending and economic expansion. Building infrastructure allows capital to accumulate, which boosts economic activity and productivity and supports the overall state of the economy. Nonetheless, it is a truth that the complex interactions between

capital accumulation, sustainable growth, and the use of natural resources have drawn notice in the field of economic development (Shi and Xu, 2023).

Impact on Regional Disparities

Regional differences are significantly influenced by infrastructure investment. Economists and decision-makers have long held the view that economic growth depends on a sufficient supply of infrastructure services (Calderón and Servén, 2014). Regional differences are significantly influenced by infrastructure investment. Economists and decision-makers have long held the view that economic growth depends on an adequate supply of infrastructure services. Horvat et al. (2021) suggested that the meagre resources of a growing market should be used to support infrastructure projects. Infrastructure spending can help reduce economic inequality by giving less developed areas better access to markets and connections. Any expenditure incurred to back up and facilitate the movement of people and goods is referred to as infrastructure. Social infrastructure includes things like Medicare, Medicaid, and health care (Wonyra and Ametoglo, 2020). Improved infrastructure should, in theory, improve regional economic integration and make resources and opportunities easier to access. Infrastructure has a significant impact on many aspects of the economy, such as trade and commerce, and its influence on the nation's imports and exports cannot be understated. Since infrastructure improves mobility and accessibility while facilitating the efficient use of resources, it is seen as the foundation of a nation's economy (Rahman *et al.*, 2021).

Salim and Negara (2018) point out that because of resource constraints, infrastructure expenditures must be carefully considered. They also indicate that strategic allocation can help to reduce regional imbalances. However, differences in the results of growth among ASEAN nations show that the advantages of infrastructure spending are not necessarily shared equally, which raises questions about the fairness of such expenditures. By the end of 2015, ASEAN had established the ASEAN Economic Community (AEC). The free flow of skilled labour, capital, investment, and commodities and services are the main objectives of the AEC, an economic integration. With the creation of the ASEAN Economic Community (AEC), ASEAN furthered its economic cooperation (Ishikawa, 2021).

Role in Regional Integration

Investing in infrastructure is essential to promoting regional integration. Nawaz and Mangla (2021) claimed that infrastructures had a major and favourable impact on regional development, both directly and indirectly. Infrastructure quantity has a comparatively large spillover effect, but infrastructure quality has a relatively higher direct influence. With its varied economic systems, the Association of Southeast Asian Nations (ASEAN) depends on infrastructure to promote regional collaboration and trade. Zhang (2023) emphasised that, as a result of the Association of Southeast Asian Nations' (ASEAN) long history, the organisation has internalised unity in diversity, centrality, and inclusive growth as distinguishing traits. However, these ASEAN traits are under pressure because to the escalating strategic competition between China and the US, which is creating strategic challenges for ASEAN. Projects like the Trans-ASEAN Gas Pipeline and the ASEAN Highway Network are examples of ones aimed at enhancing connectivity and promoting regional economic integration (Shi, Variam and Shen, 2019). Infrastructure plays a crucial role in facilitating regional security management and collaboration, as highlighted by Afrin and Islam (2022). These investments foster a more coherent regional economic framework.

High-quality infrastructure services are economically vital and required for long-term economic prosperity. In order to improve the delivery system and calibre of services, governments should invest in infrastructure and establish the necessary framework (an economy's infrastructure is made up of institutions, regulations, and laws that must be followed). Infrastructure investments can promote regional economic stability and deepen economic relations between member states by enhancing communication and transportation networks. Investments in transportation infrastructure are anticipated to have beneficial compounding effects since social welfare and economic opportunity are connected to efficient mobility. Developing nations have been adversely affected by various factors such as inadequate funding for transport infrastructure, insufficient capacity, inadequate management, insufficient coordination among modes, and difficulties in fulfilling domestic and global distribution requirements (Rodrigue, 2016).

Challenges and Opportunities

Investments in infrastructure come with a number of difficulties in addition to their many advantages. Mahmood *et al.* (2024) drew attention to a vacuum in the body of knowledge about the effects of energy projects, sustainable infrastructure, and special economic zones (SEZs) on economic resilience. This implies that it will be difficult to comprehend and record the entire extent of these infrastructure expenditures. Infrastructure project effectiveness is significantly impacted by a number of important elements, including the quality of governance, financial restrictions, and environmental effects. Liu, Song, and Xin (2022) reported that green management rules put a lot of pressure on businesses to adhere to strict environmental requirements even as they try to address environmental challenges and promote sustainable practices. Financial constraints can add to this pressure, especially for high-polluting companies, which may find it difficult to comply with new environmental laws and investment needs. The effectiveness of public infrastructure investment is challenged by differences in development outcomes among ASEAN member states, highlighting the need for better governance and strategic planning. There is a chance to bridge the gap between urban and rural communities by investing in infrastructure that is particularly suited to their needs. Improvements in transport, health and education infrastructure can improve living standards and economic prospects in rural areas, thereby mitigating economic inequality (Ejaz and Mallawaarachchi, 2023). W. A. Salim and Negara (2018) also point out that because national resources are limited, prudent project selection is crucial for infrastructure initiatives. Effective infrastructure is essential for social and economic advancement in any developing country. New approaches to financing and public-private cooperation offer the prospect of increasing the efficiency and impact of infrastructure allocation. Public-private partnerships, or PPPs, are created to cooperate between public and private parties in the planning, construction and/or use of infrastructure facilities in which they share or redistribute risks, costs, benefits, resources and responsibilities institutional frameworks (Liu, Clegg and Pollack, 2023).

Methodology

The research methods used to investigate the relationship between infrastructure investment, regional differentiation, project growth and GDP growth in six specific countries are described in this section. The study adopted a quantitative approach to examine the relationship a

between the independent variables and GDP growth through panel data analysis to obtain and evaluate. Quantitative methods are used to measure causal relationships, generalization, continuous discovery, summarize results, average data, transfer the findings to the general population. We can use them to determine the strength of interactions, calculate effect sizes, quantify priorities, and assess evidence of effectiveness (Rana, Gutierrez and Oldroyd, 2020). The World Development Indicators (WDI) provided the data for this study, and STATA statistical software was used for analysis.

The study used quantitative research, which is appropriate for using statistical methods to examine relationships between variables. The objective of quantitative research is to gain insight and understanding of the various assumptions used in the study (Ghanad, 2023). In particular, a panel data analysis technique has been chosen that allows data from several countries to be analysed within a predetermined period of time. Panel data analysis is a powerful tool that many non-profit researchers can use to further their understanding of causal relationships and/or more complex findings (Ba, Berrett and Coupet, 2023). The advantage of this approach is that it controls for country-specific effects and provides a comprehensive understanding of variation between variables.

The World Development Indicators (WDI) database was where information for this study was obtained; it offers accurate and comprehensive data on various economic indicators. The World Bank prepares the World Development Indicators (WDI), which is a very extensive and much utilized database on how most countries are progressing economically. Before embarking on statistical analysis, however, some data management needs to be done after insheeting a WDI dataset (Jeanty, 2010). In this research, we selected the Philippines, Malaysia, Cambodia, Indonesia, Brunei Darussalam and Indonesia as our chosen countries. For instance, considering that the dataset covers between 2004 and 2023 allows an examination of how project sustainability affects GDP growth in relation to disparities across different regions and infrastructure investment.

The following variables are part of the dataset:

Dependent Variable

GDP Growth (annual %)

This is the GDP growth rate expressed as a yearly percentage at market prices using constant local currency. It serves as the primary indicator of economic growth in the chosen nations.

Independent Variables

Infrastructure Investment

Calculated in current US dollars using ICT investments made through public-private partnerships (PPPs). This variable shows the amount of money that public and commercial organisations have committed to building ICT-related infrastructure.

Regional Inequities

Assessed by the proportion of the population that has access to clean cooking fuels and technologies. This variable serves as a proxy for regional inequality, representing differences in access to key services.

Sustainability of Projects

Measured on a scale from 1 (low) to 6 (high), based on the CPIA policy and institutions for environmental sustainability grading. This variable shows how well institutions and policies support sustainable development approaches.

Data Analysis

This study used panel data from 2004 to 2023 across six nations to examine the effects of several factors on GDP growth. The variables included access to clean fuels and technologies, investment in public-private partnerships, GDP growth (the dependent variable), and CPIA environmental policies and institutions (the independent variables). Using the 'xtset' command, the panel data was first configured with year set as the time variable and 'panelid' as the panel identifier. As a result, the dataset was identified as having a balanced panel with consistent observations for all 20 years across all countries.

Results

Descriptive Statistics

Table 1. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GDP Growth	120	4.4209	3.3728	-9.5183	13.25
Public-Private Investment	120	1.36E+09	1.46E+09	1,835,700	5.10E+09
Access to Climate Finance	120	62.1867	31.6343	6.1	100
CPI and Policy	120	3.0367	0.2738	2.1789	3.541

The yearly growth rate is roughly 4.42% on average, with a 3.37% standard deviation. The largest growth rate recorded is 13.25%, while the lowest result, -9.52%, indicates a notable economic downturn. A standard deviation of 1.46 billion indicates that there is significant variation in investment among nations, with an average of 1.36 billion. The range of values for access level is 6.1% to full access (100%), with an average of 62.19%. The variable indicates comparatively steady environmental policy throughout the nations, with an average of approximately 3.04 and little variation.

Correlation Analysis

Table 2. Pairwise correlation

	GDP Growth	Public Private Investment	Access to Climate Finance	CPI Policy
GDP growth	1			
Public Private Investment	-0.1425	1		
Access to climate finance	-0.5079*	0.4080*	1	
CPI policy	-0.0884	0.5918*	0.3775*	1

To comprehend the connections between the variables, a pairwise correlation matrix was created. One statistical technique for examining the relationship between the various research variables is correlation analysis. Strength, significance, and level are the three primary characteristics that are primarily assessed by correlation analysis. The p value, which would be less than 0.05, is examined to determine the significance. The correlation analysis of the many factors employed in this study is displayed in the table above. There was a modest unfavourable

link indicated by the weak negative correlation (-0.1425) that was found. Significantly, a negative connection (-0.5079*) was discovered, indicating that in this particular context, greater access to clean fuels and technologies may be linked to slower GDP growth. There was minimal to no linear association indicated by the extremely weak negative correlation (-0.0884) that was found.

Regression Analysis

Table 3. Random effect model

GDP Growth	Coef.	Std. Err.	z	P> z
Public Private Investment	-1.33E-10	2.68E-10	-0.5	0.619
Access to Climate Finance	-0.045465	0.0127753	-3.56	0
CPI Policy	-0.294167	1.454185	-0.2	0.84
_cons	8.322284	4.175089	1.99	0.046

With an overall R-squared of 0.2393, the model appears to account for almost 24% of the variation in GDP growth. A very slight and statistically insignificant negative connection ($p = 0.619$) with the dependent variable is indicated by the negative coefficient (-1.33e-10). This implies that modifications to investments made in public-private partnerships have little bearing on the model's outcome variable. With a statistical significance level of $p = 0.000$, the coefficient is -0.0455. Assuming all other variables remain unchanged, this shows that a one-unit increase in availability to clean fuels and technologies is correlated with a 0.0455-unit drop in the dependent variable. With a small confidence interval, the outcome is solid. The institutional structure and policy for environmental sustainability appear to have little effect on the dependent variable in this model, as indicated by the negative (-0.2942) but statistically insignificant ($p = 0.840$) coefficient. The constant term, which represents the dependent variable's baseline level when all predictors are zero, is statistically significant ($p = 0.046$).

Modified Wald Test for Heteroskedasticity

Infixed effectmodel, Modified Wald test was applied to ascertain whether heteroskedasticity exists.

Table 4. Modified Wald Test for Heteroskedasticity

chi2 (6)	19.25
Prob>chi2	0.0038

A p-value of 0.0038 and chi-square statistic of 19.25 showed that the test yielded strong evidence of heteroskedasticity. This indicates that the variances of errors are different among groups and thus estimates may not be correct if this problem is not prevented. Because the p-value is less than 0.05, the homoskedasticity null hypothesis has been disproved. This implies that the fixed effects regression model has evidence of groupwise heteroskedasticity.

Wooldridge Test for Autocorrelation

Similarly, another autocorrelation Wooldridge test was performed.

Table 5. Wooldridge Test for Autocorrelation

F(1, 5)	6.641
Prob > F	0.0496

The p-value was 0.0496 and an F-statistic of 6.641 obtained. The null hypothesis that there is no first-order autocorrelation at the 5% significance level was rejected since the p-value is marginally less than 0.05. This shows that the panel data may contain first-order autocorrelation evidence. The model estimates' reliability can still be affected by these findings as they show presence of first order autocorrelation in the panel data which implies that errors are time-related.

Under such conditions, however, a more reliable estimate is produced using Feasible Generalized Least Squares (FGLS) regression because there exists evidence for heteroskedasticity and autocorrelation.

Table 6. GLS Regression

GDP Growth	Coef.	Std. Err.	z	P> z
Public Private Investment	0.00	0.00	-0.15	0.883
Access to fuel and technology	-0.052	0.008	-6.59	0
CPI Policy	0.666	0.941	0.71	0.479
_cons	5.662	2.653	2.13	0.033

For public-private partnerships investments, the coefficient is 0.00, and the standard error is 0.00. According to the p-value of 0.883 and the z-value of -0.15 , this variable is not statistically significant. This suggests that the investments made by public-private partnerships have little effect on the model's annual GDP growth. On the other hand, the variable Access to fuel and technology has a standard error of 0.0078 and a coefficient of -0.0516298 . With a p-value of 0.000 and a z-value of -6.59 , it is extremely statistically significant. The negative coefficient indicates that there may be a trade-off between investing in clean energy and achieving rapid economic growth. It also reveals that more availability to clean fuels and technology is linked to a decline in yearly GDP growth.

The coefficient and standard error of the variable CPI Policy are 0.666 and 0.940, respectively. This variable is not statistically significant, as indicated by the z-value of 0.71 and the p-value of 0.479. This suggests that institutional and policy elements as measured by the CPIA have no discernible impact on GDP growth in this particular context. On the other hand, the variable access to clean fuels and technologies has a standard error of 0.0078 and a coefficient of -0.051 . With a p-value of 0.000 and a z-value of -6.59 , it is extremely statistically significant. The negative coefficient indicates that there may be a trade-off between investing in clean energy and achieving rapid economic growth. It also reveals that more availability to clean fuels and technology is linked to a decline in yearly GDP growth. The coefficient and standard error of the variable CPI policy are 0.66 and 0.94, respectively. This variable is not statistically significant, as indicated by the z-value of 0.71 and the p-value of 0.479. This suggests that institutional and policy elements as measured by the CPIA have no discernible impact on GDP growth in this particular context.

Conclusion

The study provides a comprehensive analysis of the economic impact of fiscal consequences on regional development in ASEAN countries. The results showed the importance of industry in determining GDP growth, regional differentiation and overall economic growth. Given its ability to reduce infrastructure costs, increase economies of scale and facilitate participation in global manufacturing, investment in infrastructure is certainly a key driver economy grows Analysis showed that, despite ASEAN countries spending heavily on infrastructure, this spending consistently impressed the region as a whole No economic impact

The differences mentioned earlier emphasized the need for robust, deliberate policies to ensure that infrastructure spending adequately addresses local disparities and fosters sustainable expansion.

Quantitative analysis using panel data from six ASEAN countries spanning nearly 20 years sheds important light on the relationship between infrastructure spending and economic outcomes. The results indicated that although infrastructure spending increases GDP growth, regional differences and sustainability issues mitigate this effect. Notably, there is a negative correlation between GDP and the availability of fuel and clean cooking technology, which are used as proxies for regional differences. This suggests that increases in access to basic services may not always be delivered there have been rapid economic gains but may be more indicative of serious structural problems affecting regional development. Digits do not show a statistically significant direct impact on GDP, emphasizing the need for sustainable strategies emphasize the proper use.

The study also highlights the importance of combining infrastructure spending with a comprehensive community integration strategy. There is a need to promote regional economic stability and integration with better infrastructure, as projects such as the inter-ASEAN gas pipeline and inter-ASEAN highways have shown but limitations include financial, governance restrictions problems and developments make it difficult to effectively allocate services. Ways in which policymakers will be more effective. Approaches must be adopted that are sensitive to local needs, strengthen governance structures, and leverage public-private partnerships. Although money investment in infrastructure has great potential for community development though its success depends on good planning and implementation. The study results supported comprehensive policies that promote regional integration, address regional differences, and prioritize sustainable practices. ASEAN countries can unleash the potential of infrastructure investment effectively promote equitable and sustainable economic development throughout the region by developing infrastructure projects in line with this transcendental objective.

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