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DOES INFRASTRUCTURE DEVELOPMENT MATTER FOR ECONOMIC GROWTH? THE SRI LANKAN EXPERIENCE

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Abstract

The strong surge in investment with the liberalization in Sri Lanka in 1977 included extensive infrastructural development. Further, once the civil conflict ended in 2009, policymakers gave infrastructure improvement a lot of attention. However, impact of infrastructure on economic growth is still frequently debated and understanding the nature and duration of its impact is pivotal for effective policy formulation and investment strategies. In this context, the study examines whether infrastructure development has contributed to Sri Lanka's economic growth in short run and long run, using Error Correction Model for the period of 1978 - 2021. We have made the assumption that economic growth can be described as a function of labour, capital, and the infrastructure index, which encompasses factors such as telephone availability, electricity power, road length, rail density, cargo handling at the ports and air kilometers. The study finds that the contribution from infrastructure is vital for economic growth of Sri Lanka and appropriate policies are prescribed to enhance infrastructure.

Keywords: Infrastructure, Economic growth, Error Correction Model Jel Classification: H54, O40, C32.

INTRODUCTION

Infrastructure can be broadly defined as the fundamental structural foundation of a society or an enterprise, including roads, water supply, sewage systems, power grids, flood control systems, telecommunications. The majority of industrialized nations carry out government-led infrastructure development initiatives in their early phases of growth. Infrastructure spending has the potential to increase productivity, which supports future economic growth. An effective infrastructure network can also encourage fresh investment in other sectors as well, boosting the economic pace of a country. As an example, a contemporary telecommunications infrastructure is essential for emerging countries to compete in international markets, draw in new investment, and foster domestic economic progress. However, the relationship between infrastructure development and economic growth remains a topic of debate.

In low-competition market structures, infrastructure services are often provided by centrally managed public enterprises or government departments in developing countries. However, both current and potential users of infrastructure often lack the ability to effectively use these services. The price mechanism influences production and investment decisions, but government expenses are often not reflected in prices, resulting in lost customer data. Despite the fact that excessive customer demand brought on by artificially low prices is rarely a reliable sign for service expansion.

The public sector is often the primary funder and provider of infrastructure due to its non-rival consumption (a user's consumption does not decrease the supply available to other users) and non-excludable (a user cannot be excluded from the supply when they consume it) characteristics. However, budgetary constraints often hinder investment in many nations, particularly emerging ones. As a result, public-private partnerships (PPP) are being pushed more and more to boost infrastructure investment and lessen the load on government spending. Furthermore, developing nations need support from developed economies for infrastructure development, including grants, concessional loans, and technical assistance.

Infrastructure services are crucial for economic development, but their effectiveness is often questioned due to operational inefficiencies, poor maintenance, excessive reliance on public finances, failure to meet user demands, restricted benefits to marginalized communities, and inadequate environmental stewardship. Poor performance is indicated by output loss, leading to economically unsound investments.

Significant infrastructure development projects were initiated in post - conflict Sri Lanka focusing constructing and upgrading various transport systems such as roads, railways, ports, and airports. Connections of electricity and telecommunications were improved considerably. Overall, these infrastructure development projects were expected to have a positive impact on Sri Lanka's economy, opening up new opportunities for both individuals and businesses, and accelerating the country's economic growth. In this context, both public and private sectors have increased investment in infrastructure, with the private sector gaining prominence due to government funding limitations. However, the public sector's leadership is still essential for some infrastructure projects, such as those involving roads, railroads, dams, water supply, and port development, particularly when the private sector is hesitant to participate. The nation has successfully negotiated large amounts of grants and concessional loans from foreign governments and international organizations to finance projects.

Sri Lanka continues to have a modest advantage in infrastructure development over some of its peer countries. Following the civil conflict, large-scale road development projects have been undertaken, with support from organizations like the World Bank and the Asian Development Bank. The telecom industry in Sri Lanka has become a dynamic sector due to private sector involvement and economic liberalization. Sri Lanka's telecommunications sector reached 30 million mobile subscribers by 2021, driven by advanced technology, affordability, competition, and efficient supply chain mechanisms. In the energy sector, it experienced significant growth in recent decades, with changes in distribution, consumption patterns, supply, and institutional development. The industry still depends mostly on thermal power, making Sri Lanka one of the nations with the highest costs associated with producing electricity.

Given the importance of infrastructure development for sustainable economic growth in Sri Lanka, this study investigates the short run as well as long run causality between infrastructure development and economic growth in Sri Lanka using data for the period 1978 - 2021. This study is country-specific and focuses on Sri Lanka, in contrast to the many previous cross-sectional or panel data studies on a vast number of countries where each country may not be a representative sample. Furthermore, this study develops a composite index of a stock of leading physical infrastructure indicators to examine the impact of infrastructure development on economic growth, whereas many previous literature on the growth effects of infrastructure focuses on a single infrastructure sector or a few sectors, separately. Accordingly, the main contribution of this paper to the existing literature is its attempt to use a composite index to examine the relationship between infrastructure development and economic growth in Sri Lanka.

The remainder of the paper is structured as follows: Section 2 presents a review of literature while Section 3 brief theoretical framework, construction of the Infrastructure Index and data sources. Section 4 analyses the econometric results. Finally, conclusion and recommendations are given in Section 5.

LITERATURE REVIEW

This section refers to reviewing empirical studies on the relationship between infrastructure development and economic growth in various international settings. It finds varying strength of correlations depending on countries and economic development phases. Some economies in global as well as regional context show a positive relationship while others with negative relationship between infrastructure development and economic growth. With these unobvious findings, this study aims to identify the existing effects of infrastructure development on economic growth in Sri Lanka.

The World Bank emphasized the link between infrastructure development and economic growth in 1994, with China's experience highlighting the importance of infrastructure. Easterly and Rebelo (1993) in their study, using cross-section data, found a positive relationship between economic growth and public investment in infrastructure, particularly transportation and communications, and a significant portion of total public investment.

Alleman et al. (1994) found a positive correlation between infrastructure investment and economic development in the Southern African Development Community. The study concluded that telecommunications investment and economic development have a considerable positive link, but economic growth cannot be guaranteed by this factor alone. Canning (1998) using panel data concluded that paved roads and telephones have the biggest effects on fostering economic growth, but undersupply can hinder it. Canning and Pedroni (2004) used Barro's growth model and a panel dataset of countries ranging from 1950 to 1992 to examine whether infrastructure stocks were optimally balanced for growth. Their research showed that GDP per capita and infrastructure have a two-way causal relationship, with GDP per capita being affected by shocks to infrastructure and infrastructure reacting to GDP per capita.

A thorough panel dataset spanning over 100 countries from 1960 to 2000 was analyzed by Calderon and Serven (2004), who condensed their findings into five main points including infrastructure quantity and quality have a strong negative impact on income inequality, and infrastructure stocks' volume has a significant positive impact on long-term economic growth. Overall, their findings imply that infrastructure reduces income disparity while also fostering economic growth.

KIM (2006) compared Japan's experience with South Korea, highlighting Japanese colonial investments in transportation and energy sectors aided industrialization and urbanization. These infrastructural expenditures improved productivity, raised regional production, and indirectly decreased production costs. The study of Yoshino and Nakahigashi (2004) found that infrastructure in Thailand and Japan significantly impacts productivity, with agriculture having a less significant effect in Japan. However, in Thailand, the manufacturing industry's impact was less significant than agricultural infrastructure. Their findings do not demonstrate that infrastructure directly decreased income inequality.

Hardy (1980) in his study using data from 45 countries found a significant correlation between GDP growth and telephone penetration, with the least developed economies showing the strongest two-way association. Tella et al. (2007) found mobile phone penetration significantly impacted Nigeria's economic growth. Stern and Cutler (2004) found a strong correlation between energy use and economic growth, with energy availability playing a major role. They suggested that switching to higher-quality fuels could explain a significant portion of the energy intensity drop.

Straub et al. (2008) found mixed results on the relationship between infrastructure investment and economic growth across five countries. Accordingly, roads have only favorably impacted on Thailand's total factor productivity (TFP) growth, while telecommunications investment contributed more to growth in Indonesia and the Philippines. Bougheas et al. (1999) extended Romar's endogenous growth framework to explore the relationship between infrastructure and economic growth. They found that infrastructure accumulation is crucial, especially for poor countries.

Rodriguez (2007) using a data set of country-level infrastructure stocks for 121 countries since 1960 also found evidence supporting the benefits of infrastructure investment on growth and productivity but found limited evidence supporting the idea that shrinking infrastructure provision leads to widening disparities.

A cost function that included infrastructure elements including power, communication, and transportation in Mexico was estimated in Shah's study (1992). The results showed that public infrastructure has a small but positive output multiplier effect. The estimated rate of return is between 5 and 7 percent, and the output's elasticity to a 1 percent change in infrastructure level is 0.05 percent. Aschauer (1989) found that a 1 percent increase in the ratio of public to private capital stock was associated with a 0.39 percent increase in total factor productivity in the private sector, based on annual time series data for the United States from 1949 to 1985. Sahoo et al. (2010) revealed that infrastructure development in China has a significant positive contribution than both private and public investment.

Perkins (2003) found a strong, long-term correlation between South Africa's GDP and infrastructure. Similarly, Kuralatne (2006) found that, either directly or indirectly, spending on social and economic infrastructure has a positive and considerable impact on South Africa's per capita gross value added (GVA). According to Fedderke and Garlick (2006), investment in infrastructure does appear to lead economic growth in South Africa. Fan and Chan-Kang (2005) found that low-quality roads in China have four times higher benefit-cost ratios for national GDP than high-quality roads, and that these roads elevate more rural and urban poor people over the poverty line for every Yuan invested.

There are few studies suggest that there is no relationship between infrastructure development and economic growth. Devarajan et al. (1996) found that current expenditure growth positively impacts economic growth in 43 developing countries over 20 years. However, they found a negative correlation between the capital portion of public spending and per capita growth.

In the context of South Asia, Mohanty and Bhanumurthy (2020), find that physical infrastructure has a positive effect on Indian economic growth both in the long run and short run, and the causality test supports a bidirectional causal relationship between infrastructure development and economic growth. Hulten et al. (2005) found that infrastructure investments significantly impact India's manufacturing sector's productivity growth. Wijayatunga and Jayalath (2003) in their study found that power outages in Sri Lanka could cause significant losses, potentially affecting the country's GDP by 0.9 percent. Unscheduled outages resulted in losses 1.6 times greater than scheduled outages. In their similar study (2008) for Bangladesh found that the industrial sector's losses from unscheduled power outages average US dollars 0.83 per kWh, while losses from scheduled outages only amount to US dollars 0.34 per kWh.

Based on the aforementioned empirical studies, many have concentrated on specific infrastructure sectors such as telecommunications, energy, or transport. However, some authors have examined multiple sectors simultaneously. According to these studies, most authors argue that there is a positive correlation between infrastructure development and both economic growth and poverty reduction. Overall, it is suggested that the impact of public capital or infrastructure varies across countries, regions, and sectors depending upon quantity and quality of the capital stock and infrastructure development.

Theoretical Framework and Infrastructure Index, and the Data

The production function concept has been applied in several empirical studies investigating the effect of infrastructure investment on economic growth. Using a generalized Cobb-Douglas production function and extending the neoclassical growth model to incorporate infrastructure stock as an additional input, the production function can be represented as follows.

$$Y_t = f(K_t, L_t, I_t) \quad . \; . \; . \; . \; . \; . \; . \; (1)$$

Where Yt is gross output in an economy using inputs such as capital (Kt), labour force (Lt) and infrastructure stock (It). The equation (1) specifies that growth depends on capital, labour and infrastructure. The Solow growth model explains the possibility of constant returns to scale in this expanded form of the equation. The endogenous growth model's suggestion of either constant or increasing returns on capital is also acknowledged by the model. The long run impact of infrastructure on economic growth depends on whether data are produced by an endogenous growth model or a Solow growth model. Shocks to the infrastructure stock can only have temporary consequences in the exogenous growth paradigm, which holds that long-term growth is driven by technological advancement. To investigate the effect of Sri Lanka's infrastructure stock on output, we estimate the following equation.

$$LnY_t = \alpha + \beta_1 \, lnK_t + \beta_2 \, lnL_t + \beta_3 \, lnIndex_t + e_t \; . \; . \; . \; . \; . \; . \; . \; . \; (2)$$

The expected sign of (β1, β2 and β3) is > 0.

Infrastructure Index: Using a range of definitions, including infrastructure investment or particular physical infrastructure indicators, the empirical literature has investigated the effect of infrastructure on economic growth. Using the methodology of Sahoo et al. (2010), a composite index of important infrastructure variables was created in this study to examine the relationship between infrastructure and economic growth. Six major infrastructure indicators were included in the composite index, which was created using Principal Component Analysis. These indicators included per capita electricity power consumption; telephone line per 1,000 population; rail density per 1,000 persons; percentage of class A roads and expressway out of total roads; total cargo handled at the ports; and air kilometers flown to measure the level of infrastructure. From 1978 to 2021, the level of infrastructure was measured using these indicators.

This composite measure functions as an index of the economy's infrastructure level, which helps to address problems with multi-collinearity and over-parameterization. More than 70 percent of the variation in the variable can be explained by the first main component. The primary principal component is utilized to create a composite index that captures the overall variance across different infrastructure dimensions, as indicated by the six variables, based on the ordered eigen values. The factor loadings for each of the six original variables are shown in Appendix 1.

Data: Annual data on real gross domestic product and gross capital formation are taken from Annual Reports of the Central Bank of Sri Lanka. Gross capital formation has also been taken in real terms by dividing GDP deflator. Labour force data are available only from 1990 and therefore data has been back casted from 1978 - 1989. Six Infrastructure variables considered for infrastructure index are compiled based on the data extracted from the Central Bank Annual Report in various years. The study period is 1978 - 2021. The reason for employing data from 1978 is that it was the year that Sri Lanka focused on mega infrastructure development projects after the open economy.

Unit Root Tests

In order to avoid spurious regressions while studying time series data, stationarity must be examined. Examining the stationarity of variables is essential, especially in light of the fact that a large number of time series variables in the economic domain show stochastic tendencies. When a time series is said to be stationarity, it means that important statistical characteristics like mean, variance, and autocorrelation are true over the course of the data.

There are two methods for determining whether time series data is stationarity. The initial method entails examining time series plots visually to detect trends or seasonality. The second method involves statistical tests. If the variable is non-stationarity at levels, the subsequent step is to test the difference of series. If the variable attains stationarity after being differenced once, it is referred to as integrated of order one or I(1). Common unit root tests in econometric studies include the Dickey and Fuller test (DF), the Augmented Dickey-Fuller test (ADF), and the Phillips-Perron test (PP). In this study, stationarity properties are assessed using the ADF test. This thorough examination ensures a comprehensive understanding of the stationarity characteristics of the variables in the time series data.

Autoregressive Distributed Lag (ARDL) Method

Next, we proceed with the autoregressive-distributed lag (ARDL) method, as formulated by Pesaran et al. (2001), to analyze the long-term dynamics among variables. This approach mandates that the variables involved in the cointegration relationship possess the same order of integration.

The equations to check long run relationship and short run relationship between variables are given below as equation 3 and 4, respectively:

$$GDP_t = \propto \ + \beta K_t \ + \ \Upsilon L_t + \ \partial INDEX_t \ + \ \varepsilon_t \qquad . \ . \ . \ . \ . \ (3)$$

$$\Delta GDP_t = \propto \ + \beta \Delta K_t \ + \ \Upsilon \Delta L_t + \partial \Delta INDEX_t \ \ \varepsilon_t \qquad . \ . \ . \ . \ . \ (4)$$

The ARDL (p,q) model can be expressed generally in the following way:

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{p} \lambda \Delta Y_{t-i} + \sum_{i=0}^{q} \delta \, \Delta X_{t-i} + \Phi_1 Y_{t-1} + \Phi_2 X_{t-1} + V_t \quad . . . . (5)$$

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ARDL short run term long run term

Where Yt is the GDP growth, Xt are the other independent variables such as capital, labour and the infrastructure index. P is the lags of the auto regressive terms, and the q is the lags of exogenous variables.

Choosing the optimal number of lags in an ARDL model holds significance to accurately capture the dynamics within the data. This selection process typically integrates various statistical tests, information criteria, and graphical analysis to make a well-informed decision.

Using the above equation, the general model for ARDL for I (1) variables is given as:

$$\Delta Y_t = \propto \ + \beta \Delta K_t \ + \ \Upsilon \Delta L_t + \partial INDEX_t \ - \ \theta(Y_{t-1} - \ \alpha p K_{t-1} - \ \Upsilon L_{t-1} - \partial INDEX_{t-1}). . .(6)$$

Error Correction Model

Error Correction Models (ECMs) incorporate an error correction term, which gauges the rate of adjustment towards the long-run equilibrium. This term captures the short-term dynamics, ensuring that the model rectifies deviations from equilibrium. ARDL models are appropriate when there is no cointegration, and variables move independently in the long run. Conversely, the presence of cointegration suggests a long-term relationship among variables. An ECM aims to capture the corrective process back to this long-term equilibrium in the event of short-term deviations. The error correction version of the ARDL model is expressed as follows:

$$\Delta lnY_t = \alpha_0 + \sum_{i=0}^{p} \beta_{1i}\, \Delta lnY_{t-i} + \sum_{i=1}^{p} \beta_{2i}\, \Delta lnK_{t-i} + \sum_{i=1}^{p} \beta_{3i}\, \Delta lnL_{t-i} + \sum_{i=1}^{p} \beta_{4i}\, \Delta lnIndex_{t-i} + \beta_5\, lnY_{t-i} + \beta_6\, lnK_{t-i} + \beta_7\, lnL_{t-i} + \beta_8\, lnIndex_{t-i} + \varepsilon_t \quad \ldots\ldots (7)$$

The existence of the long run relationship is confirmed with the help of an F-test that tests. The null hypothesis (H0) in the equation is β5 = β6 = β7 = β8 = 0, which means the non-existence of the long run relationship.

RESULTS AND DISCUSSIONS

This section aims to statistically validate the established relationships between infrastructure and economic growth within the context of Sri Lanka.

The first step is examining the stationarity properties of the variables, GDP, Capital, Labour and infrastructure. The order of the variables' integration is ascertained, and unit roots are tested for using the ADF test. Table 1 makes it clear that every variable has unit roots at the level below a 10 percent significant level, meaning that they are not stationary. On the other hand, first differenced series are found to be stationary when unit root tests are run on first differences of these variables. As a result, it is possible to conclude that every variable is integrated of order one I(1).

Table 1: ADF Test for Unit Root

Variable	Indicator	ADF Test		Order of Integration
		Level	First Difference	
GDP	t statistic	-1.150	-3.441	I (1)
	p value	0.687	0.062	
Capital	t statistic	0.362	-5.645	I (1)
	p value	0.979	0.000	
Labour	t statistic	-1.756	-6.350	I (1)
	p value	0.397	0.000	
Index	t statistic	-1.730	-7.200	I (1)
	p value	0.410	0.000	

As time series are I(1), the cointegration text can be performed on this to check the long run relationship among the variables.

Source: Developed by author

Autoregressive Distributed Lag Model (ARDL)

The ARDL test was employed to assess the presence of a long-term relationship among the variables. As presented in Table 2, the ARDL bound test demonstrates the presence of one cointegrating vector among economic growth, capital, labor force, and infrastructure index.

Table 2: ADRL Bound Text Results

Significance Level	Bounds	F Statistics
		4.517
		Bounds Critical Values
10.0%	I (0)	2.20
	I (1)	3.09
5.0%	I (0)	2.56
	I (1)	3.49
2.5%	I (0)	2.88
	I (1)	3.87
1.0%	I (0)	3.29
	I (1)	4.37

Note: The critical value bounds are computed by stochastic simulations using 1000 replications.

Source: Developed by author

As calculated F-statistic is higher than upper bound (I(1)) critical values, the null hypothesis of no long-run (equilibrating) relationship can be rejected in all four significance level. This confirms the existence of a long-run relationship irrespective of order of integration of variables.

An alternative method of finding cointegration, the Engle-Granger two-step method was also performed. This is a straightforward approach to test for cointegration between non-stationary time series data. Residuals are given in Appendix 3.

Pair-wise Granger causality test which provides a useful tool to investigate the causal relationship between two variables in a time series context, is also performed. Results are presented in Appendix 4.

Additionally, above ARDL bound test and Engle-Granger two-step method reject the null hypothesis of no cointegration with one cointegrating vector. Consequently, it can be inferred that there is substantial evidence substantiating the existence of a long-term relationship between economic growth and infrastructure development.

The ARDL equation is written in the following form using values of cointegration matrix generated by E-views.

$$LRGDP = -0.567 + 0.415\ LLABOR + 0.667\ LCAPITAL + 0.093\ LINDEX \quad \ldots\ldots..(8)$$

[-0.708]   [3.16]   [22.37]   [2.55]

Where, LRGDP is log of real GDP, LLABOR is log of labour, LCAPITAL is log of capital and LINDEX is log of infrastructure index.

As per the estimated equation above, a 1 per cent increase in the labour force would increase 0.415 percent of GDP and 1 percent increase in capital would increase GDP by 0.667 percent, while an increase in infrastructure by 1 percent, would increase GDP by 0.093 percent, when remaining all other things being constant.

Estimation of ARDL Models

Regression models, including ARDL models, can be diagnostically assessed for structural stability using the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) tests. When conducting time series analysis to find structural breaks or changes in the relationship between variables over time, these tests are especially helpful. The CUSUM test involves plotting the cumulative sum of recursive residuals derived from the regression model against time. A stable regression model will exhibit a CUSUM plot that remains within a certain range. The CUSUMSQ test is an extension of the CUSUM test that considers the cumulative sum of squared recursive residuals. This test is more sensitive in detecting alterations in the variance of the residuals over time.

The null hypothesis regarding the stability of the calculated coefficients of the ARDL model cannot be rejected because both the CUSUM and CUSUMSQ statistics stay within the critical bounds of the 5 percent level of significance. Figures 1 and 2 corroborate this assertion that the calculated ARDL model is stable.

Figure 1: CUSUM test

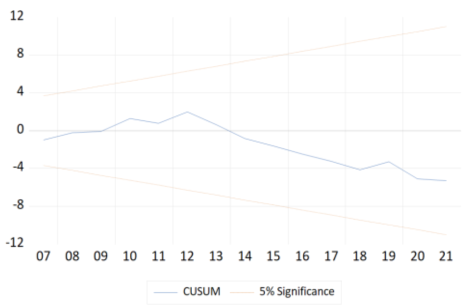
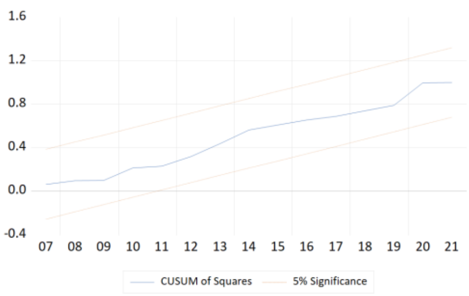


Figure 2: CUSUM of square test



Source: Developed by author

Error Correction Model

The results reveal the existing of long-run relationship between the infrastructure and economic growth in Sri Lanka. It is provided with statistical evidence to proceed with investigating long run coefficients using the ARDL error correction version to ascertain the magnitudes of the existing relationship.

We will use the ECM of ARDL to estimate the short-run dynamics among the variables, since the Bounds test proved a long-run co-integration among the variables. The error correction term is negative and significant. This shows a high level of speed of adjustment to long-run equilibrium following a short-run shock. A summary of the ECM results is presented in Table 3.

Table 3: Results of the ECM

Variable	Coefficient	Standard Error	P Value
Constant	0.035	0.007	0.000
EC(-1)	-0.064	0.084	0.045
ΔlnL	0.065	0.153	0.675
ΔlnK	0.236	0.058	0.000
ΔlnIndex	0.032	0.017	0.071

*R2=0.45; F-statistic =4.9(0.00***); Durbin-Watson stat=1.98*

Source: Developed by author

According to Table 3, the error correction term has the right negative sign and is statistically significant at the 5 percent level, as predicted theoretically. It can be inferred that Sri Lanka's GDP adapts to changes in the independent variables because the error correction term is large. This implies that the variables in the cointegrating equation have a connection of steady equilibrium. Further, this validates the use of the error correction model and reconfirms that the variables are cointegrated. The coefficients of the variables ΔlnK, ΔlnL and ΔlnIndex are short run parameters, measuring the short run impact on the dependent variable Δln GDP.

Literature provides many examples supporting the above result. Canning and Pedroni (1998) and Mohanty and Bhanumurthy (2020), find that between infrastructure development and economic growth has both long run and short run relationship. In the meantime, Perkins (2003) found a strong, long-term correlation between South Africa's GDP and infrastructure.

CONCLUSION AND RECOMMENDATIONS

This study investigates the empirical relationship between infrastructure development and economic growth in Sri Lanka spanning from 1978 to 2021 using ARDL and ECM techniques. In contrast to previous research, this study evaluates the influence of physical infrastructure on economic growth by creating a composite index for infrastructure stocks. The infrastructure level statistically significant coefficient shows that there is a statistically significant correlation between GDP and infrastructure levels in the results. Further, it indicates that there exist both short run and long run relationship between infrastructure development and economic growth.

The results indicate that policy makers should devise plans to raise the country's infrastructure in order to boost its economic expansion. Thus, in order to achieve overall economic growth, policy must be concentrated on establishing a comprehensively favorable environment. While loans can be an essential source of funding for infrastructure projects, relying solely on borrowed funds can burden government with heavy debt obligations in the long run. Therefore, infrastructure development financed by non-loan funds is crucial for fostering sustainable economic growth, promoting social equity and ensuring long term prosperity.

Based on the findings, this study proposes several avenues for further investigation and potential extensions to its research scope. There is a possibility to include more infrastructure facilities such as road transportation, water supply and irrigation to the index. Given its exclusive focus on physical infrastructure, it recommends investigating the effects of social infrastructure, such as healthcare and education, to offer a more comprehensive understanding of their impacts.

REFERENCES

Alleman J., Hunt C., Michaels D., Mueller, M., Rappoport P. and Taylor L. (1994), “Telecommunications and Economic Development: Empirical Evidence from Southern Africa”, In Proceedings of the 10th Biennial International Telecommunications Society Meeting, Sydney, Australia

Aschauer D. A. (1989), “Is Public Expenditure Productive”, Journal of Monetary Economics, pp. 177-200

Bougheas S., Demetriades P. O., and Mamuneas T. P. (1999) “Infrastructure, Specialization and Economic Growth”, Department of Economics, University of Cyprus

Calderon C. and Serven L. (2004), “The Effects of Infrastructure Development on Growth and Income Distribution”, Available at SSRN: https://ssrn.com/=625277

Central Bank of Sri Lanka - Annual Reports

Canning, D. (1998), “A Database of World Stocks of Infrastructure, 1950–1995”, World Bank Economic Review 12(3), pp. 529–47

Canning D. and Pedroni P. (2004) “The Effect of Infrastructure on Long-run Economic Growth”

Devarajan S., Swaroop V. and Zou H. (1996), “The Composition of Public Expenditure and Economic Growth”, Journal of Monetary Economics 37(2), pp 313-344

Easterly W. and Rebelo S. (1993), "Fiscal policy and Economic Growth: An Empirical Investigation", Journal of Monetary Economics, Elsevier, Vol. 32(3), pp 417-458

Estache A and Fay M. (2007) "Current Debates on Infrastructure Policy", Poverty Reduction and Economic Management Vice - Presidency, The World Bank

Fan S. and Chan-Kang C. (2005), "Road Development, Economic Growth, and Poverty Reduction in China" Research Report 138, International Food Policy Research Institute

Fedderke J. and Garlick R. (2006), "Infrastructural investment in long-run economic growth: South Africa 1875–2001, World Development, 34(6), pp 1037-1059

Hardy A. P. (1980) "The Role of Telecommunications in Economic Development", Institute for Communications Research, Stanford University, California

Hulten C. R., Bennathan E. and Srinivasan S. (2005) "Infrastructure, Externalities and Economic Development: A Study of Indian Manufacturing Industry", World Bank Research Project

KIM B. (2006) "Infrastructure Development for the Economic Development in Developing Countries: Lessons from Korea and Japan", GSICS Working Paper Series, Kobe University

Kularatne C. (2006) "Social and Economic Infrastructure Impacts on Economic Growth in South Africa" The Brichwood Hotel and Conference Centre, South Africa

Mohanty R. K. and Bhanumurthy N. R. (2020), "Analyzing the Dynamic Relationships between Physical Infrastructure, Financial Development and Economic Growth in India", Asian Economic Journal

Pesaran M. H., Shin Y. and Smith R. J. (2021), Bounds Testing Approaches to the Analysis of Level Relationships, Journal of Applied Econometrics

Rodriguez F. (2007) "Have Collapses in Infrastructure Spending Led to Cross - Country Divergence in Per Capita GDP?", Working Paper 52, United Nations Department of Economics and Social Affairs

Sahoo P., Dash R. K. and Nataraj G. (2010), "Infrastructure Development and Economic Growth in China", IDE Discussion Paper No. 261, Institute of Development Economies

Shah A. (1992), "Dynamics of Public Infrastructure, Industrial Productivity and Profitability", The Review of Economics and Statistics, 74(1), pp. 28-36

Stern D. I. and Cutler J. C. (2004) "Energy and Economic Growth", Rensselaer Working Papers in Economics, No. 0410

Straub S., Vellutini C. and and Warlters M. (2008) "Infrastructure and Economic Growth in East Asia", Policy Research Working Paper Series 4589, World Bank

Tella S. A., Amaghionyeodiwe L. A. and Adesoye B. A. (2007) "Telecommunications Infrastructure and Economic Growth: Evidence from Nigeria", UN-IDEP and AFEA

Wijayatunga P. D. C. and Jayalath M. S. (2003) "Assessment of Economic Impact of Electricity Supply Interruptions in the Sri Lanka Industrial Sector", Energy Conversion and Management, Elsevier Ltd.

Wijayatunga P. D. C. and Jayalath M. S. (2008) "Economic Impact of Electricity Supply Interruptions on the Industrial Sector of Bangladesh", Energy for Sustainable Development, The Journal of the International Energy Initiative

World Development Report (1994) "Infrastructure for Development" World Bank, Washington D.C.

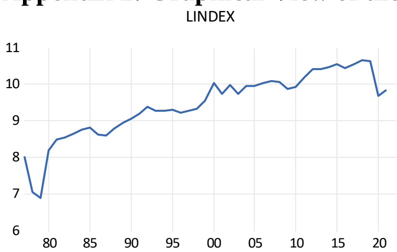
Yoshino N. and Nakahigashi M. (2004) "The Role of Infrastructure in Economic Development", ICFAI - Journal of Managerial Economics

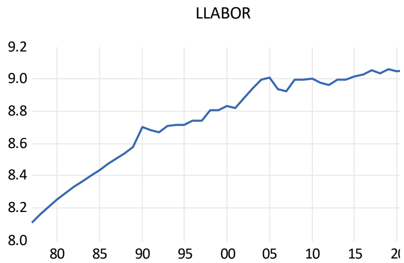
APPENDIX

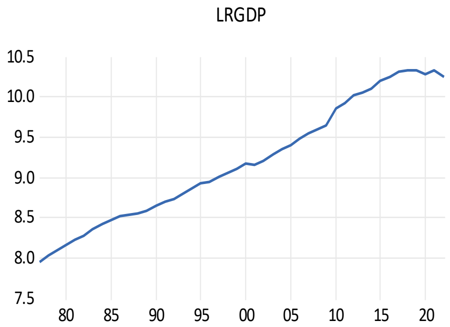
Appendix 1: Principal Component Analysis Summary Results

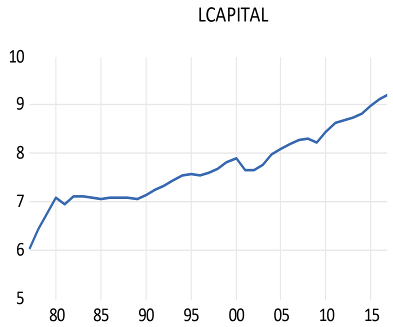
Variable	PC 1	PC 2	PC 3	PC 4	PC 5
ELEC	**0.5090**	0.0026	-0.1921	0.1875	0.8178
ENERGY	**0.4945**	0.0262	0.4773	0.6400	-0.3425
RAIL	**-0.1604**	0.9741	0.0999	0.0658	0.1051
TELE	**0.4789**	0.2067	-0.7207	-0.0814	-0.4493
AIR	**0.4913**	0.0875	0.4537	-0.7377	-0.0303

Appendix 2: Graphical View of the Data

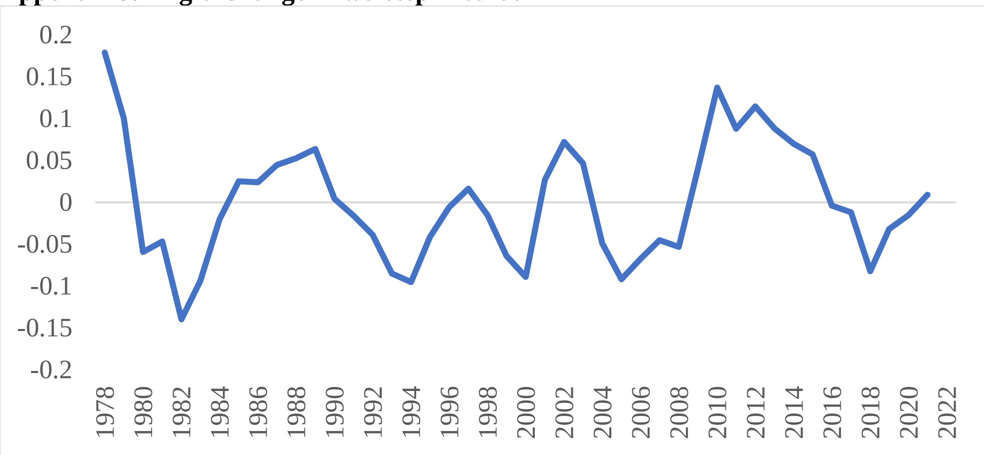








Appendix 3: Engle-Granger Two-step Method



Appendix 4: Pair-wise Granger Causality Tests

Null Hypothesis	Obs	F-Statistic	P Value
INDEX does not Granger Cause CAPITAL	43	9.911	0.000
CAPITAL does not Granger Cause INDEX		22.657	0.000
LFORCE does not Granger Cause CAPITAL	43	0.871	0.427
CAPITAL does not Granger Cause LFORCE		0.042	0.959
RGDP does not Granger Cause CAPITAL	44	11.391	0.000
CAPITAL does not Granger Cause RGDP		17.089	0.000
LFORCE does not Granger Cause INDEX	43	3.562	0.038
INDEX does not Granger Cause LFORCE		0.540	0.587
RGDP does not Granger Cause INDEX	43	5.161	0.010
INDEX does not Granger Cause RGDP		2.843	0.071
RGDP does not Granger Cause LFORCE	43	0.270	0.765
LFORCE does not Granger Cause RGDP		2.332	0.111