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DOES TRANSPORT INFRASTRUCTURE SPUR ECONOMIC GROWTH IN SOUTH AFRICA? AN EMPIRICAL INVESTIGATION

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Abstract. *This study examines the dynamic impact of transport infrastructure development on economic growth in South Africa using data from 1992 to 2021. The study was motivated by the potential of transport infrastructure as a driver of economic growth and the lack of conclusive results from the empirical studies undertaken on the subject to date. In addition, South Africa has a developed transport infrastructure; hence, it would be beneficial for policymakers to understand the exact nature of the impact that the transport infrastructure development has on the country's growth trajectory. Using the autoregressive distributed lag bounds approach, the results of the study revealed that in South Africa, transport infrastructure development has a positive impact on economic growth only in the long run, as no significant impact was established in the short run. Thus, in South Africa, investing in transport infrastructure leads to increased economic growth in the long term. It is, therefore, recommended that pro-transport infrastructure policies, as part of the country's long-term economic planning strategy, be adopted to boost the country's economic growth.*

Key words: *Transport infrastructure, public transport expenditure, economic growth, South Africa*

JEL Classification: O40, L90

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1. INTRODUCTION

The role of infrastructure in economic development has been put under scrutiny as economists, politicians and policy makers alike seek ways of boosting economic growth in various economies. The outcome of such studies bore one weakness – the results have less power to lead policy makers to precise action plans, as infrastructure is too wide a concept (Development Bank of Southern Africa "DBSA", 2023). Thus, although infrastructure is deemed key to economic growth and development by many scholars and developmental institutions, it comes as a wide spectrum, ranging from information and communication technology (ICT), transport, energy, and water and sanitation to health, housing and education infrastructure (DBSA, 2023). However, among these variants, transport infrastructure is generally regarded as one of the key infrastructures required for economic growth (see Heintz *et al*., 2009; Hasselgren, 2018; Zheng and Cheng, 2023), through its ability to provide support for manufacturing and general production activities in an economy (Fourie, 2006; Torrisi, 2009; Zheng and Cheng, 2023). Transport, according to Fusiek (2022) and the DBSA (2023), is key to development through its ability to foster wealth, equality, and well-being in every economy, especially in less-developed countries.

Effective modes of transport, backed by meaningful investment in transport infrastructure, enable the timely movement of goods and services to markets and facilitate workers' movement to the most suitable jobs (World Economic Forum, 2016; Organisation for Economic Co-operation and Development, 2023). This was a recognition that dates back to the 1770s Wealth of Nations by Adam Smith (1776), where navigable rivers, canals, and good roads were acknowledged for nearly putting remote parts of the country on a level with those in the neighbourhoods of towns.

On the one hand, South Africa is generally regarded as having a well-developed transport infrastructure, yet it has been struggling to come out of a chronic economic "depression," with annual growth rates falling since 2011 (Statistics South Africa, 2023). On the other hand, empirical studies undertaken on the relationship between these two macroeconomic variables have been far from being conclusive and have been mainly concentrated in European and Asian countries (see, among others, Ng *et al*., 2019; Zheng and Cheng, 2023). This is despite this widely accepted notion that infrastructure, in general, and transport infrastructure, in particular, is good for economic growth.

Although some studies are available on the relationship between infrastructure development and economic growth in South Africa, some of these studies focused mainly on specific sectors or regions within South Africa (see Hlotywa and Ndaguba, 2017, for road transport and economic growth; and Hanyurwumutima and Gumede, 2021, for a provincial focus). Others have also focused mainly on the causality between transport infrastructure and economic growth (see Selamolela 2018).

Against this backdrop, this study aims to investigate the dynamic impact of transport infrastructure development on economic growth in South Africa. The study uses the autoregressive distributed lag (ARDL) bounds approach to examine this linkage as it has the power to assess the dynamic impact of the transport infrastructure development on economic growth, unlike the earlier studies that used static methods (see, for example, Hlotywa and Ndaguba, 2017). Further, the study splits the regression into long-term and short-term, emphasizing the importance of the time dimension in the key dynamics of interest in this study. Additionally, unlike some previous studies that investigated the relationship between infrastructure development in general and economic growth (Palei, 2015; Timilsina *et al*., 2024), this study focusses on the impact of transport infrastructure development on economic growth. The results of the study are envisaged to contribute to finding the economic growth silver bullet for South Africa and help policymakers design the required mixed bag of evidence-based policymaking in the transport sector, with positive implications for growth in the real sector.

The study is organised into six sections. After the introductory section, Section 2 discusses the dynamics of transport infrastructure and economic growth in South Africa. Section 3 reviews the literature, while Section 4 presents the methodology employed. Section 5 summarises the empirical results, while Section 6 concludes the study.

2. Dynamics of Transport Infrastructure and Economic Growth in South Africa

South Africa makes an interesting case for a study such as this one because of its chronically depressed economic growth rates. Finding out if transport infrastructure development has a desired impact on economic growth becomes important for South Africa if policy makers are to devise growth policies that work for the country. From the global and regional perspectives, South Africa is one of the few leading economies in Africa and a force to reckon with within sub-Saharan Africa, with most of its economic features comparable to the industrialised and Western countries – characteristics that make South Africa a key player in the development of Africa. The country's transport infrastructure is one of the most well-developed in Africa (Hlotywa and Ndaguba, 2017; DBSA, 2023). Hence, establishing whether further investment in transport infrastructure in South Africa is good for the economy’s growth becomes crucial. Further investment in transport infrastructure is also crucial for regional integration and the African Continental Free Trade Area (AfCFTA), which is still rolling out, with an ultimate agenda to develop Africa and change the African poverty narrative (DBSA, 2023).

The transport infrastructure, and the transport system in South Africa in general, has evolved over the years, integrating itself with technology, environmental cleanliness, and consolidation, among other key improvement facets. Various technology trends and drivers of change have been highlighted in the transport sector. These include, among others, the Internet of Things, wearable devices, blockchain technology, and digital platforms, which facilitate transparent and responsive supply chains by tracking the movement of goods, monitoring workers’ movement in warehouses, and matching transport demand with the supply by connecting transporters and freight owners (see Who Owns Whom “WOW”, 2023).

Despite the strides made by the transport sector in infrastructure investment, the South African transport sector is marred by several challenges, which include on-the-road constraints, port delays, lack of adequate skills, rising transport costs, and aging transport infrastructure (Khuzwayo, 2018). Notwithstanding these challenges, growth in transport infrastructure, as measured by growth in public spending on the transport sector, has been noticeable, though marginal, over the review period. On the other hand, economic growth, proxied by gross domestic product (GDP) growth rate, has been struggling, increasing between 1998 and 2007 but falling since 2011 – except only in 2021 when it spiked due to the base effect following the devastating effect of the coronavirus pandemic. Overall, over the review period, economic growth had been falling. Figure 1 illustrates these trends and dynamics.

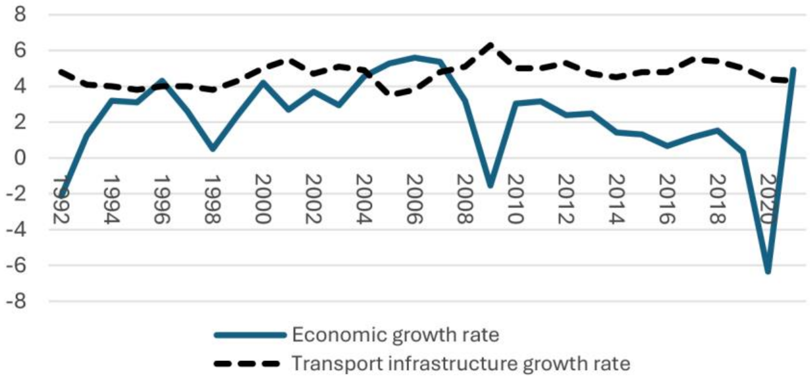

Fig. 1 Trends in transport infrastructure and economic growth in South Africa (1992-2021)
Source: South African Reserve Bank (2023); World Bank (2023)

3. LITERATURE REVIEW

Theoretical literature posits that infrastructure development, particularly transport infrastructure, plays a key role in ensuring fast economic growth and poverty alleviation (Rodrigue and Notteboom, 2023; DBSA, 2023). According to Zheng and Cheng (2023), transport infrastructure development affects economic growth in four main ways. Firstly, it allows labour to easily move between firms, and products and services from firms to households, leading to the expansion of labour and capital productivity as direct inputs. Secondly, developed transport infrastructure leads to cost savings through increased transportation efficiency. Thirdly, through accelerated industrial agglomeration, transport infrastructure development can stimulate the economy. Fourthly, a developed transport infrastructure network influences the economy by increasing the aggregate market demand. These ways reveal the importance of transport infrastructure in stimulating the economy from the theoretical front and underscore the crucial policy relevance of empirically investigating the drivers of economic growth from the perspective of transportation infrastructure development.

Although it is undisputable that transport infrastructure is good for economic growth (Holl, 2004), some theories and studies posit that in some instances, transport infrastructure may have an economic effect only if certain economic requirements and the other minimum requirements linked to investment and political and institutional requirements are fulfilled (Okechukwu et al., 2020). The extent of the effect on the domestic economy and regional economics of the transport system further differs in rural and urban areas and is subject to economic growth. It is further alluded that in some circumstances, incompatibility and trade-offs may occur between short-term benefits and sustainable development (Okechukwu et al., 2020). However, despite this negative possibility, theoretically, transportation infrastructure contributes primarily to the development of the economy and productivity.

From the empirical front, a significant amount of empirical work has been carried out in trying to establish the nature of the impact of transport infrastructure development on economic growth in various economies over varied periods and using various methodologies ranging from time series to cross-sectional and panel data-based methodologies. A review of this empirical literature reveals the three main groups within which the studies may fall.

The first group houses studies that are consistent with theory, emphasising the positive impact of transport infrastructure development on economic growth. It is in this category that the following studies fall: Gunasekera *et al*. (2008) for Sri Lanka, Heintz *et al*. (2009) for the United States of America, Jiwattanakulpaisarn *et al*. (2012) for the United States of America (US) using data for the forty-eight contiguous US states from 1984 to 2005, Pradhan and Bagchi (2013) for India over the 1970 - 2010 period using Vector Error Correction Model (VECM), Kayode *et al*. (2013) using Nigeria as a case study and time series data from 1977 to 2009 and ordinary least squares (OLS) methods, Hlotywa and Ndaguba (2017) for South Africa using (VECM), Ng *et al*. (2019) using panel-based methodology for 60 countries over the period of 3 decades from 1980 to 2010 and focusing on road transport infrastructure, Hanyurwumutima and Gumede (2021) for South Africa's two small metros, and Zheng and Cheng (2023) in the long run for the United Kingdom.

The second group is constituted by empirical studies in support of the neutrality of transport infrastructure development in the economic growth process. Empirical studies that fall within this category include Jiwattanakulpaisarn *et al.* (2009) for the North Carolina counties in the United States between 1985 to 1997 using dynamic panel regression analysis, Banerjee *et al.* (2012) in the case of China during the period from 1986 to 2003, and Hanyurwumutima and Gumede (2021) for South Africa's six big metros.

Then there is the third group, though unpopular, made up of studies that found the development of transport infrastructure to have a differentiated role in the economy and could even negatively impact economic growth. This could be due to the crowding-out effect of public investment, as an increase in government investment has been found to crowd out private consumption or private investment, thereby leading to a decrease in economic growth (see Zheng and Cheng, 2023; Schclarek, 2007; Andrade and Duarte, 2016; Hooper *et al*., 2021). Zheng and Cheng (2023), for example, while investigating the role of transport infrastructure in economic growth in the United Kingdom using data from 1970 to 2017, found that although transport infrastructure has a long-run promotive effect on economic development, its impact in the short run seems to be negative and significant. The authors concluded that there could be a differentiated role of transport infrastructure in economic growth in the UK that policy makers should consider in their future policy design. Deng *et al*. (2013), while examining the optimal level of transport infrastructure that could maximise economic growth in China using provincial panel data from 1987 to 2010, found that there is a non-monotonic link between the long-run growth rate and the stock of transport infrastructure and that the magnitude of the transport-led growth effect depends largely on the existing transport network.

Based on the empirical studies reviewed in this section, it is clear that the impact of transport infrastructure development on economic growth is far from being conclusive. The effect of transport infrastructure on economic growth has been found to vary based on a number of factors, including the study countries, study period, methodology and time frame of analysis, among other things. However, despite the variance in the outcome and the inconclusive nature of the previous empirical findings, the conventional wisdom is consistent with the theory that supports the first strand that found transport infrastructure development to have a positive impact on economic growth.

4. METHODOLOGY

To empirically assess the impact of transport infrastructure on economic growth in South Africa, the study utilised the autoregressive distributed lag (ARDL) bounds testing approach (see Pesaran and Shin, 1999; Pesaran *et al*., 2001). The choice was based on the favorable properties the method has over other conventional linear regression methods, such as the Johansen and Juselius (1990) test, among others. Its small-sample properties enhance its suitability for this study as the sample size is limited due to limited data on transport infrastructure from credible sources. Further, the ARDL approach thrives on its simplicity and flexibility of estimation procedures and robust outcomes (Nyasha *et al*., 2021; Nyasha and Odhiambo, 2022).

4.1. Model specification

In this study, economic growth (y) is captured by the growth rate of real gross domestic product (GDP). This measure is preferred as it captures how fast the economy is growing and is not affected by other possible variations in the economy. To confirm its suitability and preference, the measure has been widely used as a proxy for economic growth (see Asongu and Diop, 2022; Nyasha and Odhiambo, 2022; Nyasha, 2023). On the other hand, transport infrastructure (T-Infra) is proxied by total public expenditure on transport (see Hanyurwumutima and Gumede, 2021), and its coefficient is expected to be positive, based on the endogenous growth theory (Barro and Sala-i-Martin, 2004).

To fully specify the model and to minimise the variable-omission bias, four control variables are added. These are domestic investment (Invest), proxied by gross fixed capital formation as a proportion of GDP; trade openness (Trade), measured by the sum of exports and imports as a percentage of GDP; employment (Emp), captured by the proportion of a country's population that is employed; and exchange rate (Exchange), measured by the real effective exchange rate. All the control variables have been positively linked to economic growth, both theoretically and in most empirical studies (see Hlotywa and Ndaguba, 2017; Nyasha *et al*., 2018; Hanyurwumutima and Gumede, 2021; Nyasha 2023). Hence, their coefficients are expected to be positive and statistically significant.

Based on economic theory, the model for this study is specified as:

$$y = f(T - Infra, Invest, Trade, Emp, Exchange) \quad (1)$$

Where y is economic growth, T-Infra is transport infrastructure, Invest is domestic investment, Trade is trade openness, Emp is employment and Exchange is exchange rate.

The model specified in (1) is transformed to the ARDL representation as follows, based on Pesaran *et al.* (2001) and Nyasha and Odhiambo (2017; 2021) and Nyasha (2023).

$$\begin{aligned}\Delta y_t = \Omega_0 &+ \sum_{i=1}^{n} \Omega_{1i} \Delta y_{t-i} + \sum_{i=0}^{n} \Omega_{2i} \Delta T - Infra_{t-i} + \sum_{i=0}^{n} \Omega_{3i} \Delta Invest_{t-i} \\ &+ \sum_{i=0}^{n} \Omega_{4i} \Delta Trade_{t-i} + \sum_{i=0}^{n} \Omega_{5i} \Delta Emp_{t-i} \\ &+ \sum_{i=0}^{n} \Omega_{6i} \Delta Exchange_{t-i} + \Omega_7 y_{t-1} + \Omega_8 T - Infra_{t-1} \\ &+ \Omega_9 Invest_{t-1} + \Omega_{10} Trade_{t-1} + \Omega_{11} Emp_{t-1} \\ &+ \Omega_{12} Exchange_{t-1} \\ &+ \mu_t\end{aligned} \quad (2)$$

Where:

Ω_0 = is a constant;

Ω_1- Ω_6 = short-run coefficients

$\Omega 7_7$- Ω_{12} = long-run coefficients

Δ = difference operator

n = lag length

μ_t = white noise-error term

All the other variables remain as defined in Equation 1.

The error-correction model associated with the ARDL representation of the model for this study is as follows:

$$\Delta y_t = \Omega_0 + \sum_{i=1}^{n} \Omega_{1i} \Delta y_{t-i} + \sum_{i=0}^{n} \Omega_{2i} \Delta T - Infra_{t-i} + \sum_{i=0}^{n} \Omega_{3i} \Delta Invest_{t-i} + \sum_{i=0}^{n} \Omega_{4i} \Delta Trade_{t-i} + \sum_{i=0}^{n} \Omega_{5i} \Delta Emp_{t-i} + \sum_{i=0}^{n} \Omega_{6i} \Delta Exchange_{t-i} + \Omega_{13} ECM_{t-1} + \mu_t \quad (3)$$

Where:

ECM = error-correction term;

Ω_{11} = the coefficient of the error-correction term;

μ_t = mutually uncorrelated white-noise residuals

The rest of the variables and symbols are as defined in Equation 1 and Equation 2.

4.2. Pre-estimation procedures

Before the estimation of the specified model, unit root tests are carried out using the Dickey-Fuller generalised least square (DF_GLS) and Phillips-Peron (PP) stationarity tests to confirm_that all the series are not integrated of order two or higher as this will invalidate the use of ARDL procedure in the study. Cointegration is tested using the ARDL bounds approach to determine whether or not a long-run stable equilibrium exists among the variables in the specified model. This step is critical for the estimation of coefficients.

4.3. Data sources and definitions of variables

The annual time series data used in this study is from 1992 to 2021. The Dataset is obtained from the South African Reserve Bank “SARB” (2023) and the World Bank Databank (World Bank, 2023). Table 1 gives a summary of specific data sources and the definitions of variables.

Table 1 Definitions of variables and data sources

Variables	Definitions of variables (Measurements)	Data source
Economic growth	Growth rate of real gross domestic product (GDP)	World Development Indicators
Transport infrastructure (T-Infra)	Total public expenditure on transport	South African Reserve Bank
Investment (Invest)	Domestic investment	World Development Indicators
Trade openness (Trade)	Exports + Imports (as a percentage of GDP)	World Development Indicators
Employment (Emp)	Employment rate	-
Exchange rate (exchange)	Real effective exchange rate	World Development Indicators

5. EMPIRICAL ANALYSIS

5.1. Stationarity

The results of the unit root test are summarised in Table 2.

Table 2 Stationarity Tests of all Variables

Variable	Variables in levels		Variables in 1st difference		Conclusive order of integration
	Intercept	Intercept & Trend	Intercept	Intercept & Trend	
Dickey-Fuller generalised least square (DF_GLS)					
y	-3.285***	-3.315**	-	-	I(0)
T-Infra	-0.7352	-1.703	-4.955***	-4.973***	I(1)
Invest	-2.111**	-2.691	-	-7.265***	I(1)
Trade	-2.440**	-2.705	-	-8.562***	I(1)
Emp	-2.246**	-2.331	-	-3.887***	I(1)
Exchange	-0.246	-0.331	-3.546***	-3.601***	I(1)
Phillips – Perron (PP)					
y	-3.651***	-3.411***	-	-	I(0)
T-Infra	-1.822	-4.937***	-5.012***	-	I(1)
Invest	-2.760	-7.362***	-7.013***	-	I(1)
Trade	-2.842	-	-8.151***	-	I(1)
Emp	-1.287	-2.763*	-3.615**	-	I(1)
Exchange	-0.324	-1.331	-3.193**	-3.320***	I(1)

Notes: *, ** and *** denotes stationarity at 10%, 5% and 1% significant levels, respectively.

As summarised in Table 2, the results of the unit root tests indicate that although the order of integration is found to vary depending on the variable, condition under which stationarity is tested, and the type of the unit root test, in the main, all variables are stationary either in levels or in first difference. This confirms the suitability of the ARDL bounds testing approach to cointegration and coefficient estimation.

5.2. Cointegration

Following confirmation that no variable in the study is integrated of order 2 or higher, a cointegration test was carried out and the results are reported in Table 3.

Table 3 Bounds F-test for Cointegration

Dependent Variable	Function		F-statistic		Cointegration Status	
y	F(y| T-Infra GFCF TRADE EMP ER)		3.82^{**}		Cointegrated	
Asymptotic Critical Values						
Pesaran *et al*. (2001),	10%		5%		1%	
p.300, Table CI(iii)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Case III	2.26	3.35	2.62	3.79	3.41	4.68

Note: ** denotes statistical significance at 5% level

As reflected in Table 3, the cointegration results, based on the ARDL bounds testing procedure, show that the variables in the specified model are cointegrated. This is confirmed by the F-statistic of 3.82, which is significant at the 5% level. The results imply that a stable long-run equilibrium relationship exists among the variables in the study.

5.3. Coefficient estimation

The existence of cointegration among variables in the model opens the way for the estimation of both long- and short-run coefficients using the ADRL procedure. Before coefficients could be estimated, the ARDL model was determined using the Schwarz- Bayesian Criterion, as it was this criterion that resulted in a parsimonious model. Consequently, the optimal model for the study was determined as ARDL (1,2,1,0,1,1). The results of the coefficient estimation process, based on this ARDL model, are summarised in Table 4, where Panel 1 reports long-run coefficients while Panel 2 reports short-run coefficients.

Table 4 Empirical Results of the Estimated ARDL Model

Panel 1: Estimated long-run coefficients [Dependent variable: real GDP growth rate (y)]				
Regressor	Co-efficient (t-statistic)			
C	-65.614^{***}	(-3.900)		
T-Infra	0.152^{**}	(0.030)		
GFCF	0.617^{*}	(2.009)		
TRADE	0.257^{***}	(2.968)		
EMP	0.633^{***}	(3.500)		
ER	0.191^{**}	(2.838)		
Panel 2: Error-correction representation of the selected ARDL model [Dependent variable: real GDP growth rate (Δy)]				
Δ T-Infra	0.427	(0.550)		
Δ T-Infra 1	0.070	(0.087)		
Δ GFCF	0.561^{*}	(1.759)		
Δ TRADE	0.741^{***}	(4.271)		
Δ EMP	0.996^{**}	(2.398)		
Δ ER	0.336^{***}	(4.308)		
ECM (-1)	-0.939^{***}	(-5.044)		
R-Squared	0.860	Adj R-Squared	0.763	
SE of Regression	1.478	F-Stat F(7,20)	14.009[0.000]	
Residual Sum of Squares	34.931	DW statistic	2.039	

Note: ** and *** denote stationarity at 5% and 1% significance levels respectively.
ΔT-Infra1 = T-Infra(-1)-T-Infra(-2)

As reported in Table 4, both panels, the results of the study reveal that in South Africa, transport infrastructure development has a positive impact on economic growth, but only in the long run. No significant impact was found in the short run. This is confirmed by the long-run coefficient of T-Infra, which is positive and statistically significant at a 5% significance level, and the short-run coefficients of ∆T-Infra and ∆T-Infra 1, which are both statistically insignificant. The results are consistent with Hlotywa and Ndaguba (2017) and the United Nations (2022). They confirm that in the study country, investing in transport infrastructure has positive implications for economic growth in the long term.

As expected, the other results of the study, also reported in both panels of the same table, show that all the control variables – domestic investment, trade openness, employment and exchange rate – have a positive impact on economic growth in South Africa, irrespective of the period of analysis considered. This is confirmed by the long- and short-run coefficients of these variables, which are both positive and statistically significant. The coefficient of the error correction term [ECM (-1)] is statistically significant, with an expected negative sign, confirming that in the event of any shock, it takes the model a little over a year to return to its stable equilibrium position, at an adjustment rate of 94% per annum. The model's adjusted R-squared of 0.763 inveterate a high explanatory power of the independent variables in the specified model that have about 76% explanatory power of the variation in the economic growth variable in the study.

5.4. Diagnostic tests

To confirm the reliability of the results of the coefficient estimation, diagnostic tests were carried out on serial correlation, functional form, normality and heteroscedasticity. The results of these tests are reported in Table 5, while Figure 2 presents the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMQ) plots.

Table 5 Diagnostic Tests

LM Test Statistic	Results
Serial Correlation: CHSQ(1)	0.027[0.868]
Functional Form: CHSQ(1)	0.528[0.521]
Normality: CHSQ (2)	1.672[0.434]
Heteroscedasticity: CHSQ (1)	0.424[0.673]

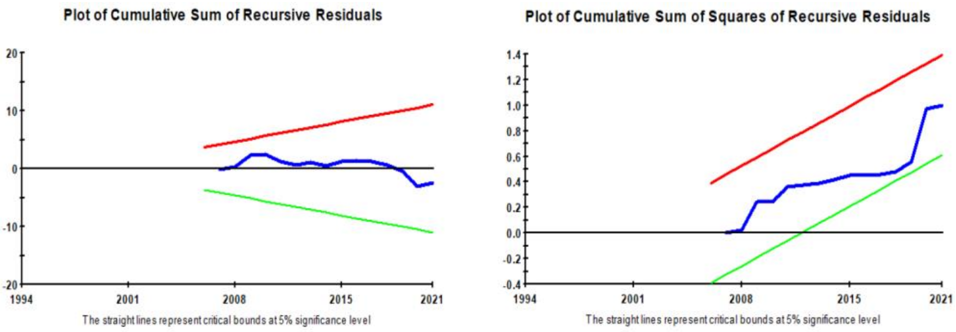

Fig. 2 CUSUM and CUSUMQ Plots

As reported in Table 5, the model passed all the diagnostic tests performed. The CUSUM and CUSUMQ plots, as reported in Figure 2, validate the consistently stable model over the study period, as reflected by the plots consistently falling within the 5% significance bands throughout the study period. Consequently, the results obtained are confirmed to be consistent, and the model is found to be reliable and valid, thereby enhancing the confidence in the robustness of the estimated model and its credibility in understanding the transport infrastructure and economic growth dynamics in South Africa.

6. Conclusion

In a quest to establish the significant drivers of economic growth in South Africa, on the one hand, and the lack of attention on transport infrastructure as a potential driver in recent times, on the other hand, this study aims to explore the dynamic impact of transport infrastructure development on economic growth in South Africa over the period 1992-2021. Using the ARDL bounds testing approach and data sourced from the SARB and the WB over the study period, the results of the study revealed that in the study country, transport infrastructure development has a positive impact on economic growth only in the long run. No significant impact was established in the short run. Thus, in South Africa, investing in transport infrastructure results in increased economic growth in the long term. Based on the results of this study, it is recommended that pro-transport infrastructure policies be adopted in an effort to boost economic growth of the country. However, in doing so, the relevant policymakers are urged to consider policy lead and lag times when implementing such policies, as the impact of infrastructure development on economic growth was only established in the long run – placing emphasis on the need for long-term economic planning. Although every effort was made to ensure that the study is analytically defensible, as with any other scientific study, this study may still have suffered from a few limitations. Despite its attempt to focus on transport as a specific type of infrastructure, the study did not drill down further to separate various types of transport infrastructure. Although this disaggregated level analysis would have resulted in more interesting outcomes, it did not take away the insights emanating from this study. Hence, the impact of this limitation is assumed to be marginal, and the results of the study are still considered defensible and usable. However, future studies are recommended to split transport infrastructure into its various categories – i.e., road, rail, air, etc., before assessing the impact of each category on economic growth.

References

Andrade, J. S., & A. P. (2016). Crowding-in and crowding-out effects of public investments in the Portuguese economy. *International Review of Applied Economics 30*(4), 1-19. https://doi.org/10.1080/02692171.2015.1122746

Asongu, S., & Diop, S. (2022). Resource rents and economic growth: Governance and infrastructure thresholds. *Working Papers of the African Governance and Development Institute* No. 72. https://dx.doi.org/10.2139/ssrn.4242086

Banerjee A., Duflo, E., & Qian, N. (2012). On the road: Access to transportation infrastructure and economic growth in China. *National Bureau of Economic Research*, 1-50. Available at: https://www.nber.org/system/files/working_papers/w17897/w17897.pdf

Barro, R. J., & Sala-i-Martin, X. (2004). *Economic Growth*. 2nd Edition, MIT, Cambridge.

Department of Transport (2023). *National land transport strategic framework (2023-2028)*. Government Gazette No. 48176.

Development Bank of Southern Africa (2023). *Widespread-economic-benefits-infrastructure-development*. Available at: https://www.dbsa.org/article/widespread-economic-benefits-infrastructure-development

Fourie, J. (2006). Economic infrastructure: A review of definitions, theory and empirics. *South African Journal of Economics*, 74(3), 530-556. https://doi.org/10.1111/j.1813-6982.2006.00086.x

Fusiek, D. A. (2022). *A drive to develop*. Available at: https://www.eib.org/en/stories/developing-countries-transport-infrastructure

Gunasekera, K., Anderson, W., & Lakshmanan, T. R. (2008). Highway-induced development: Evidence from SriLanka. *World Development, 3*(11), 2371-2389. https://doi.org/10.1016/j.worlddev.2007.10.014

Hanyurwumutima, L. K., & Gumede, S. (2021). An analysis of the impact of investment in public transport on economic growth of metropolitan cities in South Africa. *Journal of Transport and Supply Chain Management, 15*(0), a536. https://doi.org/10.4102/jtscm.v15i0.536

Hasselgren, B. (2018). *Transport Infrastructure in Time, Scope and Scale: An Economic History and Evolutionary Perspective*. Springer International Publishing AG, Switzerland. http://dx.doi.org/10.1007/978-3-319-79054-1

Heintz, J., Pollin, R., & Garrett-Peltier, H. (2009). *How Infrastructure Investments Support the US Economy: Employment, Productivity and Growth*. Political Economy Research Institute, University of Massachussetts Amberst, Massachussetts.

Hlotywa, A., & Ndaguba, E. A. (2017). Assessing the impact of road transport infrastructure investment on economic development in South Africa. *Journal of Transport and Supply Chain Management, 11*(0), a324, 1-12. https://doi.org/10.4102/jtscm.v11i0.324

Holl, A. (2004). Manufacturing location and impacts of road transport infrastructure: Empirical evidence from Spain. *Regional Science and Urban Economics, 34*(3), 341–363. https://doi.org/10.1016/S0166-0462(03)00059-0

Hooper, E., Peters, S., & Pintus, P. (2021). The impact of infrastructure investments on income inequality: evidence from US states. *Economics of Transition and Institutional Change 29*(2), 227-256. https://doi.org/10.1111/ecot.12266

Jiwattanakulpaisarn P., Noland R. B., Graham D. J., & Polak J. W. (2009). Highway infrastructure investment and county employment growth: A dynamic panel regression analysis. *Journal of Regional Science, 49*(2) 263-286. https://doi.org/10.1111/j.1467-9787.2008.00579.x

Jiwattanakulpaisarn, P., Noland, R. B., & Graham, D. J. (2012). Marginal productivity of expanding highway capacity. *Journal of Transport, Economics and Policy, 46*(3), 333-347.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration with applications to the demand for money. *Oxford Bulletin of Economics and Statistics, 52*(2), 115-225. https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x

Kayode, O., Babatunde, O., & Abiodun, F. (2013). An empirical analysis of transport infrastructure investment and economic growth in Nigeria. *Social Science, 2*(6), 179-188. https://doi.org/10.11648/j.ss.20130206.12

Khuzwayo, D. (2018). *An investigation into road freight challenges faced by transport companies in South Africa*. MSc Dissertation, University of KwaZulu-Natal – Westville Campus. Available at: https://researchspace.ukzn.ac.za/handle/10413/21819

Ng, C. P., Law, T. H., Jakarni, F. M., & Kulanthayan, S. (2019). Road infrastructure development and economic growth. *IOP Conf. Series: Materials Science and Engineering, 52*(2), 512. https://doi.org/10.1088/1757-899X/512/1/012045

Nyasha, S. (2023). The Dynamic impact of renewable energy consumption on economic growth in Zimbabwe: An ARDL approach. *Managing Global Transitions, 22*(1), 53-72. https://doi.org/10.26493/1854-6935.22.53-72

Nyasha S., Gwenhure, Y., & Odhiambo, N. M. (2018). Energy consumption and economic growth in Ethiopia: A dynamic causal linkage. *Energy and Economics, 29*(8), 1393-1412. https://doi.org/10.1177/0958305X18779574

Nyasha, S., & Odhiambo, N. M. (2022). Remittances and economic growth: Empirical evidence from South Africa. *International Journal of Trade and Global Markets, 15*(2), 254-272. https://doi.org/10.1504/IJTGM.2022.121457

Nyasha, S., Odhiambo, N. M., & Musakwa, M. T. (2021). The impact of stock market development on unemployment: Empirical evidence from South Africa. *SPOUDAI Journal of Economics and Business, 71*(1-2), 2021. Retrieved from https://spoudai.org/index.php/journal/article/view/92

Okechukwu, E. E., Madonsela, N. S., & Adetunla, A. (2020). The Effect of Transportation Infrastructure on Economic Development. In *Proceedings of the 2nd African International Conference on Industrial Engineering and Operations Management*. https://doi.org/10.46254/AF02.20200322

Organisation for Economic Co-operation and Development (2023). *Transport infrastructure trends and regional development*. Available at: https://www.oecd-ilibrary.org/sites/512e786f-en/index.html?itemId=/content/component/512e786f-en#chapter-d1e159

Palei, T. (2015). Assessing the impact of infrastructure on economic growth and global competitiveness. *Procedia Economics and Finance, 23,* 168-175. https://doi.org/10.1016/S2212-5671(15)00322-6

Pesaran, M. H., & Shin, Y. (1999). An Autoregressive Distributed-Lag Modelling Approach to Cointegration Analysis. In S. Strøm (Ed.), *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium* (pp. 371–413). chapter, Cambridge: Cambridge University Press. https://doi.org/10.1017/CCOL521633230.011

Pesaran, M., Shin, Y., & Smith, R. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*(3), 289-326. https://doi.org/10.1002/jae.616

Pradhan, R. P., & Bagchi, T. P. (2013). Effect of transportation infrastructure on economic growth in India: the VECM approach. *Research in Transportation Economics, 38*(1), 139-148. https://doi.org/10.1016/j.retrec.2012.05.008

Rodrigue, J. P., & Notteboom, T. (2023). Transportation and economic development. *The Geography of Transport Systems.* Available at: https://transportgeography.org/contents/chapter3/transportation-and-economic-development/

Schclarek, A. (2007). Fiscal policy and private consumption in industrial and developing countries. *Journal of Macroeconomics, 29*(4), 912-939. https://doi.org/10.1016/j.jmacro.2006.03.002

Selamolela, N. (2018). *The impact of transport infrastructure in the economic growth of South Africa*. PhD thesis, University of Cape Town, Cape Town. Available at: https://open.uct.ac.za/server/api/core/bitstreams/35eb7cef-9d4a-42a8-9f37-0ecf4e53157b/content

Smith, A. (1776). *The Wealth of Nations*. Strahan, W. and Cadell, T., London.

South African Reserve Bank (2023). *The South African Reserve Bank Online Data Query*. Available at: https://www.resbank.co.za/en/home/what-we-do/statistics/releases/online-statistical-query

Statistics South Africa (2023). *Gross Domestic Product (GDP), 3rd Quarter 2023*. Available at: https://www.statssa.gov.za/?page_id=1854&PPN=P0441&SCH=73565

Timilsina, G., Stern, D. I., & Das, D. K. (2024). Physical infrastructure and economic growth. *Applied Economics, 56*(18), 2142-2157. https://doi.org/10.1080/00036846.2023.2184461

Torrisi, G. (2009). Public infrastructure: Definition, classification and measurement issues. *Economics, Management, and Financial Markets, 4*(3), 100-124. Available at: https://mpra.ub.uni-muenchen.de/25850/

United Nations (2022). *Transport*. Available at: https://sustainabledevelopment.un.org/dsd_aofw_ni/ni_pdfs/NationalReports/south_africa/Transport.pdf

Who Owns Whom (2023). *Transport and logistics trends in South Africa. Who Owns Whom (Pty) Ltd*. Available at: https://www.whoownswhom.co.za/store/transport-logistics-trends-south-africa/

World Bank (2023). *World Bank Development Indicators*. Available at: http://data.worldbank.org

World Economic Forum (2016). *Competitiveness Report 2016-2017.* Available at: http://www3.weforum.org/docs/GCR2016-2017/05FullReport/TheGlobalCompetitivenessReport2016-2017_FINAL.pdf

Zhang, Y., & Cheng, L. (2023). The role of transport infrastructure in economic growth: Empirical evidence in the UK. *Transport Policy, 133,* 223-233. https://doi.org/10.1016/j.tranpol.2023.01.017

DA LI SAOBRAĆAJNA INFRASTRUKTURA PODSTIČE EKONOMSKI RAST U JUŽNOJ AFRICI? JEDNO EMPIRIJSKO ISTRAŽIVANJE

Ova studija ispituje dinamički uticaj razvoja saobraćajne infrastrukture na ekonomski rast u Južnoj Africi koristeći podatke od 1992. do 2021. Studija je motivisana potencijalom transportne infrastrukture kao pokretača ekonomskog rasta, teoretski, i nedostatkom konačnih rezultata iz empirijske studije sprovedene na ovu temu do danas. Pored toga, Južna Afrika ima razvijenu saobraćajnu infrastrukturu i bilo bi korisno za kreatore politike da znaju tačnu prirodu uticaja koji razvoj saobraćajne infrastrukture ima na ekonomski rast u Južnoj Africi nakon što se uzmu u obzir efekti specifični za zemlju – posebno s obzirom da relevantne studije dostupne o Južnoj Africi su ili zastarele ili su povezivale razvoj infrastrukture. Koristeći pristup autoregresivnih distribuiranih granica kašnjenja, rezultati studije su otkrili da u Južnoj Africi razvoj transportne infrastrukture ima pozitivan uticaj na ekonomski rast samo na dugi rok, jer u kratkom roku nije utvrđen značajan uticaj. Tako u Južnoj Africi ulaganje u transportnu infrastrukturu dugoročno dovodi do povećanog ekonomskog rasta. Stoga se preporučuje da se politike za transportnu infrastrukturu, kao deo strategije dugoročnog ekonomskog planiranja zemlje, usvoje u nastojanju da se podstakne ekonomski rast zemlje.

Ključne reči: *saobraćajna infrastruktura, trošak javnog prevoza, ekonomski rast, Južna Afrika*