Determinants of Infrastructure Development in Kenya

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Abstract

Empirical research on the macroeconomic factors influencing infrastructure development has yielded inconclusive results, with significant variations observed across studies. This study examines the determinants of infrastructure development in Kenya using a time series data analysis framework, with data spanning from 2003 to 2024. The study's main estimates use the generalized-method-of-moments (GMM) estimator that allows us to account for the potential endogeneity of the infrastructure and explanatory variables through the use of instruments. The results of this study showed that economic growth, public debt, and foreign direct investment have a significant positive influence on infrastructure development in Kenya. Interestingly, urbanization does not have a significant impact, suggesting that this factor may be less influential in infrastructure expansion. These results have significant policy implications. In order to promote infrastructure development, Kenya needs to achieve sustainable economic growth, manage public debt cautiously, and attract foreign direct investment. These findings underline the need for tailored infrastructure development policies that account for the unique macroeconomic structures and policies that influence infrastructure development and facilitate additional investment in infrastructure in Kenya.

Keywords: Infrastructure, Economic Growth, Foreign Direct Investment, Public Debt, Urbanization

Introduction

The development of infrastructure lies at the heart of economic development in the world because it raises productivity, simplifies trade, and enhances the living standards of citizens (Zakari & Musibau, 2024). According to the World Bank (2023), nations that invest highly in infrastructure achieve a 1.5% increase in Gross Domestic Product (GDP) growth annually. Infrastructure development encompasses transport, energy, water, and communication facilities, which are all critical in spurring economic activities. Economic growth, public debt, foreign direct investment (FDI), and urbanization are significant determinants of infrastructure development (Irshad & Ghafoor, 2023; Mphigalale, 2020). For example, FDI to developing countries amounted to $684 billion in 2020, with the majority going to infrastructure development. Urbanization, which is gaining pace worldwide, with 68% of the global population expected to be residing in urban centers by 2050, Carlucci et al. (2020), also points to the necessity for strong infrastructure to bolster increasing urban populations. These elements, in tandem, highlight the mutual dependence of infrastructural development and macroeconomic conditions at the global level.

In Kenya, infrastructure development has been among the priorities of the government's Vision 2030 economic plan, which is intended to make the nation a middle-income economy (Jacobsen et al., 2023; Mohammed, 2021). Notwithstanding enormous investments in developing infrastructure projects like the Standard Gauge Railway (SGR) and Lamu Port-South Sudan-Ethiopia Transport (LAPSSET) corridor, constraints like excessive public debt, standing at 69.1% of GDP in 2022 (Auma, 2018), and unequal distribution of infrastructure persist. Kenya's urbanization is also fast rising, with 28% of the population being urban residents as of 2020, and is projected to rise to 50% by 2050 (World Bank, 2023). The fast urban growth requires massive infrastructure development to facilitate economic activities and enhance living conditions (El-Bouayady & Radoine, 2023). Little is known, however, regarding the interaction between infrastructure development, public debt, FDI, urbanization, and economic growth in Kenya, and thus requires exploration.

Kenya has made significant progress in infrastructure expansion through the mid-2000s, and it boasts higher infrastructure indicators than most other sub-Saharan African countries as reported by Aggregate Infrastructure Development Index (AIDI) data compiled by African Development Bank. The AIDI is calculated through four steps: normalizing components, creating a composite index with weighted averages to minimize volatility, generating the overall index, and determining sub-regional indices based on population and infrastructure metrics (ADB, 2024). There has been a steady increase in Kenya's infrastructure development index from 2003 to 2024. Kenya was ranked 18th with a score of 26.52% in 2023, according to the AIDI. Kenya has shown progress in ICT and transportation, which has contributed to its improved AIDI ranking. Figure 1 depicts the expansion of infrastructure development (INFRA) index in Kenya over the period 2003-2024.
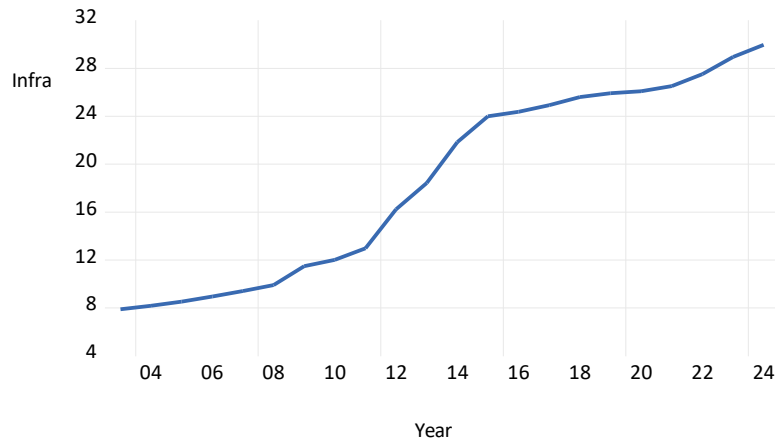
Figure 1: Evolution of infrastructural development in Kenya from 2003 to 2024.

Source: Author's conception using AIDI Data (ADB, 2024).

According to the Africa Infrastructure Development Index (AIDI) data in Figure 1, Kenya has experienced substantial infrastructure development, rising from an infrastructure index of 8 in late 2003 to 30 by early 2024 (ADB, 2024). This can be attributed to the increased investment being undertaken by the government of Kenya, growth attributed to the Information and Communication Technology (ICT), and transport sector investment and improvement.

Despite Kenya's high record of infrastructure development, the country continues to face poor financing, rising public debt, and uneven distribution of infrastructure resources (Okinda, 2020; Gitonga et al., 2022). These concerns raise questions about the efficiency and sustainability of infrastructure investments and development in Kenya (Ewusi et al., 2024). Moreover, the role of FDI, economic growth, public debt and urbanization in shaping infrastructure development is questionable (Sare et al., 2025). The research tries to bridge these gaps by examining the macroeconomic drivers of high infrastructure development in Kenya and providing policy recommendations to policymakers and stakeholders.

This research aims to analyze the macroeconomic determinants of substantial infrastructure development in Kenya. The research seeks specifically to (1) analyze the impact of economic growth on infrastructure development, (2) examine the effects of public debt on infrastructure expansion, (3) investigate the contributions of FDI to infrastructure development, and (4) determine the effects of urbanization on infrastructure development. Numerous estimating techniques for time series data models with predicted endogeneity issues are proposed in the economic literature. Using lagged explanatory factors as internal instruments, the GMM developed by Arellano and Bond (1991) is the most often used econometric technique for estimating dynamic models. The GMM estimation model was used in the current study.

Literature Review

The debate on theoretical and empirical literature surrounding the influence of macroeconomic variables on infrastructure development remains inconclusive. The Barro growth theory (1990) posited that the beneficial impact of infrastructure development could be entirely negated by taxes imposed by the government and public borrowing intended to fund such development. This conclusion was supported by subsequent studies (Mendoza et al., 1997), which determined that the detrimental effects of government

spending on infrastructure stem from the distortions and disincentives associated with taxation used to finance these projects and slowing economic growth (Mose, 2022). As outlined in public finance, these distortions arise when the government resorts to domestic borrowing to fund infrastructure through open market operations and a slowing in foreign capital outflow. This practice increases the cost of funds in the local market, ultimately crowding out private sector borrowing, which significantly affects capital formation and overall infrastructure development (Karikari et al., 2025).

The link between infrastructure development and public debt utilization is multifaceted, with positive and negative effects based on the type of debt and the type of economy. The synthesis herein explores the multidimensional functions of the utilization of public debt for infrastructure development based on lessons derived from various studies carried out in Kenya and beyond. Public debt affects infrastructural development positively and with much force over the years, but domestic debt affects it negatively but with no force. To ensure that the dividends of the public debt for infrastructures are maximized, the Kenyan government should establish agencies that regulate the execution of project works financed by the loan so that resources are effectively utilized (Joseph et al., 2024). Oladapo and Amos (2024) revealed that domestic and external debt between 1992 and 2021 were positive and meaningful with infrastructure growth. The study concluded that the rise of debt improves infrastructure and that 81 per cent of the infrastructural variance was caused by the rise of the debt and the rise of the exchange rate. The study highlights that the public debt should be invested in infrastructure to enhance the business climate and economic output, with the objective of easy repayment. Amadi and Agya (2023) revealed that the link between infrastructure and debt is negative and statistically significant. The more the increase in debt servicing, the greater the decrease in infrastructure, which hurts private investments and aggregate demand, resulting in increased unemployment levels. The study reveals that the increasing debt servicing negatively impacts infrastructure with the inference that the country should seek alternative sources of funding rather than over-reliance on borrowing. Public debt has played a pivotal role in financing major infrastructure projects like the Standard Gauge Railway (SGR), roads, and energy infrastructure in Kenya. According to Ewusi et al. (2024), Kenya's debt-financed infrastructure projects have supported short-term development goals, though concerns remain regarding long-term debt sustainability. Auma (2018) highlighted that excessive public borrowing for infrastructure has contributed to Kenya's rising debt-to-GDP ratio, which stood at 69.1% in 2022. These findings underscore the need for prudent debt management to ensure infrastructure investments yield long-term economic benefits.

Foreign direct investment (FDI) assists with the infrastructure progression and the impetus for economic modernization and development of the areas. The link between the two is complex and involves direct financial contribution, technology transfer, and institutional improvement arrangements. FDI highly encourages infrastructure growth, especially in electricity, transportation, and communication infrastructures. The study identifies greenfield investments as the most positive for the development of infrastructures, while cross-border mergers and acquisitions are of no impact or negative impact (Luu et al., 2024). Most notably, the effect of FDI is more concentrated on the development of developing countries rather than that of developed countries, especially for corruptible projects (Luu et al., 2024). Sinha and Das (2025) explore the link between FDI inflow and infrastructure for 39 countries between 2000 and 2020. The study contends that countries with good institutional quality are likely to experience a positive link between the development of infrastructure and the rate of FDI. FDI has a positive impact on the infrastructure of Kenya. The research reveals that FDI brings necessary financial resources and technology

that are crucial for speeding up projects. FDI is crucial for developing nations with financial limitations like Kenya. FDI has been instrumental in the development of ICT, energy, and transport infrastructure. Wenge and Njuguna (2024) observed that FDI significantly impacts Kenya's infrastructure, particularly in the ICT sector. Jacob et al. (2024) confirmed that FDI brings in crucial technological and financial resources that expedite infrastructure development. The government has also adopted strategies such as Special Economic Zones (SEZs) and Public-Private Partnerships (PPPs) to attract and retain foreign investors in infrastructure projects.

Hasan et al. (2024) create a positive link between economic growth and infrastructure development of the targeted Asian countries. The study emphasizes that the development of transport infrastructure, the consumption of energy, and communication infrastructures largely depend on GDP growth. Gitonga et al. (2022) and Mose (2022) provide empirical evidence showing that public investment in infrastructure contributes significantly to GDP growth. Specifically, investments in roads and ICT infrastructure have been vital in supporting Kenya's Vision 2030, which aims to transform Kenya into a middle-income economy. Moreover, Ewusi et al. (2024) found that infrastructure investment boosts productivity, particularly in the transport and energy sectors. Thus, infrastructure development is both a consequence of and a contributor to economic growth in Kenya. Infrastructure and economic development are intricately related, with a direct contribution by improving productivity and an indirect contribution by enhancing market access and the quality of the produced employment. Infrastructure development matters for economic growth, since it has been suggested by various studies for different conditions and areas that the infrastructure, including the transportation, energy, and communication sectors, enhances productivity, linkages, and efficiency, and the economic output, enhances the country's GDP.

Urbanization and infrastructure growth are interconnected processes that have far-reaching implications for the socio-economic and environmental contexts of cities globally. Infrastructure growth is fueled by the need for urban facilities, while infrastructure development is responsible for facilitating urbanization and change. Urbanization has a significant impact on infrastructure in India since cities, which contribute 62–63% of the GDP, cannot develop suitable infrastructure for their growing population. The rapid urban growth overloads the available infrastructure, including transport, housing, water, sanitation, and electricity. Even though 93% of households are electrified and 81% have latrine facilities, only 68% of urban housing is good, indicating the necessity for improved infrastructure to raise the standard of living in cities (Roy et al., 2023). Urbanization is rising rapidly, with Nairobi, Mombasa, and Kisumu experiencing intense pressure on infrastructure. According to the World Bank (2023), 28% of Kenya's population lived in urban areas in 2020, projected to reach 50% by 2050. Sergiienko et al. (2023) suggest that the most important factor that affects infrastructure is urbanization. The study points out that the economic, social, and infrastructural consequences of urbanization threaten the safety and well-being of the urbanized areas. All these consequences require the need for mitigation at the earliest so that the safety of the people and the urban area are guaranteed. The linkages between these consequences point toward the necessity of integrated strategies that solve the problems of both infrastructure and urbanization for the improvement of national security and people's safety.

Research Methodology

Data Descriptions

The research employs an explanatory research design to understand the macroeconomic factors influencing infrastructure development. The study is carried out in Kenya for the period 2003-2024. Data on infrastructure development was proxied by the Africa Infrastructure Development Index (AIDI) database produced by the African Development Bank (ADB, 2024). The AIDI also serves as a key tool in evaluating and monitoring the continent's progress toward attaining high infrastructure development. The AIDI has four composite indexes: transport, electricity, ICT, and water and sanitation, according to the Africa Infrastructure Knowledge Program Portal. The study effectively employed the independent factors delineated by Meh and Ayuk (2022) as key macroeconomic determinants of infrastructure development in Kenya. Data for the independent variables as measures of factors influencing infrastructure development, such as economic growth, public debt, foreign direct investment, and urbanization, were obtained from the World Development Indicators (WDI) of the World Bank. Table 1 describes the data variables and measures utilized in the study.

Table 1: Variable Descriptions

Variables	Measures	Data Source	Prior sign
Economic growth (GDP)	GDP per capita growth (%)	WDI	Positive (Mose, 2022)
Public debt (PD)	Debt-to-GDP ratio (%)	WDI	Positive (Amadi & Agya, 2023)
Foreign Direct Investment (FDI)	Foreign Direct Investment, net inflows (% GDP)	WDI	Positive (Jacob et al., 2024).
Urbanization (URB)	Urban population (% total population)	WDI	Positive (El-bouayady et al., 2024)
Infrastructure Development (INFRA)	Infrastructure Development Index	AIDI	Dependent variable

Table 1 describes the variables and measures used during analysis. Table 1 has also provided expected prior results of target variables against infrastructure development. Based on a simple infrastructure growth model, the specified model for this study is depicted in Equation 1:

$$INFRA_t = f(GDP_t, PD_t, FDI_t, URB_t),\tag{1}$$

Where *INFRA* represents the infrastructure development index in the given period for 2003-2024 in Kenya. Thus, the regression function describing the infrastructure development as a function of several economic factors is used during analysis. The equation is given by:

$$INFRA_t = \alpha + \delta_1 GDP_t + \delta_2 PD_t + \delta_3 FDI_t + \delta_4 URB_t + \varepsilon_t,\tag{2}$$

Where INFRA is the infrastructure development index, GDP is economic growth, PD is public debt, FDI is foreign direct investment and URB is the urbanization variable. Further, δ represents the model coefficient for independent variables 1-4, α indicates the constant term, ε is the error term in the model, and subscript t is the time dimension.

Data Analysis

Numerous estimating techniques for time series data models with predicted endogeneity issues are proposed in the economic literature. Using lagged explanatory factors as internal instruments, the GMM developed by Arellano and Bond (1991) is the most often used econometric technique for estimating dynamic models. The GMM estimation model was used in the investigation, regulating the endogeneity of regressor problems, correcting for heteroscedasticity and autocorrelation, regulating simultaneity, specification bias, removing country-fixed effects, and unobserved heterogeneity are some of the GMM technique's primary advantages (Hansen & West, 2002). For reliable results, several residual diagnostic procedures, including Hanse's and normalcy tests, were performed. The validity of the exclusion restrictions is examined using J-tests. According to the null hypothesis, instruments are appropriately omitted from the GMM regression (Hansen & West, 2002). Further, the Augmented Dickey-Fuller Test Equation was applied to establish the stationarity of study variables. Granger causality test was conducted to check for association between study variables.

Results and Discussion

Descriptive and Correlation Analysis

Descriptive and correlation estimation was conducted to describe the main features and examine the relationship of the data set for 2003-2024 (22 observations). Descriptive statistics presented in Table 2 provide an overview of the key indicators under this study using measures like mean, median and standard deviation.

Table 2: Descriptive Statistics Results

Variables	INFRA	GDP	PD	FDI	URB
Mean	18.624	2.199	48.191	0.906	25.249
Median	20.140	2.624	42.535	0.588	25.007
Maximum	29.960	5.565	70.200	3.094	31.300
Minimum	7.890	-2.758	34.200	0.113	20.948
Std. Dev.	8.044	2.026	13.055	0.827	2.916
Skewness	-0.100	-0.899	0.561	1.341	0.302
Kurtosis	1.343	3.676	1.733	3.682	2.109
Jarque-Bera	2.553	3.387	2.626	7.027	1.063
Probability	0.278	0.183	0.268	0.029	0.587
Observations	22	22	22	22	22

According to Table 2 result, infrastructure (INFRA) index variables, the mean is 18.62, and the standard deviation is 8.04, indicating moderate volatility in the rate of infrastructure development over the years in Kenya. The skewness of -0.10 indicates a roughly symmetrical distribution, while the kurtosis of 1.34 indicates a relatively flat distribution compared to a normal distribution. The Jarque-Bera statistic (2.55) and its probability (0.28) suggest that the data for infrastructure is normally distributed. Economic growth (GDP) has a mean value of 2.20, and a standard deviation of 2.03, indicating moderate volatility in GDP growth in Kenya. The negative skewness (-0.90) indicates a left-skewed distribution, meaning there are more years with lower GDP growth rates. The kurtosis of 3.68 indicates a leptokurtic distribution, indicating heavier tails and a more peaked distribution than a normal distribution. The Jarque-Bera statistic (3.39) and

probability (0.18) indicate that the GDP data is also normally distributed. As shown in Table 2, public debt (PD) data, the mean level is 48.19, with a standard deviation of 13.06, indicating significant variation in public debt across the years. The positive skewness (0.56) shows a right-skewed distribution with more years having less public debt levels. The kurtosis level of 1.73 indicates a relatively flat distribution. The Jarque-Bera statistic (2.63) and probability (0.27) suggest that the debt data are normally distributed. Foreign direct investment (FDI) has a mean value of 0.91, with a standard deviation of 0.83, suggesting moderate volatility in FDI inflows. The positive skewness (1.34) reveals a right-skewed distribution, with more years of lower FDI inflows. The kurtosis value of 3.68 suggests a leptokurtic distribution. Urbanizations (URB) 's mean rate is 25.25, and the standard deviation is 2.92, indicating fairly stable urbanization rates over the years. The positive skewness (0.30) indicates a slightly right-skewed distribution, and the kurtosis statistic of 2.11 indicates a pretty typical distribution. The Jarque-Bera statistic (1.06) and probability (0.59) confirm that the urbanization data is normally distributed.

The study adopted a pairwise correlation test on the linear link between infrastructure data and explanatory variables. The correlation matrix determines the strong correlations between the variables of concern. Table 3 presents the result of a pairwise correlation matrix between two or more variables.

Table 3: Correlation Matrix Results

	INFRA	GDP	PD	FDI	URB
INFRA	1				
GDP	0.256	1			
PD	0.866***	0.203	1		
FDI	-0.051	0.068	-0.300	1	
URB	0.960***	0.290	0.889***	-0.064	1

*Note: ***, ** and * signifies significance at a 1%, 5% and 10% level of significance*

Table 3 shows that the infrastructure variable is strongly positively correlated with urbanization at 0.960 and public debt at 0.866, which implies that urbanization creates infrastructure needs, typically financed by public debt in Kenya. The correlation of infrastructure with economic growth is weaker at 0.256, which implies that other variables influence the link between the two. Public debt is strongly correlated with urbanization at 0.889 but negatively correlated with foreign direct investment at -0.300, meaning too much debt deters FDI. FDI has weak correlations with most variables, which implies that it has not been a major driver of infrastructure growth in Kenya. These Table 3 results capture the complex link among infrastructure, debt, urbanization, and growth, and the need for targeted policies to ensure sustainable development in Kenya.

Unit Root Analysis

The study applied the Augmented Dickey-Fuller (ADF) unit root test to analyze the stationary properties of study variables. Table 4 shows the stationarity or unit root test result for all study variables.

Table 4: Stationarity Test Results

Variables	Level		First Difference		Remark
	t-Statistics	**Prob.**	**t-Statistics**	**Prob.**	
INFRA	-0.700	0.824	-5.195	0.000	Non-stationary
GDP	-4.556	0.002			Stationary
PD	-2.586	0.113	-4.940	0.001	Non-stationary
FDI	-3.105	0.041			Stationary
URB	2.812	1.000	-4.710	0.001	Non-stationary

*Note: *** and ** signifies significance at a 1% and 5% level of significance.*

Stationarity is a prerequisite for the validity of regression analysis results since non-stationary variables can yield spurious and misleading findings. According to Table 4 results, infrastructure variables are not stationary at the level but are stationary after taking the first difference, which is denoted as I(1). Economic growth is stationary at the level, i.e., it is integrated of order zero, I (0), and does not need differencing. Public debt is non-stationary at the level but becomes stationary after the first difference, I (1). FDI is stationary at level I (0) and doesn't require differencing. Urbanization is non-stationary at the level but becomes stationary after the first difference, I (1). These results highlight the need to achieve stationarity in time series data to obtain non-spurious results and valid statistical inferences.

Regression Analysis

The GMM regression model was used to estimate the relationship between Kenya's infrastructure development and macroeconomic determinants. Table 5 shows the results of the generalized method of moments (GMM) regression analysis.

Table 5: Regression Coefficients

Variable	Coefficient	Standard Error	T-Statistics	P-Value
GDP	0.509	0.145	3.511***	0.002
PD	0.626	0.069	8.970***	0.000
FDI	1.939	0.916	2.115**	0.048
URB	0.046	0.259	0.179	0.859
	Adjusted R^2		0.680	
	Durbin-Watson statistics		2.050	
	J-Statistics		4.281	
	Jarque-Bera test		0.398	

*Note: *** and ** and * signifies significance at a 1%, 5% and 10% level of significance*

According to Table 5 findings, economic growth (GDP) indicates a positive and statistically significant coefficient of 0.509, which indicates that infrastructure development is more possible in the event of increased economic growth in Kenya. According to the result for every 1% increase in the economic growth, the infrastructure development will increase by 0.509%. An increasing economy can be followed by more government revenues and private investments, which are utilized to invest in infrastructure. This is consistent with the forecast that when GDP rises, there is more ability to finance and invest in infrastructure growth, including transport networks, energy facilities, and communications centres. The importance of GDP highlights the importance of policies that seek to ensure sustainable economic growth to finance the

expansion of infrastructure (Gitonga et al., 2022). Hasan et al. (2024) confirm the study that it creates a positive link between GDP and the infrastructure of the targeted Asian countries. The study emphasizes that the development of transport infrastructure, the consumption of energy, and communication infrastructures largely depend on the contribution of GDP growth (Meh & Ayuk, 2022).

Public debt (PD) also possesses a very high and positive coefficient of 0.626, suggesting that for every 1% increase in public debt, infrastructure development will increase by 0.626%. It implies that public debt is playing an important part in funding Kenya's infrastructure projects. Public debt has been a source of major finance for mega-scale infrastructure projects like the Standard Gauge Railway (SGR) and energy projects. Nevertheless, making infrastructure investment feasible, also sparks concerns over debt sustainability. The findings indicate that debt is necessary in the short- and medium terms for developing infrastructure but has to be wisely managed so it does not involve long-term budget risks. Oladapo and Amos (2024) confirm with the study that domestic and public debt between 1992 and 2021 were positive and significant with infrastructure progression through enhancing the business climate and economic output, with the aim of easy repayment. Amadi and Agya (2023) confirm with the study that the link between the two variables is negative and statistically significant. The more the increase in debt servicing, the greater decrease that occurs in infrastructure, hurts private investments and aggregate demand, with the resultant effect of increased unemployment levels (Arthur, 2025). The study reveals that the increasing debt servicing has negative impacts on infrastructure development with the inference that the country should seek alternative sources of funding rather than over-reliance on borrowing.

The foreign direct investment (FDI) coefficient is positive and significantly valued at 1.939, indicating how critical foreign investment is in sparking infrastructure development in Kenya as presented in Table 5. The result suggests that for every 1% increase in the FDI, the infrastructure development will increase by 1.939%. Foreign investment is not only capital but also technology, expertise, and innovation, which play a vital role in the undertaking of sophisticated infrastructure projects. FDI has been pivotal in the energy, telecommunication, and transport sectors in Kenya. According to Jacob et al. (2024), FDI brings necessary financial resources and technology that are crucial for speeding up infrastructure projects in developing countries (Jacob et al., 2024). The importance of FDI underscores the necessity of policies that make an investment environment attractive, including reforms in regulations, political stability, and incentives to foreign investors (Luu et al., 2024). Sinha and Das (2025) confirm the study which explores the link between FDI inflow and infrastructure for 39 countries between 2000 and 2020. The study contends that countries with good institutional quality are likely to experience a positive link between the development of infrastructure and the rate of FDI. However, countries with low institutional ratings are unlikely to experience a positive relationship. The study highlights the importance of institutional quality for using the rate of FDI for the development of infrastructure, identifying areas of investments and countries requiring institutional improvement for the development of infrastructure. In addition, this goes contrary to the study that FDI does not enhance the comprehensive development of the social infrastructure of the country. The study identifies the necessity for higher FDI for the implementation of the schemes of the physical infrastructure of the country and that the contribution of the latter assists in supplementing the domestic effort for filling the project gap of the country. Good governance norms are required for the effective allocation of resources (Noah & David, 2024).

Urbanization (URB) has a coefficient of 0.046, and it is not statistically significant so, the urbanization rate does not directly affect infrastructure expansion here. The result indicates that for every 1% increase in urbanization, the infrastructure expansion will have a minimal increase of 0.046%. Although urbanization would normally raise the demand for infrastructure, for example, housing, transport, and utilities, results show that the interaction between the two variables has negligible impact in Kenya. This may result from unbalanced urban development or a lack of proper infrastructure spending within cities to sustain increasing demand (El-bouayady et al., 2024). However, Sergiienko et al. (2023) suggest that the most important factor that affects infrastructure expansion is the urbanization rate of the country. The study points out that the economic, social, and infrastructural consequences of urbanization threaten the safety and well-being of the urbanized areas. All these consequences require the need for mitigation at the earliest so that the safety of the people and the urban area are guaranteed. A low J-statistic value (4.281) and a high p-value (typically below 0.05) suggest that the instruments are valid, potentially leading to acceptable parameter estimates. According to the null hypothesis, instruments are appropriately omitted from the GMM regression. Adjusted R squared (coefficient of determination) was found as 0.680. this indicates that economic growth, public debt, FDI and urbanization cause 68 per cent of all the variations in infrastructure development in Kenya. The p-value for the Jarque-Bera test was found to be more than 0.05 as shown in Table 5. This implies that variables in the data set were normally distributed. A value of Durbin Watson is close to 2 suggesting no serial correlation.

Causality Test Results

The study adopted a pairwise Granger causality test to analyze the path of the link between infrastructure development and predictors. Table 6 shows the Granger causality results of the macroeconomic determinants of infrastructure development.

Table 6: Causality Result

Null Hypothesis	Observations	F-Statistics	Probability
GDP does not cause INFRA	21	0.068	0.796
INFRA does not cause GDP		1.045	0.320
PD does not cause INFRA	21	4.710**	0.043
INFRA does not cause PD		20.251***	0.000
FDI does not cause INFRA	21	12.477***	0.002
INFRA does not cause FDI		0.316	0.580
URB does not cause INFRA	21	0.660	0.427
INFRA does not cause URB		1.469	0.241

*Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ are significant levels. Lags=1*

Table 6 results indicate that there exists a bi-directional causality relationship between public debt and infrastructure, whereby public debt influences infrastructure projects and infrastructure, influences borrowing to fund enormous project expenses. Increased public debt can be used to fund infrastructure projects, while well-developed infrastructure can stimulate economic growth, potentially leading to increased tax revenue and reduced debt burden in Kenya. FDI has a unidirectional causality relationship with infrastructure, provoking the role of foreign investment toward financing infrastructure. FDI can provide capital, technology, and expertise that can be used to build and improve infrastructure, leading to economic growth and improved living standards. There is no strong causal link between infrastructure and

economic growth or infrastructure and urbanization, which mirrors that the variables are not impacting one another directly over the span of time that has been observed. These findings reveal the major position of FDI and public debt in facilitating infrastructure expansion, and other factors can exert minimal impact on the interaction among economic growth, urbanization, and infrastructure expansion in Kenya.

Conclusion and Recommendations

Conclusion

Using the Generalized Method of Moments (GMM) model, the research examined the determinants of substantial infrastructure development in Kenya, 2003-2024, with emphasis on the effects of public debt, economic growth, foreign direct investment and urbanization rate. The results indicate that public debt, economic growth and foreign direct investment strongly support infrastructure development, while urbanization has minimal contribution. Economic growth, having a positive and significant coefficient, reflects the significance of an expanding economy in mobilizing resources to invest in infrastructure projects. Public debt is significant as well in the financing of large infrastructure projects, though its sustainability is problematic. Foreign direct investment (FDI), with a positive and significant coefficient, reflects the significance of foreign investment in mobilizing capital, technology, and expertise to fuel large projects. Urbanization itself does not directly impact infrastructure development in this regard, implying that other factors may have a stronger influence. The causality tests also confirm a two-way causality between public debt and infrastructure development, with debt causing infrastructure projects and infrastructure development causing borrowing to increase. Increased public debt can be used to fund infrastructure projects, while well-developed infrastructure can stimulate economic growth, potentially leading to increased tax revenue and reduced debt burden in Kenya. FDI causes unidirectional infrastructure development, highlighting the contribution of foreign investment in financing infrastructure. However, no causal effects were substantial between economic growth and infrastructure development or between urbanization and infrastructure development, meaning that these variables did not directly affect one another during the study period, pointing to complex interactions that may require deeper policy analysis. These results have significant policy implications. In order to promote infrastructure development, Kenya needs to achieve sustainable economic growth, manage public debt cautiously, and attract foreign direct investment. Regulations for developing a friendly investment environment, including political stability and regulatory reforms, are critical in guaranteeing higher FDI inflows. Further, prudent management of public debt is needed to prevent infrastructure investment from triggering unbalances in fiscal vulnerabilities. Urbanization, for purposes of research at hand, does not directly impact infrastructure development. However, management of the demand for infrastructure by fast-growing urban agglomerations remains central to ensuring sustainable development.

Recommendations and Suggestions for Future Studies

Based on the findings of this study, which show that infrastructure development in Kenya is significantly influenced by economic growth (GDP), public debt (PD), and foreign direct investment (FDI), the following policy recommendations are provided. These are grounded in empirical evidence and are tailored to address the shortcomings identified in the current policy landscape.

Strengthen Sustainable Public Debt Management: The study found that public debt has a strong positive effect on infrastructure development, but the bidirectional causality with infrastructure suggests a potential risk of debt spirals if not well managed. Kenya's reliance on debt financing for major infrastructure projects such as the Standard Gauge Railway has increased fiscal vulnerability. Thus, the government should prioritize borrowing for economically viable and high-return infrastructure projects, enhance transparency and monitoring through a strengthened debt management framework, and Limit exposure to non-concessional debt by expanding access to concessional loans.

Improve the Investment Climate to Attract More FDI: FDI was found to have a significant and unidirectional impact on infrastructure development. However, institutional inefficiencies, bureaucratic red tape, and policy unpredictability have limited Kenya's ability to attract high-quality foreign investment. The government should Streamline regulatory processes and reduce approval delays for infrastructure investments, strengthen institutions such as the Kenya Investment Authority to offer investor facilitation services and provide targeted incentives for FDI in priority infrastructure sectors such as ICT, energy, and transport.

Promote Economic Growth through Infrastructure-Driven Productivity: The study confirms that economic growth enhances infrastructure development. However, infrastructure gaps particularly in transport and ICT still constrain productivity in key sectors. To amplify the positive feedback loop between growth and infrastructure, focus infrastructure spending on sectors with the highest multiplier effect on GDP, including rural roads, energy, and digital connectivity and support public-private partnerships (PPPs) that can leverage private capital for strategic infrastructure projects.

Exercise Caution in Interpreting Urbanization's Role: Although urbanization was included as an explanatory variable, the study found its effect on infrastructure development to be statistically insignificant. As such, no specific policy recommendation is offered in this area beyond a general note that urban development should remain aligned with economic growth and FDI priorities, rather than being treated as a primary driver of infrastructure development.

Limitations of this research include dependence on available data (2003–2024), consideration of only four macroeconomic determinants, and Kenya-specific results that constrain generalizability. Future research includes considering additional variables such as governance indicators and climate resilience, longitudinal or cross-country data, qualitative approaches, and subnational inequalities or innovative technologies such as smart infrastructure. These actions would offer more useful and pragmatic suggestions for constructing infrastructure in Kenya and sub-Saharan Africa.

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