Comparative Evidence for Innovative Models for Infrastructure Financing in Ghana

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ARTICLE DETAILS

History
Received:
September 11, 2024
Revised:
December 02, 2024
Accepted:
December 12, 2024
Published:
January 01, 2025

Keywords
Infrastructure development
Infrastructure Bonds
Public-Private Partnerships
Private Sector Investment
Sovereign Wealth Funds

ABSTRACT

Purpose
This study explores the role of innovative financing models in overcoming infrastructure development challenges in developing countries. Infrastructure—encompassing transportation, energy, water, and telecommunications—is crucial for economic growth and social inclusion. However, many developing nations face financing gaps due to fiscal constraints, underdeveloped financial markets, and reliance on public funding.

Methodology
The study uses a quantitative approach to examine how Public-Private Partnerships (PPPs), infrastructure bonds, Sovereign Wealth Funds (SWFs), and blended finance can mobilize private sector investment, based on secondary data from government publications, international financial institutions, and academic journals. Secondary data was collected from 2010 to 2023. For data analysis, regression was used.

Findings
The findings reveal that while innovative financing models can significantly impact infrastructure development, their success depends on robust regulatory frameworks, political stability, and local capacity building. Public-private partnerships (PPPs) enhance project efficiency and accountability by distributing risks between the public and private sectors. Infrastructure bonds effectively mobilize long-term capital, while sovereign wealth funds (SWFs) provide a sustainable source of financing. Blended finance, which combines public and private capital, has proven particularly effective in sectors that are otherwise unattractive to private investors due to high risks.

Conclusions
The research identifies several challenges, including the need for improved regulatory and policy frameworks to attract private investment and ensure transparency. The study concludes that while innovative financing models are essential for bridging the infrastructure financing gap, their effectiveness depends on creating enabling environments that support private sector participation. Additionally, there is a pressing need for capacity building within the public sector to effectively manage complex financing structures.

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1. Introduction

Infrastructure development is crucial for economic growth and social progress. However, many countries face significant challenges in financing the necessary infrastructure. Financing infrastructure projects, particularly in developing countries, remains a formidable challenge due to limited public resources, fiscal constraints, and underdeveloped financial markets (World Bank, 2020; Estache & Garsous, 2012). Traditionally, infrastructure projects in developing countries have been financed through public funds, often supplemented by international aid and loans from multilateral development banks. Reliance on public funding alone is insufficient due to the limited capacity of public sectors to undertake large-scale infrastructure projects and competing demands on government budgets (United Nations, 2020). Consequently, there is an urgent need for innovative financing models that can leverage private sector capital and expertise. These models not only help bridge the infrastructure financing gap but also promote efficiency and sustainability in project implementation. Public-private partnerships (PPPs), infrastructure bonds, sovereign wealth funds (SWFs), and blended finance are among the innovative approaches gaining traction in developing countries (International Monetary Fund [IMF], 2019).

Developing countries face an infrastructure financing gap that is both substantial and persistent. The World Bank (2020) estimates that developing nations need to invest approximately $2 trillion annually to meet their infrastructure needs. This gap is exacerbated by rapid urbanization and population growth, which place additional strain on existing infrastructure and necessitate new investments (Organisation for Economic Co-operation and Development [OECD], 2019). PPPs have emerged as a critical tool for mobilizing private sector investment in infrastructure. By sharing risks and responsibilities between the public and private sectors, PPPs can enhance project efficiency and accountability.

Studies indicate that PPPs can deliver infrastructure projects more quickly and at a lower cost compared to traditional public procurement methods (IMF, 2019). Successful examples of PPPs in developing countries include the Queen Alia International Airport in Jordan and the Lekki Toll Road in Nigeria (African Development Bank [AfDB], 2021; Bhattacharya et al., 2015). Infrastructure bonds are another innovative financing mechanism that has gained prominence. These bonds allow governments and corporations to raise long-term capital from domestic and international investors for infrastructure projects (World Economic Forum, 2020). In Kenya, infrastructure bonds have been used to finance road and energy projects, providing a reliable source of funding that does not strain public finances (Central Bank of Kenya, 2022). SWFs, state-owned investment funds typically derived from natural resource revenues, offer a sustainable and substantial source of infrastructure financing. The Nigeria Sovereign Investment Authority (NSIA) has allocated significant resources to infrastructure development, including investments in the Lagos-Ibadan Expressway and the Second Niger Bridge (NSIA, 2023). SWFs can provide patient capital, which is crucial for the long-term nature of infrastructure investments.

Blended finance combines concessional finance from public or philanthropic sources with private capital to achieve development objectives. This approach mitigates investment risks for private investors and enhances the viability of infrastructure projects. The Global Infrastructure Facility (GIF) has successfully utilized blended finance to mobilize private investment in developing countries, supporting projects such as renewable energy in India and water supply systems in Indonesia (GIF, 2021). Blended finance can address market

failures and catalyze investments in sectors that are otherwise unattractive to private investors (GIF, 2021).

Despite the potential of these innovative financing models, several challenges must be addressed to maximize their effectiveness. The private sector has been identified as a potential source of significant investment for infrastructure development. However, attracting private investment poses its own set of challenges. Many private investors are hesitant to invest in developing countries due to perceived risks such as political instability, lack of regulatory frameworks, and concerns about project viability (Ehlers, 2014). Additionally, a lack of local expertise and capacity to structure and manage complex financing arrangements can deter private sector involvement (Griffith-Jones & Kollatz, 2015; OECD, 2019). Although innovative financing models, such as PPPs, infrastructure bonds, SWFs, and blended finance, offer potential solutions to these challenges, their implementation in developing countries has been limited and uneven. For example, while PPPs have successfully mobilized private capital in some regions, their broader adoption is often hampered by inadequate legal and institutional frameworks (Yescombe, 2017; Inderst, 2013).

Given these challenges, there is an urgent need for comprehensive strategies and frameworks that can effectively leverage both public and private sector resources. These strategies should aim to create an enabling environment for private investment, strengthen regulatory and institutional frameworks, and build local capacity for managing innovative financing models. Addressing these issues is critical to closing the infrastructure financing gap and fostering sustainable development in developing countries.

- This study examines how innovative financing models impact infrastructure financing in developing countries, with a specific focus on Nigeria and Ghana. The paper aims to: Evaluate the effectiveness of innovative financing models in infrastructure development in developing countries.
- Identify the challenges and barriers to implementing innovative financing models in developing countries.
- Analyze the impact of regulatory frameworks on the success of innovative financing models in developing countries.

2. Literature Review

Several studies synthesize existing research on the practical outcomes and effectiveness of innovative financing models in infrastructure development. Research findings consistently highlight that public-private partnerships (PPPs) can enhance infrastructure quality and service delivery by leveraging private sector expertise and investment. Studies by Estache and Garsous (2012) and the World Bank (2017) indicate that PPPs contribute to improvements in project efficiency, cost-effectiveness, and timely completion.

There is substantial evidence underscoring the critical role of regulatory frameworks in shaping the success of infrastructure financing models. Effective regulations enhance transparency, mitigate risks, and build investor confidence, thereby facilitating sustainable infrastructure development. Regulatory clarity and consistency are crucial for attracting private sector investments and ensuring that projects meet both economic and social objectives.

Additionally, studies on infrastructure bonds and blended finance mechanisms demonstrate their effectiveness in mobilizing private capital for public infrastructure projects. These financial instruments diversify funding sources, reduce fiscal burdens on governments, and encourage long-term investment in essential infrastructure sectors.

Several studies (Ezejiofor & Agyare, 2021; Ansah & Ofori, 2019) have focused on the impact of infrastructure bonds in enhancing infrastructure quality and service delivery. Researchers conducted a comprehensive analysis of infrastructure bond-funded projects across multiple sectors and regions, revealing that infrastructure bonds play a crucial role in mobilizing private capital for large-scale infrastructure projects. By attracting institutional investors seeking stable returns, infrastructure bonds facilitate improvements in infrastructure reliability and service coverage. This financing mechanism has proven effective in addressing critical infrastructure needs, particularly in transportation and utilities, thereby contributing to sustainable economic development.

Other studies (Olalekan & Adu, 2020; Mensah & Darko, 2019) examine the role of PPPs in improving infrastructure quality in urban settings. These studies highlight how partnerships between governments and private entities enhance infrastructure maintenance and upgrade efforts. Findings indicate that PPPs leverage private sector expertise and investment, leading to improved operational efficiency and service delivery. Research by Oladipo and Awoyemi (2019) and Addo and Asante (2018) focuses on sovereign wealth funds (SWFs) and their contribution to financing infrastructure projects. SWFs have been shown to support infrastructure development initiatives by bridging funding gaps and mitigating financial risks associated with large-scale projects. The findings underscore the strategic role of SWFs in infrastructure finance, highlighting their potential to enhance economic stability and promote sustainable infrastructure investments globally.

Addressing blended finance models, several studies (Ogunleye & Iyanda, 2022; Quarshie & Tetteh, 2021) discuss their impact on infrastructure development in rural areas. These studies analyzed case studies where blended finance mechanisms combined public and private funds to finance infrastructure projects in underserved regions. Findings indicate that blended finance models enhance project viability by leveraging diverse funding sources and aligning investor interests with development goals. By mobilizing private sector capital alongside public resources, blended finance promotes inclusive development and reduces infrastructure disparities in rural communities.

Adeoye and Salisu (2023) and Mensah and Osei (2023) analyzed bond-funded initiatives in the renewable energy sector, highlighting their contribution to sustainable infrastructure development. Infrastructure bonds were found to attract investment in clean energy technologies by offering stable returns and mitigating financial risks associated with renewable energy investments. Their study underscores the transformative impact of infrastructure bonds in facilitating the transition to renewable energy sources, supporting environmental sustainability goals, and advancing energy infrastructure resilience. Adebayo and Olowooker (2021) investigated the role of regulatory frameworks in enhancing the effectiveness of PPPs in Nigeria and found that robust regulatory frameworks—including transparent procurement processes and clear contract terms—significantly improve project outcomes. Similarly, Mensah and Boateng (2020) examined the regulatory challenges faced by infrastructure projects in Ghana. Using a mixed-methods approach, their study collected data from government reports and interviews with industry experts. Results showed that inadequate regulatory frameworks lead to delays and cost overruns in infrastructure projects.

Focusing on the impact of regulatory quality on infrastructure financing in developing countries, Smith and Brown (2019) conducted a comparative analysis of multiple case studies across different regions. Their findings indicate that countries with well-defined and enforced regulatory frameworks attract more private investments in infrastructure. The study highlights that clear regulations reduce uncertainty and enhance investor confidence, which is crucial for financing large-scale infrastructure projects.

Ogunleye and Ajayi (2022) analyzed the effectiveness of regulatory reforms in Nigeria's energy sector through a longitudinal analysis of policy changes and their impact on project implementation and financial performance. Results demonstrated that regulatory reforms aimed at increasing transparency and reducing bureaucratic hurdles significantly improved the sector's attractiveness to private investors. Quarshie and Ofori (2021) examined the role of regulatory frameworks in promoting sustainable infrastructure development in Ghana. Through an assessment of environmental and social impact assessments mandated by regulatory authorities, the study found that stringent regulations not only protect the environment but also enhance the social benefits of infrastructure projects. The findings suggest that integrating sustainability criteria into regulatory frameworks supports long-term development objectives and increases public support for infrastructure initiatives.

In Ghana, researchers conducted an empirical study on the role of capacity building in the sustainability of water supply projects. Utilizing case studies and interviews with local government officials and community leaders, the study found that capacity-building efforts—including training in maintenance and management—were crucial for the long-term sustainability of water infrastructure (Asare & Mensah, 2020). Jones and Smith (2021) focused on the effects of capacity building on the efficiency of transportation infrastructure projects in developing countries. Their study analyzed data from multiple transportation projects, comparing those with robust capacity-building programs to those without. Results indicated that projects with comprehensive capacity-building initiatives experienced significantly fewer implementation issues and higher operational efficiency.

Adebayo and Ilesanmi (2021) conducted an empirical review in Nigeria to assess the impact of capacity building on the implementation of renewable energy projects. The study utilized quantitative data from project reports and qualitative data from interviews with key stakeholders. Findings revealed that capacity-building initiatives, particularly in technical skills and project management, played a vital role in the successful deployment and operation of renewable energy systems. The study concluded that continuous capacity development is crucial for scaling up renewable energy infrastructure to meet national energy goals. In another study on capacity building and infrastructure development in Ghana, Owusu and Ankomah (2019) explored the relationship between capacity-building programs and public infrastructure project performance. Using a mixed-methods approach, the study collected data from public sector employees and project stakeholders. Findings demonstrated that capacity-building programs significantly improve project planning, execution, and monitoring. The study highlighted the need for tailored capacity-building strategies to address specific skill gaps and promote knowledge transfer within the public sector.

Several studies have examined the impact of sustainable infrastructure investments on economic growth and social equity in Nigeria. A study by Ogunleye and Adeyemi (2020) employed a mixed-methods approach, combining quantitative data from economic performance indicators with qualitative insights from stakeholder interviews. Findings

revealed that infrastructure projects incorporating sustainability principles—such as renewable energy and green building practices—significantly contribute to economic resilience and job creation. The study emphasizes that integrating sustainability into infrastructure planning promotes environmental conservation and enhances social equity by providing broader access to essential services. Researchers in Ghana conducted an empirical study on the role of sustainable infrastructure in achieving long-term development goals. Using a longitudinal analysis of infrastructure projects in the energy and transportation sectors, Asante and Oppong (2021) found that projects adhering to sustainable development standards demonstrated improved operational efficiency and lower environmental impacts. Their study stresses that incorporating sustainability criteria into infrastructure development is essential for achieving national development objectives and ensuring equitable distribution of infrastructure benefits among the population.

A review focused on the outcomes of sustainable water infrastructure projects in developing countries found that projects prioritizing resource efficiency and community involvement significantly improved water access and quality while reducing operational costs (Smith & Johnson, 2022). The study highlights that sustainable approaches to water infrastructure not only address immediate supply challenges but also contribute to long-term environmental sustainability and public health improvements. Afolabi and Olowu (2019) assessed the impact of sustainable transport infrastructure on urban development in Nigeria. Using traffic flow data, pollution metrics, and urban resident surveys, their study found that sustainable transport initiatives—such as public transit systems and non-motorized transport infrastructure—led to reduced traffic congestion and lower greenhouse gas emissions. Additionally, these projects improved urban mobility and accessibility, particularly for low-income populations. The study concludes that sustainable transport infrastructure is crucial for creating more livable and equitable urban environments.

In Ghana, Kwakye and Boateng (2020) analyzed the sustainable development outcomes of rural electrification projects. Their research combined quantitative measures of electrification rates with qualitative assessments of community impacts. Findings indicate that rural electrification projects integrating renewable energy sources—such as solar and wind—provided reliable and affordable electricity while also spurring local economic activities and improving educational outcomes. The study emphasizes that sustainable electrification initiatives are key drivers of rural development, helping to reduce poverty and promote social inclusion.

3. Methodology

3.1. Data

The paper focuses on innovative financing models for infrastructure development based on evidence from Ghana and Nigeria from 2010 to 2023. We collect exiting data that has been previously collected and published by past researchers, institutions, and organizations, from secondary data sources including government publications, academic journal articles, as well as reports from international financial institutions such as the World Bank and IMF. These sources provide comprehensive information on infrastructure financing mechanisms, investment outcomes, and related metrics that are critical indicators of the economic and infrastructural progress in these countries (Johnston, 2017). The study leveraged the extensive research and analysis already conducted by reputable organizations and scholars, thus ensuring the reliability and validity of the information. The data collection process ensured that the collected data was pertinent to the research objectives.

3.2. Method

The paper offers a quantitative analysis of the relationships and impacts of innovative financing mechanisms on infrastructure development. The paper uses Pearson correlation and ordinary least squares (OLS) regression to show the relationship between various financing models and infrastructure development outcomes based on equation (1).

$$\text{IDY}_t = \beta_0 + \beta_1 NPPP_t + \beta_2 PPPV_t + \beta_3 CRB_t + \beta_4 SWF_t + \beta_5 PBF_t + \beta_6 PBFV_t + \beta_7 SCR_t + \beta_8 PSI_t + \beta_9 GDP_t + \beta_{10} IFL_t + \mu_t \quad (1)$$

The variables include infrastructure development outcome (IDF), number of public-private partnership projects (NPPP), value of public-private partnership projects (PPPV), amount of capital raised through bonds (CRB), investment in infrastructure by Sovereign Wealth Funds (SWF), volume of projects using blended finance (PBF), Strength and Clarity of Regulations (SCR), Political Stability Index score (PSI), Gross Domestic Product Growth Rate (GDP), and Inflation Rate (IFL). Also, μ_t is the error term, β0 is the intercept term while β_1, β_2, β_3, β_4, β_5, β_6, β_7, and β_8 are the coefficients for the respective independent variables.

Pearson correlation was used to measure the strength and direction of the linear relationship between variables related to innovative financing models and infrastructure development outcomes. This analysis helped in identifying significant correlations between different financing mechanisms, such as Public-Private Partnerships (PPPs), infrastructure bonds, and the resultant infrastructure development metrics in Nigeria and Ghana (Cohen et al., 2003). Each value in the matrix represents the correlation coefficient between two variables, indicating the strength and direction of their linear relationship. A positive correlation coefficient suggests a direct relationship, where an increase in one variable is associated with an increase in the other. A negative correlation indicates an inverse relationship. This matrix is instrumental in identifying potential interdependencies that can inform strategic decisions and policy formulations among variables.

OLS regression models provided estimates of the effect sizes and significance levels, allowing for a comprehensive understanding of how various financing mechanisms influence infrastructure development. The estimation explores the relationships and determines the impact of the various types of financing models (independent variables) on infrastructure development outcomes (i.e., dependent variables).

4. Results and Implications

4.1. Results

Table 4.1 reports the basic statistics of the data. The mean of NPPP and PPPV projects, respectively, are 4.21 and $485.87 million. The average capital raised through bonds (ACRB) is $268.14 million, while the mean investment in infrastructure by SWF is $176.62 million. The volume of projects using blended finance (PBF) has an average of 3.93 projects, with a mean value of $94.15 million for PBFV. The average scores for strength and clarity of regulations (SCR) and political stability index (PSI) are 5.31 and 5.19, respectively. The mean GDP growth rate (GDPGR) is 4.65%, and the mean inflation rate (IR) is 10.33%.

NPPP has a standard deviation of 2.19, indicating moderate variability in the number of projects. PPPV and ACRB have standard deviations of $228.64 million and $109.84 million, respectively, suggesting significant variability in financial metrics. The standard deviation for IISWF is $88.52 million, indicating a considerable range in infrastructure investments. PBF and PBFV have standard deviations of 1.81 and $48.77 million, respectively. SCR and PSI have standard deviations of 2.83 and 2.82, respectively, indicating variability in regulatory strength and political stability. GDPGR and IR have standard deviations of 2.64% and 5.85%, respectively, reflecting moderate to high variability in economic performance.

The skewness and kurtosis values provide additional insights into the distribution characteristics of the variables. NPPP has a skewness of 0.45, indicating a slight right skew. PPPV and CRB have skewness values of 0.22 and 0.29, respectively, indicating slight right skewness. SWF has a skewness of -0.13, suggesting a slight left skew. The kurtosis values for these variables are negative, indicating a flatter distribution than the normal distribution. Jarque-Bera test results and their associated probabilities indicate that most variables do not significantly deviate from normality, with probabilities above 0.05.

Table 4.2 reports for the correlation evidence amongst the variables related to innovative financing models for infrastructure development. The strongest positive correlation observed is between CRB and SCR (0.482), suggesting that effective regulatory environments significantly enhance the ability to raise capital through bonds. Similarly, NPPP shows a moderate positive correlation with CRB (0.455) and SCR (0.237), indicating that both regulatory clarity and bond markets are supportive of public-private partnerships. The negative correlation between NPPP and GDP (-0.189) suggests that an increase in the number of PPP projects might be associated with a slower GDP growth rate. This could indicate that while PPPs are crucial for infrastructure, they might not immediately reflect in GDP growth or could imply a diversion of resources from other growth-stimulating activities.

The correlation between PPPV and PBFV (0.298) highlights that as the value of PPP projects increases, so does the value of projects utilizing blended finance. This relationship underscores the complementary nature of these financing models in mobilizing resources for infrastructure. Interestingly, SWF shows minimal correlations with most variables, indicating that sovereign wealth fund investments in infrastructure might operate relatively independently of the other variables considered. The correlation between PSI and other variables is generally low, with a slight negative correlation with GDP (-0.132) and IFL (-0.135), suggesting that political stability does not significantly correlate with economic performance metrics in this context.

Table 4.1.Descriptive statistics

Variable	Mean	Std. Dev.	Skewness	Kurtosis	JB	P-value
NPPP	4.21	2.19	0.45	-0.95	1.32	0.52
PPPV	485.87	228.64	0.22	-1.15	0.91	0.63
CRB	268.14	109.84	0.29	-0.75	0.67	0.71
SWF	176.62	88.52	-0.13	-1.22	1.24	0.54
PBF	3.93	1.81	-0.34	-1.19	1.21	0.55
PBFV	94.15	48.77	0.47	-1.18	1.31	0.52
SCR	5.31	2.83	0.07	-1.29	1.20	0.55
PSI	5.19	2.82	-0.31	-1.13	1.00	0.61
GDP	4.65	2.64	-0.10	-1.37	1.47	0.48
IFL	10.33	5.85	0.26	-1.59	1.75	0.41

Note: JB is Jarque-Bera

Source: Author's own elaboration

Table 4.2.Correlatiom matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
NPPP(1)	1	0.30	0.46	0.01	0.19	0.16	0.24	-0.05	-0.19	0.03
PPPV(2)	0.30	1	0.36	0.10	0.05	0.30	0.25	-0.09	-0.20	0.16
CRB(3)	0.46	0.36	1	0.23	0.02	0.16	0.48	0.07	0.05	-0.13
SWF(4)	0.01	0.10	0.23	1	-0.03	0.06	0.04	-0.08	0.02	0.20
PBF(5)	0.19	0.05	0.02	-0.03	1	0.33	-0.08	0.17	-0.22	0.01
PBFV(6)	0.16	0.30	0.16	0.06	0.33	1	0.25	-0.04	-0.12	-0.05
SCR(7)	0.24	0.25	0.48	0.04	-0.08	0.25	1	0.08	0.24	0.01
PSI(8)	-0.05	-0.09	0.07	-0.08	0.17	-0.04	0.08	1	-0.13	-0.14
GDP(9)	-0.19	-0.20	0.05	0.02	-0.22	-0.12	0.24	-0.13	1	-0.07
IFL(10)	0.03	0.16	-0.13	0.20	0.01	-0.05	0.01	-0.14	-0.07	1

Source: Author's own elaboration

The results indicate a significant and positive relationship between several financing mechanisms and infrastructure development outcomes, with specific variables showing stronger predictive power. The coefficients for NPPP and PPPV are 0.045 and 0.032 respectively, with both variables showing statistically significant t-values of 2.142 and 2.133, and corresponding probabilities of 0.041 and 0.042. This suggests that both the number and value of PPP projects positively contribute to infrastructure development. PPPs appear to play a crucial role in mobilizing resources and enhancing infrastructure capabilities, highlighting their effectiveness in addressing the financing gaps in these developing countries. The capital raised through bonds (CRB) also shows a significant positive impact with a coefficient of 0.250 and a t-value of 3.125 (p=0.005), emphasizing the importance of bond markets in supporting large-scale infrastructure projects.

The investment by Sovereign Wealth Funds exhibits a minimal effect on infrastructure development, with a coefficient of 0.012 and a non-significant t-value of 0.324. This indicates that while the funds are a potential source of infrastructure financing, their impact may not be as pronounced as other mechanisms. The volume of projects using blended finance (PBF) and its value (PBV) show positive coefficients of 0.087 and 0.065 respectively, with significant t-values of 2.636 and 2.600. These results highlight blended finance as an effective tool for mobilizing private capital and addressing the infrastructure financing needs in Nigeria and Ghana.

The strength and clarity of regulations (SCR) also emerge as a significant predictor of infrastructure development, with a coefficient of 0.210 and a t-value of 2.692 (p=0.012). This underscores the importance of a robust regulatory framework in facilitating effective infrastructure financing and development. The Political Stability Index (PSI), however, shows a non-significant impact with a coefficient of 0.015 and a t-value of 0.789 (p=0.438), suggesting that political stability alone does not significantly influence infrastructure outcomes within the studied period. The GDP growth rate (GDP) has a positive and significant coefficient of 0.145, indicating that economic growth is an important factor in infrastructure development.

Lastly, the inflation rate (IFL) exhibits a negative coefficient of -0.062 with a marginally non-significant t-value of -1.824, suggesting that higher inflation may impede infrastructure development efforts, although this relationship is not strongly supported. The overall model statistics, as represented by the adjusted R-squared of 0.80, indicate a good fit, with the independent variables collectively explaining a substantial portion of the variance in infrastructure development. The F-statistic of 2.42 confirms the model's significance, supporting the validity of the findings and the relevance of the included variables in explaining infrastructure development in Nigeria and Ghana.

Table 4.3. Estimated model for IDF

Variable	Coeff	Std. Error	t-Stat	Prob.
Const.	-1.572	0.632	-2.486	0.019
NPPP	0.045	0.021	2.142	0.041
PPPV	0.032	0.015	2.133	0.042
CRB	0.250	0.080	3.125	0.005
SWF	0.012	0.037	0.324	0.748
PBF	0.087	0.033	2.636	0.014
PBFV	0.065	0.025	2.600	0.015
SCR	0.210	0.078	2.692	0.012
PSI	0.015	0.019	0.789	0.438
GDP	0.145	0.066	2.197	0.036
IFL	-0.062	0.034	-1.824	0.084
Statistic				
R2 (Adj)	0.8005			
F-stat	2.4222			
DW	1.7643			
Prob(F)	0.0053			

Source: Author's own elaboration

4.2. Evaluation of Working Hypotheses

The first hypothesis tests whether innovative financing models, such as Public-Private Partnerships (PPPs), infrastructure bonds, Sovereign Wealth Funds (SWFs), and blended finance, significantly contribute to infrastructure development. The number and value of PPP projects show positive and significant coefficients corresponding to the p-values of 0.041 and 0.042, thus indicating that an increase in both the number and value of PPP projects significantly promotes infrastructure development. Moreover, capital raised through bonds has a highly significant positive coefficient with a p-value of 0.005. This robust positive relationship underscores the effectiveness of bond markets in mobilizing substantial capital for infrastructure projects. Similarly, blended finance variables (PBF and PBV) demonstrate significant positive impacts with coefficients having p-values of 0.014 and 0.015, respectively. These results collectively reject the null hypothesis, affirming that innovative financing models play a crucial role in enhancing infrastructure development in developing countries like Nigeria and Ghana.

The second null explores the presence of significant challenges and barriers to the implementation of innovative financing models. The SCR variable shows a positive and significant coefficient, indicating that a robust regulatory framework is crucial for the successful implementation of innovative financing models. This finding suggests that one significant barrier to the effectiveness of these models is the regulatory environment. Developing countries often face challenges in establishing clear, consistent, and supportive regulations, which can hinder the attraction of private investment and the successful deployment of financing mechanisms. The PSI variable, while showing a positive coefficient, is not significant. This implies that political stability alone may not be a substantial barrier. Nevertheless, political stability can influence investor confidence and the broader economic environment, indirectly affecting the feasibility of innovative financing models.

The third null examines whether regulatory frameworks significantly influence the success of innovative financing models. The positive and significant coefficient of the SCR variable directly refutes the null. The analysis clearly demonstrates that the strength and clarity of regulations are pivotal in ensuring the effectiveness of financing mechanisms like PPPs, bonds, and blended finance. A well-defined regulatory framework reduces uncertainties, provides clear guidelines for project implementation, and ensures the enforcement of contracts, all of which are essential for attracting private investment. The significance of the SCR variable highlights the importance of regulatory reforms in developing countries to create an enabling environment for innovative financing models. Inconsistent or weak regulations can deter investors and complicate the execution of infrastructure projects, emphasizing the need for robust legal and institutional frameworks to support these financing mechanisms.

4.3. Managerial and Economic Implications

The findings from this study underscore the significant impact of innovative financing models on infrastructure development in developing countries, particularly in Nigeria and Ghana. Public-private partnerships (PPPs) emerged as a pivotal mechanism, with both the number and value of PPP projects showing significant positive correlations with infrastructure development. This aligns with the literature indicating that PPPs are effective in mobilizing private investment, enhancing project efficiency, and sharing risks between the public and private sectors (Yescombe, 2017). The significance of PPPs is further supported by real-world examples, such as the Queen Alia International Airport in Jordan and the Lekki Toll Road in Nigeria, which have successfully attracted substantial private investment and delivered infrastructure projects more efficiently (African Development Bank, 2021).

The regression analysis also highlighted the crucial role of infrastructure bonds in financing large-scale infrastructure projects. The significant positive coefficient for capital raised through bonds (ACRB) reinforces the argument that infrastructure bonds are a viable solution for mobilizing long-term capital from domestic and international investors. This finding is consistent with the broader understanding that infrastructure bonds can attract institutional investors with long-term investment horizons, such as pension funds and insurance companies (Inderst, 2013). In Kenya, for instance, infrastructure bonds have been successfully used to finance road and energy projects, providing a reliable source of funding without excessively burdening public finances (Central Bank of Kenya, 2022).

Blended finance, another innovative model, also demonstrated a positive impact on infrastructure development. The coefficients for the volume and value of projects using blended finance (VPBF and VPBF) were both significant, suggesting that combining concessional finance with private capital can effectively mitigate investment risks and enhance project viability. This supports the findings of the Global Infrastructure Facility (2021), which has utilized blended finance to mobilize private investment in sectors like renewable energy and water supply systems in developing countries. By addressing market failures and making projects more attractive to private investors, blended finance plays a crucial role in bridging the infrastructure financing gap (OECD, 2019).

The importance of a robust regulatory framework was highlighted by the significant positive coefficient of the strength and clarity of regulations (SCR) variable. This finding underscores the necessity of clear, consistent, and supportive regulations for the success of innovative financing models. Effective regulatory frameworks reduce uncertainties, provide clear guidelines for project implementation, and ensure contract enforcement,

thereby creating an enabling environment for private investment (Transparency International, 2022). The study's results emphasize that regulatory reforms are essential for attracting private investment and facilitating the successful deployment of financing mechanisms.

While political stability (PSI) did not show a significant impact in the regression analysis, it remains an important contextual factor that can influence investor confidence and the broader economic environment. Although the study did not find a direct significant relationship, political stability can indirectly affect the feasibility of innovative financing models by shaping the overall investment climate. This nuanced understanding aligns with the broader literature, which suggests that while political stability is crucial, its effects on infrastructure financing may be mediated through other factors such as economic policies and regulatory frameworks (Ehlers, 2014).

5. Conclusions

This study attempts to establish how innovative financing models impact infrastructure development in Nigeria and Ghana. The research adopts a quantitative approach, utilizing secondary data from credible sources such as government publications, international financial institutions, and academic journals. The primary goal is to evaluate the effectiveness of financing mechanisms like infrastructure bonds, Public-Private Partnerships, Sovereign Wealth Funds, and blended finance in addressing the substantial infrastructure financing gaps faced by these countries.

The analysis reveals that PPPs play a crucial role in mobilizing private investment and enhancing infrastructure development. Both the number and value of PPP projects show significant positive correlations with infrastructure outcomes, indicating their effectiveness in leveraging private sector resources and expertise. This finding is consistent with existing literature, which highlights the efficiency and risk-sharing benefits of PPPs in delivering infrastructure projects more quickly and at lower costs compared to traditional public procurement methods.

Infrastructure bonds also emerge as a significant contributor to infrastructure development. The analysis shows that the amount of capital raised through bonds has a robust positive impact, highlighting their importance as a long-term financing solution. Infrastructure bonds attract institutional investors like pension funds and insurance companies, which have long-term investment horizons and seek stable returns. This aligns with the broader understanding that infrastructure bonds can provide a reliable source of funding for large-scale projects without placing undue strain on public finances. Successful case studies from Kenya demonstrate how infrastructure bonds have been effectively utilized to finance critical infrastructure projects.

Blended finance is shown to significantly promote infrastructure development. The study finds that both the volume and value of projects using blended finance have positive impacts, suggesting that this model effectively mitigates investment risks and enhances project viability. Blended finance addresses market failures and attracts private investment in sectors that might otherwise be underfunded. This finding supports the effectiveness of blended finance in mobilizing private capital for infrastructure projects, as evidenced by successful initiatives by the global infrastructure facility in various developing countries.

The study underscores the critical role of a robust regulatory framework in the success of innovative financing models. The strength and clarity of regulations significantly influence the effectiveness of financing mechanisms like PPPs, bonds, and blended finance. A well-defined regulatory environment reduces uncertainties, provides clear implementation guidelines, and ensures contract enforcement, all of which are essential for attracting private investment. The findings emphasize the need for regulatory reforms in developing countries to create an enabling environment for innovative financing models. Weak or inconsistent regulations can deter investors and hinder the successful execution of projects.

The paper recommends some policies that can create an enabling environment for innovative financing models, thereby bridging the infrastructure financing gap and fostering sustainable development and economic growth.

- First, there is a need for policymakers to prioritize the development of clear, consistent, and supportive regulations that provide the necessary guidelines and enforcement mechanisms for infrastructure projects. Robust regulatory environments reduce uncertainties and attract private investments by ensuring transparency, accountability, and the enforcement of contracts. Regulatory reforms should focus on streamlining approval processes, establishing clear project guidelines, and ensuring effective monitoring and evaluation mechanisms.
- Second, there is a need to enhance the skills and knowledge of public sector officials involved in infrastructure financing and management. Training programs and workshops can help officials understand complex financing arrangements, negotiate favorable terms with private partners, and manage large-scale projects effectively. Building local expertise is essential for the successful implementation of innovative financing models and for ensuring sustainable infrastructure development.
- Third, there is a need to leverage international support and cooperation. Developing countries can benefit from the expertise and financial resources of international organizations, development banks, and donor agencies. These entities can provide technical assistance, funding, and risk mitigation tools to support infrastructure projects. Collaborative efforts with international partners can enhance the effectiveness of innovative financing models and ensure the successful implementation of infrastructure projects.

Author Contributions: Kayode conducted conceptualization, Analysis, Overall Draft, and Review**.**

Funding: No Funding.

Conflicts of Interest: No conflict of interest.

References

Adebayo, O., & Ilesanmi, T. (2021). Capacity building and renewable energy project success in Nigeria. *Energy Policy Journal*, 15(4), 78-92.

Adeshina, T., Alaje, C., Idaeho, R. (2021). Infrastructural development in Nigeria: Challenges for private sector participation and the way forward. Lagos: Jackson, Etti & Edu. https://jee.africa/wp-content/uploads/2021/01/Infrastructural-Development-in-Nigeria-Challenges-for-Private-Sector-Participation-and-the-Way-Forward.pdf

Afolabi, T., & Olowu, K. (2019). Sustainable transport infrastructure and urban development in Nigeria. *Urban Studies Review*, 21(2), 134-149.

African Development Bank. (2021). *PPP frameworks in Africa*. Retrieved from https://www.afdb.org

Akomea-Frimpong, I., Jin, X., Osei-Kyei, R., & Kukah, A. S. (2023). Public–private partnerships for sustainable infrastructure development in Ghana: a systematic review and recommendations. *Smart and Sustainable Built Enviro nment*, 12(2), 237- 257.

Aladejana, S.A., Okeowo, I.A., Oluwalana, F.A & Alabi, J.A. (2021). Debt burden and infrastructural development in Nigeria. *International Journal of Academic Research Business and Social Science,* 11(1), 419-432.

Allen, F., & Gale, D. (2019). Financial regulation in developing economies. *International Journal of Finance and Economics*, 26(1), 45-60.

Amaefule, L.I. & Umeaka, E. C. (2016). Effect of government's borrowing on Nigerian infrastructural development. *Euro-Asia Journal of Economics and Finance*, 4(4), 93-112.

APM Group International. (2024). Efficiency and Effectiveness: PPP as a Potential Source of Higher Efficiency for Infrastructure Projects. https://ppp-certification.com/ppp-certification-guide/52-efficiency-and-effectiveness-ppp-potential-source-higher-efficiency

Asante, J., & Oppong, D. (2021). Role of sustainable infrastructure in achieving development goals in Ghana. *Development Economics Review*, 29(2), 101-115.

Asante-Addo, Collins; Weible, Daniela (2020): Profiling consumers based on information use and trust in a developing economy, International Journal of Consumer Studies, ISSN 1470-6431, Wiley, Hoboken, NJ, Vol. 44, Iss. 3, pp. 285-295, https://doi.org/10.1111/ijcs.12565

Asare, R., & Mensah, P. (2020). Capacity building and sustainability of water supply projects in Ghana. *Water Resources Management Journal*, 18(3), 201-215.

Bahoo, S., Alon, I., & Paltrinieri, A. (2020). Sovereign wealth funds: Past, present and future. *International Review of Financial Analysis*, 67, 101418. https://doi.org/10.1016/j.irfa.2019.101418

Bhattacharya, A., Oppenheim, J., & Stern, N. (2015). Driving sustainable development through better infrastructure: Key elements of a transformation program. Global Economy and Development at Brookings. Retrieved from https://www.brookings.edu

Börner, J., & Voss, J. (2021). Regulatory practices and innovative financing in infrastructure development. *Regulatory Policy Review*, 33(4), 321-338.

Central Bank of Kenya. (2022). Infrastructure bonds in Kenya. Retrieved from https://www.centralbank.go.ke

Davies, I.E.E., Nwankwo, C.O., Olofinna, O.M. & Michael, T.A. (2019). Insight review on impact of infrastructural development in driving the SDGs in developing nations: a case study of Nigeria. International Conference on Sustainable Infrastructural Development. 10.1088/1757-899x/640/1/012112.

Ehlers, T. (2014). Understanding the challenges for infrastructure finance. BIS Working Papers No 454. Retrieved from https://www.bis.org

Estache, A., & Garsous, G. (2012). The impact of infrastructure on growth in developing countries. *International Finance Corporation*.

Garnaut, R. (2020). Long-term impacts of infrastructure financing models on sustainable development. *Global Development Perspectives*, 17(2), 89-103.

Global Infrastructure Facility. (2021). Blended finance for infrastructure. Retrieved from https://www.globalinfrafacility.org

Griffith-Jones, S., & Kollatz, M. (2015). Meeting the infrastructure challenge in developing countries: The role of public-private partnerships. *International Policy Centre for Inclusive Growth.* Retrieved from https://www.ipcig.org

Inderst, G. (2013). *Private infrastructure finance and investment in Europe*. EIB Working Papers 2013/02. Retrieved from https://www.eib.org

Infrastructure Concession Regulatory Commission. (2024). PPP, Public-Private partnership. https://www.icrc.gov.ng/ppp/

International Monetary Fund. (2019). Public-private partnerships: Risks and opportunities. Retrieved from https://www.imf.org

Johnston, M. P. (2017). Secondary Data Analysis: A Method of which the Time Has Come. Qualitative and Quantitative Methods in Libraries, 3(3), 619-626.

Jones, M., & Smith, A. (2021). Capacity building and infrastructure project efficiency in developing countries. *International Journal of Project Management*, 39(5), 501-517.

Khan, A. & Cheng, M. (2023). Do Green Bonds Play a Role in Achieving Sustainability? Sustainability, 15(13). 10.3390/su151310177

Khan, A. (2019). Strategies for effective capacity building in infrastructure management. *Journal of Infrastructure Development*, 22(3), 78-92.

Kodongo, O., ul Mukoki, P. & Ojah, K. (2023). Bond market development and infrastructure-gap reduction: The case of Sub-saharan Africa. *Economic Modelling*, 121, 106230. https://doi.org/10.1016/j.econmod.2023.106230

Kwakye, F., & Boateng, K. (2020). Sustainable electrification and rural development in Ghana. *Energy for Sustainable Development*, 28(2), 150-165.

Lewis, L. (2023). Rural and Urban Water Issues in Africa. USA: The Water Project. https://thewaterproject.org/water-crisis/water-in-crisis-rural-urban-africa?cv=1&session-id=b88243d272574589b3b30db60d3bdf19.

Mairura, J (2024). Nigeria's Mega Project: $2 Billion Lagos-Calabar Coastal Highway Project Takes Shape as Expected Completion Time is Announced. Construction review. https://constructionreviewonline.com/construction-projects/nigerias-mega-project-2-billion-lagos-calabar-coastal-highway-project-takes-shape-as-expected-completion-time-is-announced/

Mensah, K., & Boateng, R. (2020). Regulatory challenges in Ghana's infrastructure projects. *Journal of African Development*, 27(1), 43-58.

Nigeria Sovereign Investment Authority. (2023). Annual report. Retrieved from https://www.nsia.com.ng

OECD. (2018). Making Blended Finance Work for the Sustainable Development Goals. OECD Publishing.

OECD. (2019). Infrastructure financing in developing countries. Retrieved from https://www.oecd.org

Ogunleye, T., & Adeyemi, T. (2020). Regulatory reforms in Nigeria's energy sector and investor attractiveness. *Energy Policy and Economics*, 34(3), 202-218.

Okoro, I., & Uche, E. (2019). Impact of capacity building on infrastructure project success in Nigeria. *Journal of Project Management Research*, 31(2), 98-110.

Olatunji Fadeyi, A. A. (2016). Assessment of Public-Private Partnership on Infrastructural Development in Nigeria: Challenges and Prospects. 3rd International Conference on African Development Issues, 222- 226.

Organisation for Economic Co-operation and Development. (2019). Infrastructure financing in developing countries. Retrieved from https://www.oecd.org

Owusu, F., & Ankomah, K. (2019). Capacity building and public infrastructure performance in Ghana. *Public Administration and Development Journal*, 37(4), 45-61.

Quarshie, M., & Ofori, E. (2021). Regulatory frameworks and sustainable infrastructure development in Ghana. *Sustainability Studies Journal*, 16(1), 88-102.

Rybnicek, R., Plakolm, J., Baumgartner, L. (2020, April). Risks in Public–Private Partnerships: A Systematic Literature Review of Risk Factors, Their Impact and Risk Mitigation Strategies. Public Performance & Management Review. https://www.tandfonline.com/doi/full/10.1080/15309576.2020.1741406

Smith, L., & Brown, P. (2019). Regulatory quality and infrastructure financing in developing countries. *Finance and Development Review*, 24(3), 127-143.

Smith, M., & Johnson, R. (2022). Outcomes of sustainable water infrastructure projects in developing countries. *Water and Environmental Management Journal*, 36(4), 212-228.

Transparency International. (2022). Infrastructure governance in developing countries. Retrieved from https://www.transparency.org

United Nations. (2020). Financing for sustainable development report. Retrieved from https://www.un.org

World Bank Data Bank. (2024). World development indicators; public-private partnership investment in energy 2020 data. https://databank.worldbank.org/source/world-development-indicators

World Bank. (2017). Public-Private Partnerships Reference Guide (3rd ed.). World Bank Group.

World Bank. (2020). Closing the infrastructure gap. Retrieved from https://www.worldbank.org

World Bank. (2020). Public-Private Partnerships Reference Guide (3rd ed.). World Bank Group.

World Economic Forum. (2020). Mobilizing institutional investors for infrastructure. Retrieved from https://www.weforum.org

Yescombe, E. R. (2017). Public-private partnerships for infrastructure: *Principles of policy and finance (2nd ed.)*. Butterworth-Heinemann.