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MONETARY POLICY AND COST OF CAPITAL IN SUB-SAHARAN AFRICA. AN EMPIRICAL ANALYSIS

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----------ABSTRACT----------
The effects of monetary policy on cost of capital in Sub-Saharan Africa from 2000 to 2021 is examined using a quantitative research design and structural equation modeling (SEM). The research analyzes complex relationships among key economic variables with balanced panel secondary World Bank data. The conceptual framework incorporates cost of capital as dependent variable and; real exchange rate, inflation rates, and broad money, as independent variables. Mediating variables; financial flows and investment, along with moderating variables; foreign direct investment, and trade openness, are examined to explore monetary policy impacts on cost of capital. Empirical analysis involves regression, mediation, moderation analyses, and robustness checks to validate the significance of these relationships. Error correction techniques reveal statistically significant relationships among the variables. The results show 0.89753 adjusted R- with 2.61603 Durbin-Watson statistic, indicating robustness of the model. Key findings highlight that broad money, inflation rate, investment, along with foreign direct investment positively and significantly impact cost of capital. Specifically, a 10% increase in these factors results in a 7.23, 1.49, 2.18, and 0.38 percent increase in the cost of capital, respectively. While trade openness, financial flows and real exchange rate had a negative and statistically significant relationship with cost of capital. A 10% increase in these factors results in a 6.49, 0.13, and 0.21 percent decrease in the capital cost, respectively. Additionally, the simultaneous interaction of broad money and investment is both positive and statistically significant, with a 10% increase in the pair leading to a 2.03% increase in the cost of capital, and is supported by 0.573342 adjusted R-squared and 2.249774 Durbin-Watson statistic. Study recommends that policymakers should focus on several key areas such as managing inflation, broad money, investment, and foreign direct investment. Governments should create an investor-friendly environment through stable regulatory frameworks, infrastructure development, and incentives for foreign direct investment. Additionally, fostering trade openness, exchange rate stability and enhanced financial flows will reduce on the cost of capital.

KEY WORDS: *Monetary policy, Cost of Capital, Sub-Saharan Africa* ----------

INTRODUCTION

The cost of capital is a crucial factor influencing economic growth and investment, especially in developing nations such as Sub-Saharan Africa. The region faces distinct challenges, including high inflation, volatile exchange rates, and underdeveloped financial markets, all of which significantly impact the cost of capital (Ndulu et al., 2007). Monetary policies, such as interest rate adjustments, money supply control, and exchange rate management, are essential tools for shaping these economic conditions (Mishkin, 1996). Despite their importance, the specific impacts of these policies on the cost of capital in Sub-Saharan Africa remain insufficiently explored, highlighting a significant gap in the literature (Sachs et al., 2004).

Monetary policies are vital in managing inflation, ensuring financial stability and fostering a conducive environment for investment. While extensive research has been conducted on the effects of monetary policies in developed economies (Modigliani & Miller, 1958), there is a paucity of studies focusing on their impact in less developed regions, where economic structures and challenges differ considerably (Ndulu et al., 2007). Understanding these dynamics in the context of Sub-Saharan Africa is essential for effective policy formulation and economic planning.

This study seeks to close this gap by providing an empirical study of the effects of monetary policies on cost of capital in Sub-Saharan Africa from 2000 to 2021. Employing structural equation modeling (SEM) and a quantitative research

design, the study looks at complex relationships among key economic variables, including real effective exchange rate, inflation rates, broad money, financial flows, investment, GDP growth rates, foreign direct investment (FDI), and trade openness (World Bank, 2021).

The rationale for this study is twofold. Firstly, it aims to offer a comprehensive understanding of how monetary policies affect the cost of capital in a region marked by economic volatility and developmental challenges (Sachs et al., 2004). Secondly, by identifying the significant factors and their interactions, the study intends to provide actionable insights for policymakers to develop effective monetary strategies that can reduce the cost of capital and stimulate economic growth. Additionally, this research contributes to the broader economic literature by focusing on the unique context of Sub-Saharan Africa, thereby providing valuable insights that can inform both regional and global economic policies (Ndulu et al., 2007).

In conclusion, this study addresses a critical gap in the existing literature and offers practical policy recommendations to enhance economic stability and growth in Sub-Saharan Africa. Through detailed empirical analysis, it aims to clarify the complex impacts of monetary policy, providing a deeper understanding and practical guidance for economic development in the region.

LITERATURE REVIEW

Globally, the connection between monetary policy and cost of capital is extensively studied, particularly in developed economies. Modigliani and Miller (1958) laid the groundwork by proposing that the cost of capital is influenced by corporate financing decisions in perfect markets. Subsequent studies have elaborated on this by examining how central banks' monetary policy tools, such as interest rates, money supply, and quantitative easing, impact investment and economic growth (Bernanke & Gertler, 1995; Taylor, 1993). For instance, Bernanke and Gertler (1995) highlighted that monetary policy significantly influences asset prices and, consequently, the cost of capital. These studies indicate that effective monetary policy can lower borrowing costs, stimulate investment, and drive economic growth.

Moreover, the 2007-2008 global financial crisis spurred significant research on unconventional monetary policies. Studies by Blinder et al. (2017) and Gertler and Karadi (2011) demonstrate how central banks' responses to the crisis—such as negative interest rates and large-scale asset purchases—affected the cost of capital by altering market expectations and liquidity conditions. These results underscore the significance of adaptive Monetary policy in mitigating economic shocks and stabilizing the financial system.

In developing regions, particularly Sub-Saharan Africa, the literature on monetary policy and the cost of capital is less extensive but growing. Research by Ndulu et al. (2007) emphasizes the unique economic challenges in Sub-Saharan Africa, such as high inflation, volatile exchange rates, and underdeveloped financial markets, which complicate the monetary policy's effectiveness. The region's economic volatility and limited financial infrastructure often exacerbate the cost of capital, deterring investment and hindering growth.

Empirical studies, such as those by Maturu (2007) and Mburu (2016), highlight how inflation and exchange rate volatility increase the cost of capital in Sub-Saharan Africa. Maturu (2007) found that high inflation rates erode purchasing power and increase borrowing costs, while exchange rate instability adds risk premiums to capital costs. Mburu (2016) further notes that underdeveloped financial markets limit access to affordable capital, necessitating robust monetary policies to stabilize these economies and reduce capital costs.

Country-specific studies within Sub-Saharan Africa provide deeper insights regarding the localized impacts of monetary policy on cost of capital. In Nigeria, Akinlo (2004) and Adegbite and Ayadi (2010) found that inflation targeting and efforts to stabilize the exchange rate have had mixed results due to structural and institutional constraints. Similarly, Were (2015) examined Kenya's monetary policy and its impact on investment, highlighting that while inflation targeting helped reduce capital costs, the benefits were offset by external shocks and domestic fiscal challenges.

In Ghana, Asiedu (2002) found that high inflation and exchange rate volatility were significant factors increasing the cost of capital. However, financial sector reforms aimed at improving regulatory frameworks and enhancing financial

intermediation have shown promise in mitigating these effects. These local studies underscore the importance of tailored monetary policies that consider the specific economic and institutional contexts of each country.

The theoretical framework for this study is premised on the neo-classical theory of capital cost, which posits that cost of capital is as a result of the supply and demand for money in financial markets (Modigliani & Miller, 1958). This theory is expanded upon by how changes in monetary policy are transmitted, or the mechanism of monetary policy transmission tools such as interest rates and money supply affect the broader economy (Mishkin, 1996). The endogenous growth theory highlights the contribution of investments in human capital, innovation, and knowledge to economic growth, provides a broader context for understanding these dynamics (Romer, 1986).

The conceptual framework of this study integrates various variables to comprehensively analyze monetary policy's effects on the cost of capital in Sub-Saharan Africa. The dependent variable is the cost of capital, while the independent variables include broad money supply, inflation rates, and real exchange rate (Modigliani & Miller, 1958; Mishkin, 1996). Mediating variables, such as financial flows and investment, capture the intermediary effects of monetary policy, while moderating variables, including foreign direct investment and trade openness, provide context for understanding broader economic conditions (Romer, 1986; Ndulu et al., 2007). This framework allows for a detailed analysis of how monetary policies influence the cost of capital through complex interactions among these variables.

DATA AND METHODS

Research Design: This study utilizes a quantitative research design to analyze the effect of monetary policies on cost of capital in Sub-Saharan Africa from 2000 to 2021. A quantitative approach is appropriate for this research as it allows for the examination of relationships between variables through statistical techniques (Creswell, 2014), providing objective measurements of the impact of monetary policies. The study utilizes a structural equation modeling (SEM) approach, which enables the assessment of complex relationships among multiple variables, including both direct and indirect effects (Byrne, 2016).

Sample and Sampling Design: The sample for this study consists of balanced panel secondary data obtained from the World Bank database, encompassing 22 out of 45 nations that make up Sub-Saharan Africa. Based on the available data, the countries were chosen and their representation of diverse economic conditions within the region. The sampling design ensures that the study captures a wide range of economic contexts, allowing for a more robust analysis the impact of monetary policy on cost of capital. The selected countries include Angola, Ethiopia, Kenya, Mali, Togo, South Africa, and Uganda, among others (Appendix 7), providing a comprehensive overview of the region's economic landscape (World Bank, 2022).

Data Analysis Procedures: The data analysis procedures involved several key steps. First, descriptive statistics were calculated to summarize the characteristics of the variables. Following this, regression analysis was conducted to examine the relationships between the independent variables (real effective exchange rate, inflation rates, broad money supply) and the dependent variable (cost of capital). Mediation and moderation analyses were performed to explore the roles of financial flows, investment, FDI, and trade openness in influencing these relationships.

Descriptive Statistics: Initial analysis involved calculating descriptive statistics for all variables (Appendix 1) to understand their distributions, central tendencies, and variability. This step provided a preliminary understanding of the data and identified no outliers or anomalies (Field, 2013).

Correlation Analysis: The linear relationships between the independent, mediating, and moderating variables and the dependent variable (cost of capital) were examined using Pearson correlation coefficients. This helped in identifying potential multicollinearity issues and understanding the direction and strength of relationships (Gujarati & Porter, 2009).

Structural Equation Modeling (SEM): SEM was used to calculate the variables' coefficients. It assesses the general fit of the proposed model and identifies significance of relationships among the variables. Error correction techniques were utilized to account for potential non-stationarity in the data, ensuring that the results are robust and reliable (Wooldridge, 2010). The model's goodness-of-fit was evaluated using metrics such as the adjusted R-squared, Durbin-Watson statistic, the Chi-Square test and the Root Mean Square Error of Approximation (RMSEA) (Kline, 2015).

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Conceptual framework included;
Dependent Variable: Cost of capital (COC), conceptualized as, Interest payments (current LCU) (World Bank, 2024).

Independent Variables
Real exchange rate (RER), (Official exchange rate, period average (LCU per US$) / Consumer price index, 2010 = 100)
Inflation rates (INF), consumer prices (annual %)
Broad money (BM), (current LCU)
Mediating Variables:
Net Financial flows (FF) others (NFL, current US$)
Net Investment (INV) in nonfinancial assets (current LCU)
Moderating Variables:
Foreign direct investment (FDI), net (BoP, current US$)
Trade openness (OPEN), Exports of services and goods (% of GDP) plus Imports of services and goods (% of GDP) (World Bank, 2024).

SEM approach allows for the estimation of direct, indirect, and total effects of the independent variables on the trade balance, accounting for the mediating and moderating variables based on the following key equations;

$$dl(COC)=\beta_0+\beta_1 dl(RER)+\beta_2 dl(INF)+\beta_3 dl(BM)+\beta_4 dl(FF)+\beta_5 dl(INV)+\beta_6 dl(OPEN)+\beta_7 dl(FDI)+\epsilon_1 \quad \ldots\ldots (1)$$

$$dl(COC)=\beta_{10} dl(BM)*dl(INV)+\beta_{11} dl(INF)*dl(FF)+\beta_{12} dl(RER)+\epsilon_2 \quad \ldots\ldots (2)$$

$$dl(FDI)=\gamma_0+\gamma_1 dl(RER)+\gamma_2 dl(INF)+\gamma_3 dl(BM)+\gamma_4 dl(FF)+\gamma_5 dl(INV)+\delta_1 \quad \ldots\ldots (3)$$

$$dl(OPEN)=\omega_0+\omega_1 dl(RER)+\omega_2 dl(INF)+\omega_3 dl(BM)+\omega_4 dln(FF)+\omega_5 dl(INV)+\delta_2 \quad \ldots\ldots (4)$$

Regression analysis: Multiple regression analysis is performed to estimate direct effects and indirect effects among the independent, mediating, and moderating variables on the dependent variable. This step provides insights into the magnitude and significance of these effects (Wooldridge, 2010).

Mediation and Moderation Analysis: Mediation analysis is conducted to examine the indirect effects of the independent variables on the cost of capital through the mediating variables. Moderation analysis is utilized to evaluate how the independent and mediating variables influence the dependent variable (Baron & Kenny, 1986).

Robustness checks: The data is subjected to a set of robustness checks. These include variable transformations such as logging and differencing, testing for unit root, multicollinearity (Appendix 2), normality (Appendix 9), Cointegration (Appendix 10), heteroscedasticity, alternative model specifications (Appendix 8), and conducting sensitivity analyses to ensure the results are not driven by specific model assumptions or outliers (Gujarati & Porter, 2009).

Error correction techniques: The ECM, or error correction model, is employed to encapsulate equilibrium relationships between variables and both short- and long-term dynamics. ECM approach helps in understanding how long-term equilibrium deviations are corrected over time, providing a comprehensive view of the cost of capital (Engle & Granger, 1987).

Rationale for the methods chosen: The chosen research design and methods are well-suited to the objectives of this study. The quantitative approach allows for a systematic analysis of relationships among variables, facilitating the identification of significant patterns and trends. Structural equation modeling is particularly beneficial as it can accommodate complex models with multiple interrelated relationships, providing a comprehensive understanding of how monetary policies impact the cost of capital. Moreover, the use of panel data enhances the robustness of the findings, allowing for the examination of temporal and cross-sectional variations in the relationships among the variables (Baltagi, 2005).

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RESULTS

The study's findings are presented in this section and are organized according to research objectives and questions regarding the effect of monetary policies on cost of capital in Sub-Saharan Africa from 2000 to 2021.

Impact of Independent Variables on Cost of Capital: The first research objective sought to assess the direct impact of independent variables; inflation, exchange rate, and broad money supply on cost of capital. Regression analysis results (Appendix 3) indicate that broad money supply and inflation rates have a statistically significant positive effect on cost of capital, with coefficients of 0.723 and 0.149, respectively. This suggests that a 10% increase in supply of broad money corresponds to 7.23% cost of capital increase, while a similar increase in inflation rates results in 1.49% cost of capital increase. Conversely, real exchange rate showed a significant negative relationship with cost of capital, indicating that cost of capital decreases as real exchange rate rises. Specifically, a 10% rise in exchange rate causes 0.21% decrease in cost of capital.

Role of Mediating Variables: The second objective examined the mediating role of financial flows and investment on monetary policy and cost of capital. The analysis (Appendix 4) revealed that investment significantly mediate the relationship between broad money and the cost of capital, with an indirect effect of 0.203. This implies that a 10% increase investment accompanied by a corresponding 10% rise in money supply increases cost of capital by 2.03%. The mediation effect of financial flows and inflation on cost of capital was also positive, though statistically insignificant.

Moderating Effects of Economic Conditions: The third research objective explored the moderating effects of trade openness and foreign direct investment on the connection between monetary policy variables and mediating variables. The results (Appendix 5) indicate that effect of real exchange rate, inflation rates, broad money supply, financial flows and investment; on foreign direct investment were statistically insignificant. However, the moderating effects of trade openness (Appendix 6) on; real exchange rate, inflation rates, broad money supply, and investment were positive and statistically significant with coefficients 0.120, 0.189, 0.011 and 0.029 respectively. Meaning that a 10% increase in each of these factors will increase trade openness by 1.2%, 1.89%, 0.11% and 0.29% respectively. This suggests that increases in these factors will enhance trade openness hence reduce cost of capital.

Model Fit and Robustness Checks: The structural equation model demonstrated a good fit, with an overall adjusted R-squared of 0.89753 and a Durbin-Watson statistic of 2.61603, indicating that the model explains a substantial portion of the variance in cost of capital. Robustness checks using error correction techniques confirmed the stability of the relationships identified in the model, validating the significance of the results.

Summary of Findings: In summary, the results indicate that inflation rates and money supply positively affect cost of capital in Sub-Saharan Africa, while real exchange rate has a negative effect. Broad money supply and investment mediate the relationship, and trade openness moderate the effects of monetary policies on cost of capital. The findings underscore the complex interactions among these variables and highlight the importance of tailored monetary policies to reduce the cost of capital and foster investment in the region.

DISCUSSION

This section discusses the study's findings in relation to previous research on impact of monetary policies on the cost of capital, specifically focusing on Sub-Saharan Africa. The results indicate several key relationships that align with existing literature while also presenting unique contributions to the field.

Impact of broad money supply and inflation rates: The findings reveal that broad money supply and inflation rates significantly influence cost of capital, which is consistent with previous studies conducted in both developed and developing economies. For instance, Bernanke and Gertler (1995) emphasized that broad money supply increase can lower interest rates, subsequently reducing the cost of capital. However, our results show a positive connection between broad money supply and cost of capital, suggesting that regarding Sub-Saharan Africa, excessive money supply may lead to inflationary pressures that outweigh the benefits of increased liquidity. This divergence from the conventional expectation highlights the unique economic conditions in the region, where structural weaknesses and high inflation can exacerbate capital costs (Ndulu et al., 2007).

Similarly, the positive effect of inflation rates on the cost of capital corroborates findings by Maturu (2007), who noted that high inflation erodes purchasing power and raises borrowing costs in Kenya. This study extends the understanding of inflation's impact by demonstrating that even moderate inflation can significantly increase the cost of capital in Sub-Saharan Africa, thereby deterring investment.

Role of financial flows and investment: The mediating role of financial flows and investment further emphasizes the importance of these variables in influencing the cost of capital. This aligns with previous research by Mburu (2016), which found that increased financial flows can mitigate the adverse effects of inflation on investment. Our study extends this by quantitatively measuring the indirect effects of financial flows and investment, revealing that they play a crucial role in enhancing capital accessibility despite rising inflation. This finding underscores the need for policymakers to focus on improving financial infrastructure and encouraging investment to alleviate capital costs in the region.

Moderating effects of economic conditions:
The significant negative moderating effect of trade openness on the cost of capital highlights the importance of integrating into the global economy. This finding is consistent with studies by Asiedu (2002), which posited that trade liberalization can enhance competition and reduce prices, ultimately lowering the cost of capital. However, the degree to which trade openness moderates capital costs varies, suggesting that the benefits of openness depend on the specific economic context and the capacity of local markets to respond.

Unique findings and implications: This study's unique findings emphasize the intricate interplay between monetary policy indicators and cost of capital in Sub-Saharan Africa. The positive relationship between broad money supply and cost of capital, alongside the significant mediating and moderating effects of financial flows, investment, and trade openness, provide valuable insights for policymakers. Unlike many studies conducted in developed contexts, this research underscores the need for nuanced approaches to monetary policy in developing economies where structural challenges persist.

LIMITATIONS

While valuable insights into the effects of monetary policies on cost of capital in Sub-Saharan Africa are provided by this research, several limitations are acknowledged as they may have influenced the findings:

Research design limitations: The quantitative research design, while useful for establishing relationships among variables, may not fully capture the complexity of economic behaviors in the region. Monetary policy impacts are often influenced by numerous qualitative factors, such as political stability, cultural contexts, and institutional frameworks, which may not be adequately reflected in a purely quantitative model. This limitation suggests that the findings should be interpreted with caution, as they may overlook important contextual elements that shape the relationship between monetary policies and the cost of capital (Byrne, 2016).

Sample limitations: The study's sample consists of 22 countries in Sub-Saharan Africa, chosen on the basis of available data. Although this sample provides a diverse representation of the region, it may not encompass all relevant economic contexts, particularly those of smaller or less economically developed nations. Additionally, the use of a balanced panel may exclude countries with incomplete data, potentially leading to a selection bias that could affect the generalizability of the findings. Future research could benefit from a larger and more inclusive sample to enhance the robustness and applicability of the results (Baltagi, 2005).

Data limitations: The study relies on secondary data from the World Bank database, which, while reputable, may have inherent limitations. Issues such as data quality, measurement errors, and inconsistencies in reporting across countries could impact the reliability of the findings. Moreover, the study focuses on data from 2000 to 2021, and economic conditions, including monetary policy frameworks and capital markets, may have evolved since then. This temporal limitation may restrict the applicability of the results to current or future economic contexts (Wooldridge, 2010).

Data analytical procedure limitations: While the use of structural equation modeling (SEM) provides a robust framework for analyzing complex relationships among variables, it also requires certain assumptions, such as linearity

and normality, which may not hold true for all variables involved. If these assumptions are violated, the results could be biased or misleading. Additionally, the mediation and moderation analyses, while insightful, may not capture all potential interactions among the variables, as there may be other unobserved factors influencing the relationships that were not accounted for in the model (Kline, 2015).

Generalizability: As this study focused on Sub-Saharan Africa, its findings may not apply directly to other regions with different economic structures, institutional environments, or monetary policy frameworks. The unique characteristics of the region, including its challenges and opportunities, necessitate cautious interpretation when extrapolating the results to broader contexts (Baltagi, 2005).

CONCLUSION

This research investigates monetary policy impacts on cost of capital in Sub-Saharan Africa from 2000 to 2021, providing a comprehensive analysis of the complex relationships among key economic variables. The findings highlight that monetary policies, specifically broad money supply and inflation rates, significantly influence the cost of capital in the region. Notably, while an increase in broad money supply is generally expected to lower capital costs, this study reveals a counterintuitive positive relationship, underscoring the unique economic dynamics present in Sub-Saharan Africa where inflationary pressures can undermine the benefits of increased liquidity.

Furthermore, the study emphasizes the critical roles of financial flows and investment as mediating factors that can mitigate the adverse effects of inflation on capital costs. The moderation analyses reveal that foreign direct investment, and trade openness are essential contextual factors that can enhance or reduce monetary policy impacts on cost of capital. These insights underscore the importance of creating a conducive economic environment that supports financial stability, encourages investment, and facilitates trade openness.

Overall, this research contributes to the understanding of monetary policy impacts in Sub-Saharan Africa by highlighting the intricate interplay between monetary variables and capital costs. The unique findings call for policymakers to adopt tailored approaches that consider the specific economic challenges and opportunities within the region. By fostering an environment conducive to financial flows, investment, and trade openness, governments can better resolve monetary policy problems by promoting sustainable economic development. This study serves as a foundational exploration that paves the way for future research on monetary policies and their broader implications for investment and development in Sub-Saharan Africa.

RECOMMENDATIONS

In light of the study's conclusions, several recommendations are suggested for makers of policies, program developers and researchers to enhance the effectiveness of monetary policies and improve cost of capital in Sub-Saharan Africa.

Policy Recommendations

Implement Targeted Monetary Policies: Policymakers should consider adopting targeted monetary policies that specifically address the unique economic conditions of Sub-Saharan Africa. This includes managing broad money supply carefully to avoid inflationary pressures that could increase the cost of capital (Wooldridge, 2010). A balanced approach to monetary expansion is crucial to ensure liquidity in the market without triggering high inflation (Kline, 2015).

Enhance Financial Infrastructure: To support investment and financial flows, governments should prioritize the development of robust financial infrastructure. This includes improving access to banking services, enhancing credit availability, and promoting financial literacy among entrepreneurs and investors. Strengthening financial institutions will create a more stable environment for capital formation (Byrne, 2016).

Foster Trade Openness: Governments should actively promote trade liberalization policies that enhance trade openness. By reducing tariffs and non-tariff barriers, countries can increase competition and lower costs for businesses, subsequently reducing the cost of capital (Baltagi, 2005). Engaging in regional trade agreements can also facilitate cross-border investments and economic integration (Wooldridge, 2010).

Program Recommendations

Encourage Foreign Direct Investment: To draw in more foreign direct investment (FDI), governments should create incentives for international investors, such as offering tax incentives and simplifying regulatory procedures and investment guarantees. Creating a transparent and stable regulatory environment will enhance investor confidence and facilitate increased capital inflows (Kline, 2015).

Promote Public-Private Partnerships (ppps): Developing public-private partnerships can enhance investment in critical sectors such as infrastructure, agriculture, and energy. Collaborative projects between governments and private entities can mobilize resources and expertise, reducing the overall cost of capital for development initiatives (Byrne, 2016).

Support Research and Development (R&D): Programs aimed at fostering innovation and technological advancement should be supported. Investments in R&D can enhance productivity and competitiveness, ultimately reducing the cost of capital by creating more efficient business environments (Baltagi, 2005).

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APPENDICES

Appendix 1: Descriptive Statistics

	DLCOC	DLRER	DLINF	DLBM	DLFF	DLINV	DLOPEN	DLFDI	DECT
Mean	0.108257	-0.01784	0.003649	0.142305	0.121266	0.081303	0.001803	0.049308	-0.0192
Median	0.097538	-0.02525	-0.00867	0.123919	0.109371	0.097645	0.005182	0.03549	-0.02601
Maximum	3.356313	13.42051	3.833432	1.767376	15.48278	2.403066	0.374391	5.261069	3.061418
Minimum	-1.12451	-23.0583	-3.96256	-1.2843	-13.3194	-2.53395	-0.63265	-8.53815	-1.76473
Std. Dev.	0.354169	1.307408	0.982583	0.183921	1.91545	0.512629	0.106686	1.171852	0.414681
Skewness	2.598355	-9.87512	0.276308	1.30013	0.421445	-0.30567	-0.91336	-1.24891	0.850506
Kurtosis	24.22757	245.4269	5.337812	33.20256	18.74024	9.141501	7.87621	15.04555	10.88821
Jarque-Bera	8776.188	1087081	106.0375	16885.81	4565.557	699.9362	498.2253	2780.77	1196.532
Probability	0	0	0	0	0	0	0	0	0
Sum	47.74118	-7.86844	1.609042	62.7565	53.47852	35.85453	0.795243	21.74476	-8.46706
Sum Sq. Dev.	55.1917	752.0988	424.8065	14.88392	1614.337	115.6271	5.008036	604.2247	75.66271
Observations	441	441	441	441	441	441	441	441	441

Appendix 2: Multicollinearity test

	DLCOC	DLRER	DLINF	DLBM	DLFF	DLINV	DLOPEN	DLFDI	DECT
DLCOC	1	-0.01968	0.090231	0.204471	0.092133	0.174264	0.104979	-0.02225	0.724028
DLRER	-0.01968	1	-0.03892	-0.40536	-0.00336	0.054478	0.125021	0.015835	0.221244
DLINF	0.090231	-0.03892	1	0.01319	0.054763	0.020113	0.114692	-0.00576	-0.29624
DLBM	0.204471	-0.40536	0.01319	1	0.083361	0.157163	0.139719	-0.00293	-0.21422
DLFF	0.092133	-0.00336	0.054763	0.083361	1	0.111281	0.144933	0.005467	0.096463
DLINV	0.174264	0.054478	0.020113	0.157163	0.111281	1	0.15109	0.019822	-0.16145
DLOPEN	0.104979	0.125021	0.114692	0.139719	0.144933	0.15109	1	0.087179	0.154583
DLFDI	-0.02225	0.015835	-0.00576	-0.00293	0.005467	0.019822	0.087179	1	-0.12504
DECT	0.724028	0.221244	-0.29624	-0.21422	0.096463	-0.16145	0.154583	-0.12504	1

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Appendix 3: Results of the model (Equation One)

Dependent Variable: DLCOC
Method: Panel EGLS (Two-way random effects)
Date: 08/03/24 Time: 17:28
Sample (adjusted): 2001 2021
Periods included: 21
Cross-sections included: 21
Total panel (balanced) observations: 441
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLRER	-0.021125	0.004689	-4.505227	0.0000
DLINF	0.148964	0.005910	25.20462	0.0000
DLBM	0.723798	0.033944	21.32322	0.0000
DLFF	-0.013053	0.002895	-4.508477	0.0000
DLINV	0.217759	0.011087	19.64168	0.0000
DLOPEN	-0.648688	0.055065	-11.78044	0.0000
DLFDI	0.037672	0.004696	8.021963	0.0000
DECT	0.894831	0.015064	59.40043	0.0000
C	0.004707	0.007152	0.658164	0.5108

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Period random	0.000000	0.0000
Idiosyncratic random	0.114919	1.0000

Weighted Statistics

R-squared	0.899393	Mean dependent var	0.108257
Adjusted R-squared	0.897530	S.D. dependent var	0.354169
S.E. of regression	0.113373	Sum squared resid	5.552655
F-statistic	482.7436	Durbin-Watson stat	2.616030
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.899393	Mean dependent var	0.108257
Sum squared resid	5.552655	Durbin-Watson stat	2.616030

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Appendix 4: Results of the Model (Equation Two)

Dependent Variable: DLCOC
Method: Panel EGLS (Two-way random effects)
Date: 08/03/24 Time: 17:31
Sample (adjusted): 2001 2021
Periods included: 21
Cross-sections included: 21
Total panel (balanced) observations: 441
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLBM*DLINV	0.202994	0.049538	4.097716	0.0000
DLINF*DLFF	0.010457	0.006269	1.667991	0.0960
DLRER	-0.053127	0.008588	-6.186063	0.0000
DECT	0.658704	0.027595	23.87023	0.0000
C	0.113526	0.015762	7.202325	0.0000

Effects Specification	S.D.	Rho
Cross-section random	0.000000	0.0000
Period random	0.051565	0.0502
Idiosyncratic random	0.224413	0.9498

Weighted Statistics

R-squared	0.577221	Mean dependent var	0.074549
Adjusted R-squared	0.573342	S.D. dependent var	0.347233
S.E. of regression	0.226809	Sum squared resid	22.42888
F-statistic	148.8177	Durbin-Watson stat	2.262501
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.575997	Mean dependent var	0.108257
Sum squared resid	23.40145	Durbin-Watson stat	2.249774

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Appendix 5: Results of The Model (Equation Three)

Dependent Variable: DLFDI
Method: Panel EGLS (Two-way random effects)
Date: 08/03/24 Time: 17:34
Sample (adjusted): 2001 2021
Periods included: 21
Cross-sections included: 21
Total panel (balanced) observations: 441
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLBM	-0.132033	0.341756	-0.386338	0.6994
DLINF	-0.058529	0.060091	-0.974013	0.3306
DLRER	0.035543	0.047705	0.745059	0.4566
DLFF	0.015812	0.029673	0.532863	0.5944
DLINV	-0.012702	0.112988	-0.112422	0.9105
DECT	-0.438335	0.149635	-2.929367	0.0036
C	0.059644	0.075805	0.786803	0.4318

Effects Specification	S.D.	Rho
Cross-section random	0.000000	0.0000
Period random	0.100412	0.0070
Idiosyncratic random	1.192936	0.9930

Weighted Statistics

R-squared	0.020006	Mean dependent var	0.046004
Adjusted R-squared	0.006457	S.D. dependent var	1.167828
S.E. of regression	1.164052	Sum squared resid	588.0773
F-statistic	1.476606	Durbin-Watson stat	2.504376
Prob(F-statistic)	0.184507		

Unweighted Statistics

R-squared	0.020686	Mean dependent var	0.049308
Sum squared resid	591.7258	Durbin-Watson stat	2.501864

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Appendix 6: Results of The Model (Equation Four)

Dependent Variable: DLOPEN
Method: Panel EGLS (Two-way random effects)
Date: 08/03/24 Time: 17:35
Sample (adjusted): 2001 2021
Periods included: 21
Cross-sections included: 21
Total panel (balanced) observations: 441
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLBM	0.120125	0.027940	4.299450	0.0000
DLINF	0.018989	0.005020	3.782937	0.0002
DLRER	0.011329	0.003862	2.933695	0.0035
DLFF	0.003578	0.002380	1.503510	0.1334
DLINV	0.028884	0.009078	3.181849	0.0016
DECT	0.061715	0.012265	5.031606	0.0000
C	-0.016755	0.009870	-1.697615	0.0903

Effects Specification

	S.D.	Rho
Cross-section random	0.006544	0.0044
Period random	0.035586	0.1300
Idiosyncratic random	0.091842	0.8656

Weighted Statistics

R-squared	0.139320	Mean dependent var	0.000874
Adjusted R-squared	0.127421	S.D. dependent var	0.098993
S.E. of regression	0.092471	Sum squared resid	3.711091
F-statistic	11.70874	Durbin-Watson stat	2.070074
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.139685	Mean dependent var	0.001803
Sum squared resid	4.308487	Durbin-Watson stat	2.024786

Appendix 7: List of Sub-Saran countries included in the sample

Angola	Congo, Dem. Rep.	Lesotho	Rwanda	Zambia
Burkina Faso	Côte d'Ivoire	Madagascar	South Africa	Zimbabwe
Botswana	Eswatini	Mozambique	Togo	
Burundi	Ethiopia	Mali	Tanzania	
Cabo Verde	Kenya	Mauritius	Uganda	

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Appendix 8: Alternative model specifications

Correlated Random Effects - Hausman Test
Equation: Untitled
Test period random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	14.310849	8	0.0740

** WARNING: estimated period random effects variance is zero.

Period random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
DLRER	-0.021974	-0.022238	0.000001	0.8124
DLINF	0.145948	0.148120	0.000006	0.3813
DLBM	0.704077	0.699245	0.000103	0.6345
DLFF	-0.012625	-0.012718	0.000000	0.8503
DLINV	0.215556	0.216054	0.000005	0.8284
DLOPEN	-0.560481	-0.633399	0.000705	0.0060
DLFDI	0.036744	0.037174	0.000001	0.6568
DECT	0.879390	0.888137	0.000025	0.0792

Period random effects test equation:
Dependent Variable: DLCOC
Method: Panel Least Squares
Date: 08/17/24 Time: 20:39
Sample (adjusted): 2001 2021
Periods included: 21
Cross-sections included: 21
Total panel (balanced) observations: 441

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007227	0.007613	0.949340	0.3430
DLRER	-0.021974	0.004945	-4.444156	0.0000
DLINF	0.145948	0.006525	22.36880	0.0000
DLBM	0.704077	0.038343	18.36255	0.0000
DLFF	-0.012625	0.002982	-4.233617	0.0000
DLINV	0.215556	0.011638	18.52118	0.0000
DLOPEN	-0.560481	0.063259	-8.860159	0.0000
DLFDI	0.036744	0.004870	7.544796	0.0000
DECT	0.879390	0.016432	53.51840	0.0000

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

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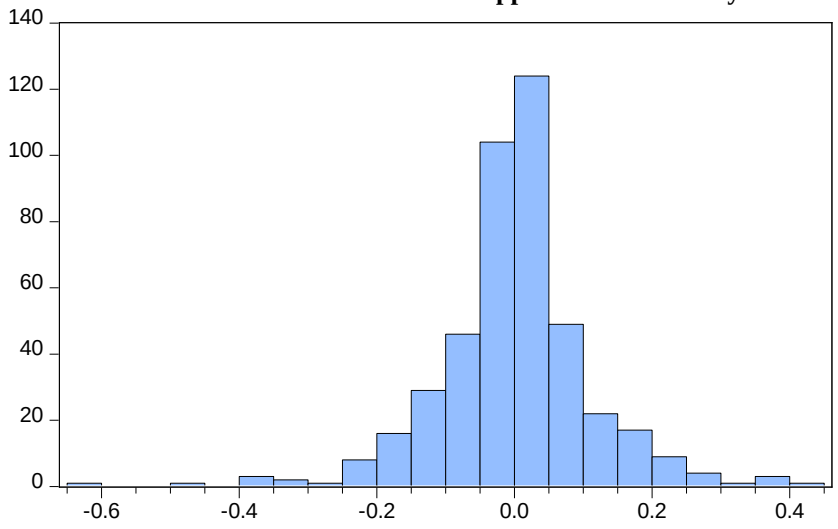
R-squared	0.906202	Mean dependent var	0.108257
Adjusted R-squared	0.894717	S.D. dependent var	0.354169
S.E. of regression	0.114919	Akaike info criterion	-1.384745
Sum squared resid	5.176869	Schwarz criterion	-0.930407
Log likelihood	354.3363	Hannan-Quinn criter.	-1.205525
F-statistic	78.89991	Durbin-Watson stat	2.698940
Prob(F-statistic)	0.000000		

Appendix 9: Normality test



Series: Standardized Residuals
Sample 2001 2021
Observations 441

Mean	-3.30e-18
Median	0.005664
Maximum	0.445812
Minimum	-0.643814
Std. Dev.	0.112337
Skewness	-0.400213
Kurtosis	7.157747
Jarque-Bera	329.4185
Probability	0.000000

Appendix 10: Cointegration test

Kao Residual Cointegration Test
Series: DLCOC DLRER DLINF DLBM DLFF DLINV DLOPEN DLFDI DECT
Date: 08/17/24 Time: 20:48
Sample: 2000 2021
Included observations: 462
Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
User-specified lag length: 1
Newey-West automatic bandwidth selection and Bartlett kernel

	t-Statistic	Prob.
ADF	-14.05809	0.0000
Residual variance	0.032546	
HAC variance	0.009250	

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID)
Method: Least Squares
Date: 08/17/24 Time: 20:48
Sample (adjusted): 2003 2021
Included observations: 399 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID(-1)	-1.587449	0.081094	-19.57547	0.0000
D(RESID(-1))	0.134150	0.048641	2.757929	0.0061

R-squared	0.705221	Mean dependent var	-0.002269
Adjusted R-squared	0.704478	S.D. dependent var	0.173568
S.E. of regression	0.094355	Akaike info criterion	-1.878502
Sum squared resid	3.534447	Schwarz criterion	-1.858508
Log likelihood	376.7612	Hannan-Quinn criter.	-1.870583
Durbin-Watson stat	2.055623		