Impact of Education Spending on Exchange Rates in Top 4 Africa [1] Economies (1990-2022)
Panel Regression Analysis

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• Abstract

It is crucial for a country's growth and development to invest in the skills and knowledge of its people. Education and training play a key role in enhancing citizens' abilities, positively impacting economic growth and increasing production. This, in turn, can strengthen the local currency against foreign currencies. The main focus of this study is to examine the amount of money the four largest productive countries in Africa (South Africa, Egypt, Algeria, Tunisia) invest in education. we aim to analyze how education spending influences the real exchange rate in these countries. By studying the patterns in education spending and its impact on the real exchange rate, our goal is to provide a comprehensive understanding of the importance of investing in education and the benefits it offers to a country's economy in the long term. This study will offer valuable insights into the linkage between education spending and the real exchange rate for policymakers, economists, and analysts. We have used panel data for the top 4 African countries to establish this relationship. The results seek to demonstrate that education spending leads to increased job market competitiveness. With globalization and international companies expanding worldwide, there is a rise in skilled workers from these countries, particularly in fields like business, engineering, and medicine. This influx leads to an increase in foreign currency income, impacting the exchange rates in these countries. This study substantiates a strong connection between education and the mitigation of exchange rate increases and the depreciation of the local currency.

Keywords: spending on education, exchange rate, Africa, panel data, public expenditure

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[1] Nigeria was excluded due to the lack of accurate and reliable data, in terms of their source, for some important variables in the model.

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أثر الإنفاق على التعليم على معدل سعر الصرف
في أكبر 4 دول اقتصاديًا في أفريقيا (1990-2022)

د. عبد الله الشافعي

● مُلخص:

يعتبر الانفاق على التعليم من العوامل الهامة جدا لنمو وتطور الدول، حبث يلعب التعليم والتدريب دوراً رئيسياً في تعزيز قدرات المواطنين، مما يؤثر إيجابياً على النمو الاقتصادي وزيادة الإنتاج، مما يعزز من قيمة العملة المحلية مقابل العملات الأجنبية. تركز هذه الدراسة علي دراسة الانفاق علي التعليم في أكبر أربع دول اقتصاديا في قارة أفريقيا(جنوب أفريقيا، ومصر، والجزائر، وتونس) . نهدف إلى تحليل كيفية تأثير الإنفاق على التعليم على سعر الصرف الحقيقي في هذه الدول. لكي يتضح أهمية الاستثمار في التعليم والفوائد التي يقدمها لاقتصاد الدولة، تقدم هذه الدراسة رؤية حول العلاقة بين الإنفاق على التعليم وسعر الصرف الحقيقي لصانعي السياسات والاقتصاديين والمحللين، وتم استخدام بيانات مجمعة لأعلي 4 دول أفريقية اقتصاديا لإيجاد هذه العلاقة، وتشير النتائج إلى أن الإنفاق على التعليم يؤدي إلى زيادة القدرة التنافسية للعمالة في هذه الدول في سوق العمل الدولي، وخاصة مع زيادة العولمة الاقتصادية، حيث أصبحت الشركات الدولية تعمل في معظم الدول وتمتد أنشطتها التجارية لتغطي كافة ارجاء العالم ، وتستقطب هذه الشركات الايدي العاملة ذات المهارة سواء للعمل محليا او دوليا ، وخاصة في مجالات مثل الأعمال التجارية والهندسة والطب، ادت الي تدفق المزيد من العملات الأجنبية لداخل هذه الدول نتيجة لدخل هذه العمالة من النقد الأجنبي محليا اوتحويلات هذه العمالة من الخارج، وادي هذا التدفق إلى زيادة الدخل من العملات الأجنبية، مما يؤثر بالحد من ارتفاع أسعار الصرف وانخفاض قيمة العملة المحلية لهذه الدول.

الكلمات المفتاحية: الإنفاق على التعليم، سعر الصرف، أفريقيا، الإنفاق العام

- **Introduction**

    Our proposed research project aims to undertake an extensive study on the intricate relationship between public spending on education and the real exchange rate in the four largest African countries in terms of GDP, namely South Africa, Egypt, Algeria, and Morocco. Our primary objective is to delve into the previously unexplored link between education spending and economic indicators such as the growth rate and exchange rate. We seek to gain comprehensive insights into the impact of education spending on the economy and its potential for fostering sustainable growth. We firmly believe that investing in education is critical to boosting production and growth, as it has the potential to enhance the human element, which is indispensable in the production process. However, measuring the impact of spending on education on the growth rate can be misleading in cases where countries have a significant expatriate population. To address this issue, we propose measuring the impact of education spending on the exchange rate, which can shed light on the essential nature of education spending in such circumstances. To achieve our research objectives, we intend to analyze data covering a substantial time period, from 1990 to 2022, in order to minimize deviations and identify any emerging trends or patterns. Our research project posits that spending on education, when combined with quality education, can cultivate a human resource capable of competing in the international labor market. This is crucial as the labor market has become increasingly globalized with the advancement of communication technology and the proliferation of remote jobs, which can directly impact the real exchange rate by bringing more foreign currencies into the country. Increased spending on education can help individuals keep pace with modern technology and create opportunities for employment abroad, particularly in cases where the local job market fails to provide sufficient opportunities. Historically, spending on education has enabled local individuals to seek work abroad, resulting in an inflow of foreign currencies into the local market through remittances to their families, an increase in

investments due to savings, or a direct inclination to invest in their home country. We have selected data from the largest economies on the African continent, as well as from developing countries and countries with significant emigrant populations, due to their similar economic, social, and political conditions. Additionally, these regions often experience unusual circumstances such as wars, conflicts, and revolutions, which can potentially affect the data series for the indicators used in the measurement. Our research project is pivotal in understanding the impact of education spending on the exchange rate, which, in turn, can support policymakers in making well-informed decisions on public spending. By scrutinizing the relationship between education spending and the exchange rate, our research aims to contribute significantly to the ongoing discourse on the pivotal role of education in economic development. Ultimately, we hope to help shape policies that prioritize investments in education as a means of achieving sustainable growth and development.

- **Literature Review**

Chinn (1999) It has been challenging to establish a robust connection between the actual exchange rate and the relative productivity differential. Bils and Klenow (2000) According to recent research, it has been found that the relationship between school enrollment and per capita GDP growth is not as straightforward as previously thought. The study suggests that there are other unaccounted for variables that also play a significant role in influencing economic growth. Psacharopoulos, G., and Patrinos, H.A. (2002), Investing in education is akin to investing in physical capital as both serve as important drivers of economic growth and development. However, there exists a notable disparity in research when it comes to studying the returns to education at both micro and macro levels. Therefore, it is crucial to conduct further research to better understand and quantify the broader social benefits derived from schooling. Hanushek and Woessmann (2007) Based on extensive evidence, it is irrefutable that the cognitive capacities of individuals

significantly influence their personal income, the distribution of income in society, and overall economic advancement. Cooray (2009) The examination of the connection between education and economic growth reveals that the influence of human capital on economic expansion varies depending on the specific measure of human capital that is employed for the assessment. On the other hand, V. and Lane's 2009 study, the aim was to illustrate the impact of government spending composition on long-term real exchange rate dynamics. The findings revealed that government consumption typically leads to real appreciation, while government investment does not have a significant long-term effect on the real exchange rate within the group of EMU member countries. Yildirim, N., Karakoyun, H. D., & Hepsag, A. (2011) In economic literature, the impact of government expenditures on economic growth is a subject of considerable importance. A specific focus of analysis in this field is the causal relationship between public educational expenditures and economic growth in Turkey during the period from 1973 to 2009. The findings of the study reveal that the causality is observed solely from economic growth to educational spending and not the other way around. In other words, increased economic growth appears to drive higher levels of educational spending, while higher educational spending does not seem to have a direct impact on economic growth during the period under consideration. Caputo, R. and Fuentes, M. (2012) In our recent empirical study, we investigated the factors influencing the real exchange rate (RER). Our findings indicate that government transfers play a significant role in influencing the RER in emerging economies. Specifically, we observed that transfers have a tendency to appreciate the RER. Additionally, we found that an increase in public investment can lead to RER depreciation in these economies. Moreover, our study revealed that the net external assets position only exhibits a significant effect in the context of developing economies. Overall, our research provides valuable insights into the determinants of RER in different economic settings. Maitra, B., & Mukhopadhyay, C. K. (2012) n this research paper, an in-depth analysis was

conducted to investigate the influence of public expenditure on the education and healthcare sectors on the Gross Domestic Product (GDP) of 12 countries across the Asia-Pacific region. The study identified cointegrating relationships in six countries, implying a long-term connection between public spending in these sectors and the overall economic performance. Furthermore, the findings revealed that increased spending on education was associated with GDP growth in nine countries, while healthcare spending contributed to the GDP growth in five countries. Additionally, the study provided insights into the timing of the impact of these expenditures, highlighting that the gestation lag of education spending was observed to be longer than that of healthcare spending. This suggests that the economic effects of investments in education may take longer to materialize compared to investments in healthcare within the context of the countries studied. Aladejare S. A. (2013) The research delves into a comprehensive examination of the correlation between government expenditure and economic expansion in Nigeria spanning the period from 1961 to 2010. The findings of the study underscore the significance of judicious allocation of public resources towards ventures with tangible economic value and the collaborative efforts between the government and private enterprises in prioritizing pivotal infrastructural development to foster sustainable economic progress. Cakrani, E., Pranvera, P. and Koprencka, L. (2013) n this paper, I conducted an in-depth analysis to examine the effects of government spending on the real exchange rate in Albania. To do this, I employed a log liner model using quarterly data. The findings of the study revealed a noteworthy relationship, indicating that government spending contributes to the overvaluation of the real exchange rate. This insight sheds light on the intricate dynamics between government expenditures and the exchange rate in the Albanian context. Mekdad, Y., Dahmani, A., & Louaj, M. (2014) In this article, an in-depth analysis is conducted to explore the intricate relationship between education and economic growth in Algeria over a span of 38 years, from 1974 to 2012. The study employs an endogenous

growth model to examine the impact of various factors on the economic landscape of the country. Notably, the research findings reveal that public expenditure on education plays a crucial role in fostering positive economic growth. Furthermore, the study identifies capital, labor, and GDP as additional variables that contribute to economic expansion, albeit to a lesser extent when compared to the significant impact of education. Mallick, L., Das, P. K., & Pradhan, K. C. (2016) In a comprehensive analysis of educational spending and its impact on economic growth, a study examined the expenditure on education and its relationship to the economic development of 14 major Asian countries over a period spanning from 1973 to 2012. The findings of the study unequivocally demonstrated a positive correlation between educational expenditure and economic growth across all 14 countries. This compelling evidence strongly suggests that making substantial investments in education is crucial for fostering sustained and substantial economic development in these nations. Wataru Miyamoto, Thuy Lan Nguyen, Viacheslav Sheremirov (2016) The research delves into the intricate dynamics of how the level of financial development can influence the connection between investment in education and the overall economic growth in China. The study demonstrates that in less affluent provinces, financial development has the potential to amplify the positive impact of investment in education on economic growth. Conversely, in more prosperous regions, the effect of financial development on the relationship between education investment and economic growth is found to be less significant. These findings underline the importance of tailoring financial development initiatives to target poorer provinces as a strategy to bolster and support education investment, and in turn, foster economic growth. Moritz cruz, Josue zavaleta (2021) The paper provides an in-depth analysis of the impact of financial development on the correlation between education investment and economic growth in China over the period of 2005 to 2019. The research findings indicate that in provinces with below-average GDP per capita, financial development plays a crucial role in

amplifying the positive effect of education investment on economic growth. The study suggests that targeting financial development in these specific regions can effectively encourage and support growth-promoting initiatives. Li, X., & Wye, C. (2022) The study explores the impact of financial development on the connection between investment in education and economic growth in China. The results indicate that in less affluent provinces, financial development can strengthen the positive effect of education investment on economic growth, even if the indicators for education investment and financial development initially show negative effects on economic growth. The study suggests that targeting financial development strategies to poorer provinces can help foster education-driven economic growth. Mabrouki, M. (2022) The study examines the impact of human capital, education, and Egypt faced an economic crisises during the period of syudy, compounded by historical economic policy errors. The high percentage of final consumption expenditure by Households and NPISHs in GDP highlights the profound impact of the economic crisis on consumer behavior and spending patterns. This in-depth analysis sheds light on the intricate interactions between economic variables and the influence of policy measures on economic indicators, offering valuable insights into the economic landscape of the sampled countries. During the specified period (1990-2022), tourism revenues, Egypt's oil revenues, and Suez Canal revenues declined due to the global decrease in oil trade. The diminishing oil prices also led to a reduction in remittances from Egyptians working abroad, consequently affecting the economies of the countries where they were employed. Moreover, Egypt's population growth during this period exerted additional pressure on the economy. However, despite these challenges, the state's revenues increased due to the energy crisis and high oil prices, resulting in changes in spending percentages and output, ultimately contributing to an upsurge in the gross domestic product during the same period. patents on economic growth in Scandinavian countries from 1990 to 2019. Various econometric methods are used to analyze the relationship

between these variables. The findings indicate that education, life expectancy, population, gross fixed capital formation, and the number of patents are positively correlated with economic growth. However, expenditure on education has a negative effect on economic growth. This research provides insights into sustainable growth through innovation and knowledge, emphasizing the importance of the triple helix approach. Nhung Thuy Tran (2023) This study explores the connection between public spending on education and economic growth in ASEAN nations from 1995 to 2018. It also examines the influence of government budget allocation on the quality of education. The study used multiple regression and VAR models, as well as Unit Root, Johansen Co-integration, and Causality tests. The research revealed a positive relationship between government spending on education and economic growth in ASEAN countries, and demonstrated that investing in education contributes to improving education quality. The paper concludes with recommendations for fostering high-quality education and promoting economic growth.

• Model Specification and Methodology:

In this study, we investigated the impact of education expenditure, gross capital formation, official exchange rate, final consumption expenditure, broad money, and deposit interest rate on the exchange rate. We used data from 1990 to 2022 to measure this impact through a regression equation. Our findings provide valuable insights into the relationship between these factors and the exchange rate, laying the groundwork for future economic analysis. We collected a long data series for the top 4 African economies from 1990 to 2022 to assess the impact of education expenditure, gross capital formation, official exchange rate, final consumption expenditure, broad money, and deposit interest rate on the exchange rate through a regression equation:

Exr = a + b1Bro + b2Cfc + b3Idr + b4 Ged + b5Hen + b6GS + U1

Exr = Official exchange rate (LCU per US$, period average)

Bro = Broad money (growth annual %)

Cfc = Gross capital formation % (of GDP)

Idr = Deposit interest (rate %)

Hen = Households and NPISHs (final consumption expenditure % of GDP)

Ged = education expenditure % of (GNI)

GS = Gross savings % of (GDP)

a = intercept term.

b, b1, b2, b3, b4, b5, b6 = The parameters

UI = Random variables

Table1: Variable (1990-2022)

| Variable	definition	Data	Variable
Exr	Official exchange rate (LCU per US$, period average)	World bank	Independent
Bro	Broad money (growth annual %)	World bank	Depended
Cfc	Gross capital formation % (of GDP)	World bank	Depended
Idr	Deposit interest (rate %)	World bank	Depended
Hen	Households and NPISHs (final consumption expenditure % of GDP)	World bank	Depended
Ged	education expenditure % of (GNI)	World bank	Depended
GS	Gross savings % of (GDP)	World bank	Depended

- **Fixed or Random Model or Pooled OLS regression (Hausman Test- Wald test)**

In this analysis, we first consider the pooled OLS model to establish the relationship between the dependent and independent variables. Next, we explore the random model to further investigate this relationship, followed by an assessment of the fixed model. Finally, we use the Hausman specification test for model diagnosis to determine whether the fixed or random effect estimation technique is most suitable for the observed data. Both models seem appropriate, so we conduct hypothesis testing to make a decision. The null hypothesis states that the random effects model is appropriate, while the alternative hypothesis proposes that the fixed effects model is appropriate. To choose between a random effect regression and Pooled OLS regression, we make use of the Wald Test. If the probability value of the Wald test is less than 5%, we reject the null hypothesis. Conversely, if the probability value is greater than 5%, we accept the null hypothesis.

- **Results and Discussion**

In our analysis, we first examine the distribution and assess whether the observed series of Exr displays a stochastic trend. Figure 1 displays a time plot, histogram, and normal Q-Q plot of Exr data from 1990 to 2022. Analysis of the figures suggests that the Exr series shows signs of stationarity around the mean.

Figure1: Exr Variable (1990-2022)

Exr

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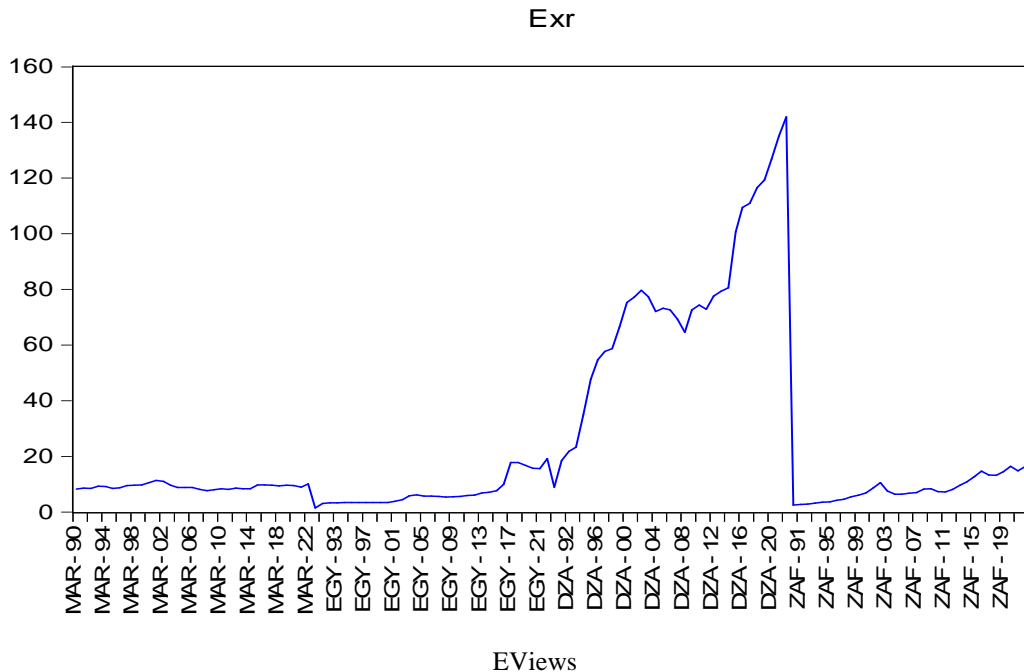
Upon conducting a comprehensive analysis of the time series graph and descriptive statistics for various variables in the common sample, it is evident that the variable of Official exchange rate (LCU per US$, period average) exhibits the highest level of volatility when compared to the other variables under study. The data reveals significant fluctuations in the official exchange rate, particularly during the period from 1990 to 1991 in South Africa. Notably, the exchange rate of the dinar to the US dollar experienced a gradual and controlled slide, declining from to 8,032 DZD per dollar by September 1991. Subsequently, the implementation of reforms led to an accelerated sliding process, with the dinar's exchange rate dropping to 12,119 DZD per US dollar in 1990 and further decreasing to 13.88 DZD per US dollar in 1991. These fluctuations underscore the influential role of economic policies in shaping exchange rate movements. Furthermore, the variable of education expenditure % of (GNI) demonstrated relatively minor fluctuations, ranging between 3% and 7% across the sampled countries. This stability in education

expenditure as a percentage of GNI reflects a harmonization of policies in the education sector among the studied countries, offering valuable insights into the policy measures adopted. In the same period, the percentage of Households and NPISHs (final consumption expenditure % of GDP) stood at 86%, signifying a substantial share of GDP in 1986. Notably, Egypt faced an economic crisises during the period of syudy, compounded by historical economic policy errors. The high percentage of final consumption expenditure by Households and NPISHs in GDP highlights the profound impact of the economic crisis on consumer behavior and spending patterns. This in-depth analysis sheds light on the intricate interactions between economic variables and the influence of policy measures on economic indicators, offering valuable insights into the economic landscape of the sampled countries. During the specified period (1990-2022), tourism revenues, Egypt's oil revenues, and Suez Canal revenues declined due to the global decrease in oil trade. The diminishing oil prices also led to a reduction in remittances from Egyptians working abroad, consequently affecting the economies of the countries where they were employed. Moreover, Egypt's population growth during this period exerted additional pressure on the economy. However, despite these challenges, the state's revenues increased due to the energy crisis and high oil prices, resulting in changes in spending percentages and output, ultimately contributing to an upsurge in the gross domestic product during the same period. Notably, Algeria (DZA) experienced a remarkable 30% increase in remittances in 2008 and a 54% growth in broad money (annual %), primarily influenced by the substantial rise in hydrocarbon prices, leading to broad money expanding by 41% of the initial money stock. Domestic credit witnessed a 22% decrease from the initial money stock, mainly driven by the government's efforts to preserve windfall hydrocarbon revenue. Additionally, repayments were made by the Sonagraph Group, comprising national companies in the hydrocarbon sector, for short-term bank loans contracted during 1999-2001. In 2019, broad money in Algeria accounted for

approximately 81% of the gross domestic product (GDP), marking a slight decrease compared to the previous year. Furthermore, gross capital formation as a percentage of GDP reached its highest record at 50.7% in DZA 2015. This surge was a consequence of a severe decline in GDP, plummeting from 214 billion dollars in 2014 to 166 billion dollars in the current year. The deposit interest rate reached its peak at 16% in DZA 1995 due to a high level of inflation in 1995. Conversely, the lowest recorded interest rate of 1.75% was noted in DZA 2006 due to low inflation. Additionally, the gross savings as a percentage of GDP reached the highest level at 57% in DZA 2008 due to a surge in petrol prices, while the lowest recorded percentage of 9.6% was reported in EGY 2015 owing to a low interest rate.

Figure2: Exr Variables (1990-2022)

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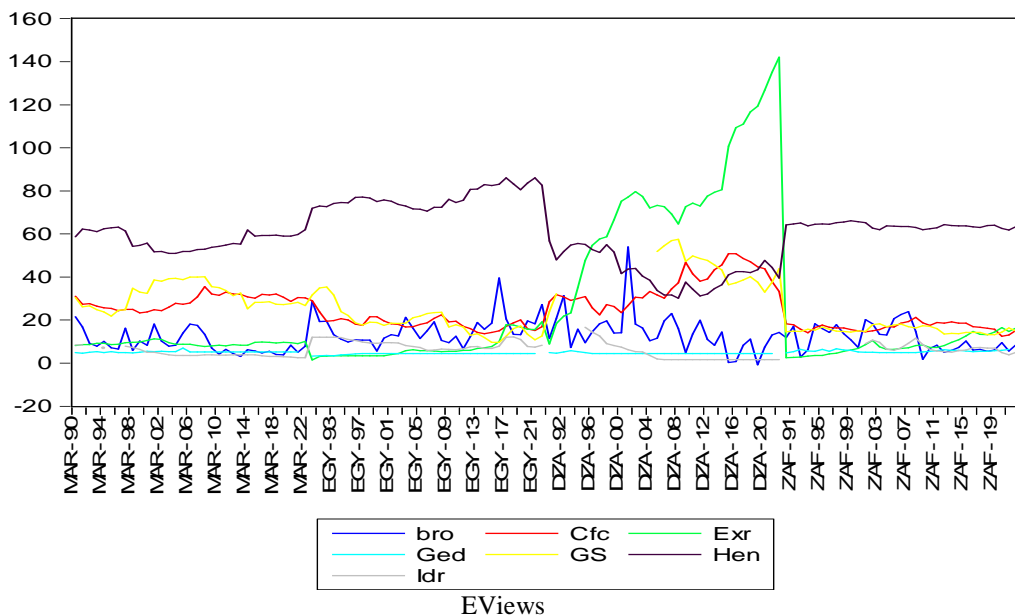
- **Unit roots test**

The unit roots test results suggest that all variables in the top 4 African economies study are stable in the first-order differences, except for the Bro, Idr, and Ged variables, which are stable at the level. This provides confidence in conducting tests and helps to explain the relationships between the study variables:

Table2: Egypt variables (Dickey-Fuller test statistic)

indicator	level		1st	
	Statistic	**prob**	**t-statistics**	**prob**
Exr	1.23280	0.8912	-5.63299	0.0000
Bro	-3.71356	0.0001		
Cfc	0.0001	0.2743	-6.91209	0.0000
Idr	-5.04955	0.0000		
Hen	-0.48604	0.3135	-5.18809	0.0000
Ged	-3.10940	0.0009		
GS	-1.37703	0.0843	-3.11236	0.0009
GS	-1.327226	0.6088	-5.457480	0.0000

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- **Panel Multiple Regression: Pooled OLS regression model**

In the Pooled OLS regression model, we are investigating the connection between the predictor and outcome variables within a specific entity. This model assumes the presence of a time-invariant variable within the entity that could potentially influence or create bias in the variables we are interested in. To address this, the Pooled OLS regression model eliminates the impact of these time-invariant characteristics, allowing us to more accurately evaluate the direct effect of the predictor on the outcome variable. The time-invariant variables are accounted for in the intercept of the model. We start by testing whether the collective explanatory variables have a statistically significant effect on the response variable (EXR) by conducting a hypothesis test with the null hypothesis Ho: $\beta 1 = \beta 2 = \ldots = \beta P = 0$. The results of the regression analysis are presented in Table 3 for further examination.

Table 3: Regression Analysis Using the Pooled OLS regression model

Variables	Coefficient	Standard Error T-Statistic	t-Statistic	Probability
BRO	0.306065	0.110167	2.778177	0.0056
CFC	1.461281	0.140639	10.39030	0.0000
GED	-27.23424	1.516770	-17.95542	0.0000
GS	-2.219742	0.124009	-17.89987	0.0000
IDR	-2.716959	0.369179	-7.359467	0.0000
HEN	-2.209063	0.120838	-18.28122	0.0000

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In the pooled OLS regression model, the analysis revealed that BRO has a statistically significant and positive effect on Exr, with a probability value of 0.005 and a t-statistic of 2.77. CFC also demonstrates a significant and positive effect on Exr, with a probability of 0.0000 and a t-statistic of 10.3. Furthermore, GED has a significant and negative effect on Exr, supported by a probability of 0.0000 and a t-statistic of -17.9, while GS displays a similar impact on Exr, with a probability of 0.0000 and a t-statistic of -17.8. Additionally, HEN exhibits a significant and negative effect on Exr, with a probability of 0.0000 and a t-statistic of -7.3, and IDR also demonstrates a significant and negative effect on Exr, with a probability of 0.000 and a t-statistic of -2.7.The adjusted R-squared (R^2) value indicates that approximately 77% of the variability in Exr can be explained by the explanatory variables. The remaining 23% suggests that other factors outside the model may influence Exr in the top 4 African economies. Moreover, the analysis concludes with the assertion that the F-statistic is statistically significant, validating the overall significance of the model

- **Panel Multiple Regression: Fixed Effect Model**

In the fixed effect model, we are investigating the relationship between the predictor and outcome variables within a specific entity, assuming the existence of a time-invariant variable within that entity that may influence or bias the variables we are studying. The fixed effect model aims to eliminate the impact of these time-invariant characteristics, making it easier to assess the direct effect of the predictor on the outcome variable. This is achieved by absorbing the time-invariant variables into the intercept. The initial step involves testing whether the explanatory variables collectively have an impact on the response variable (EXR) by conducting a test of the null hypothesis Ho: $\beta1 = \beta2 = \ldots = \beta P = 0$. The results of the regression analysis are presented in Table 4

Table 4: Regression Analysis Using the Fixed Effect Model

Variables	Coefficient	Standard Error T-Statistic	t-Statistic	Probability
BRO	-0.151681	0.148291	-1.022859	0.3092
CFC	0.441034	0.237467	1.857240	0.0666
GED	3.911052	2.917284	1.340648	0.1835
GS	0.116228	0.320303	0.362869	0.7176
HEN	1.667671	0.442734	3.766753	0.0003
IDR	0.109048	0.588808	0.185201	0.8535

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The results from the Fixed Effect Model analysis indicate that BRO has an insignificant and negative effect on Exr, supported by a probability value of 0.3092 and a t-statistic of -1.02. Similarly, CFC exhibits an insignificant and positive effect on Exr, with a probability of 0.0666 and a t-statistic of 0.44. GED also displays an insignificant and positive effect on Exr, supported by a

probability of 0.1835 and a t-statistic of 1.34, while GS demonstrates an insignificant and positive effect on Exr, with a probability of 0.7176 and a t-statistic of 0.36. On the other hand, HEN shows a significant and positive effect on Exr, indicated by a probability of 0.0003 and a t-statistic of 3.7. Finally, IDR has an insignificant and positive effect on Exr, with a probability of 0.8535 and a t-statistic of 0. 185.The model's adjusted R-squared (R2) suggests that approximately 94% of the variability in Exr can be explained by the included explanatory variables. This leaves around 6% of the variability unaccounted for, which could potentially be influenced by other factors in the top 4 African economies. Additionally, the F-statistic indicates a significant probability, further supporting the validity of the model.

- **Panel Multiple Regression: Random Effect Model**

The random effects model differs from the fixed effects model in that it assumes the variations across entities are random and uncorrelated with the predictor or independent variables in the model. In this approach, it is believed that differences across entities play a role in the response variable. The random effects model assumes that the error term is uncorrelated with the predictor variables, which allows for time-invariant variables to function as predictors. This also enables generating inferences beyond the sample used in the model. Initially, the model tests whether the explanatory variables collectively have an effect on the response variable (EXR) by testing the null hypothesis HO: $\beta1 = \beta2 =\ldots= \beta P = 0$. The regression analysis in Table 4 reveals that the F-value (53.4) and p-value (0.0000) indicate that the variables are significantly different from zero. As a result, we reject the null hypothesis that the explanatory variables (capital adequacy, asset quality, management quality) collectively have no effect on the EXR. This suggests that the predictor variables indeed influence EXR. Moreover, the model is deemed appropriate as approximately 76% of the variation in EXR is accounted for by the explanatory variables used in the model, as indicated by the Adjusted R-squared value in Table 5

Table 5: Regression Analysis Using the random Effect Model

Variables	Coefficient	Standard Error T- Statistic	t-Statistic	Probability
BRO	0.306065	0.289930	1.055648	0.2939
CFC	1.461281	0.370123	3.948093	0.0002
GED	-27.23424	3.991724	-6.822677	0.0000
GS	-2.219742	0.326357	-6.801568	0.0000
HEN	-2.209063	0.318012	-6.946476	0.0000
IDR	-2.716959	0.971578	-2.796441	0.0063

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The regression analysis reveals that BRO has an insignificant but positive effect on Exr, with a probability value of 1.05 and a t-statistic of 0.29. On the other hand, CFC shows a significant and positive effect on Exr with a probability of 0.0000 and a t-statistic of -6.82. Moreover, GED, GS, and HEN all demonstrate significant and negative effects on Exr, with probabilities of 0.000 and t-statistics of -6.8, -6.8, and -6.9, respectively. IDR also has a significant and negative effect on Exr, with a probability of 0.0063 and a t-statistic of -2.7. The adjusted R-squared (R^2) suggests that approximately 76% of the changes in Exr can be explained by the explanatory variables. This indicates a relatively high level of explanatory power. The remaining 24% of variation in Exr could be attributed to other factors not included in the analysis but capable of influencing the exchange rate in the top 4 African economies. Furthermore, the probability of the F-statistic is significant, reinforcing the overall explanatory strength of the model.

Model Diagnosis: Random Effect Model or Fixed Effect Model or Pooled OLS regression model

- **Hausman Specification Test:**

The regression analysis reveals that BRO has an insignificant but positive effect on Exr, with a probability value of 1.05 and a t-statistic of 0.29. On the other hand, CFC shows a significant and positive effect on Exr with a probability of 0.0000 and a t-statistic of -6.82. Moreover, GED, GS, and HEN all demonstrate significant and negative effects on Exr, with probabilities of 0.000 and t-statistics of -6.8, -6.8, and -6.9, respectively. IDR also has a significant and negative effect on Exr, with a probability of 0.0063 and a t-statistic of -2.7. The adjusted R-squared (R2) suggests that approximately 76% of the changes in Exr can be explained by the explanatory variables. This indicates a relatively high level of explanatory power. The remaining 24% of variation in Exr could be attributed to other factors not included in the analysis but capable of influencing the exchange rate in the top 4 African economies. Furthermore, the probability of the F-statistic is significant, reinforcing the overall explanatory strength of the model.

Table 6: Hausman specification test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	25.494860	6	0.0003

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- **Testing for the Random Effect: Wald Test**

The Wald Test is a statistical test used to compare the suitability of a random effects regression model with a Pooled Ordinary Least Squares (OLS) regression model for a given set of data. In this test, we evaluate the null hypothesis (H0) that the random effects model is not significantly different from the Pooled OLS model. If the probability value of the Wald test is less than 5%, we reject the null hypothesis, indicating that the random effects model is favored as the better model. Conversely, if the

probability value of the Wald test is greater than 5%, we accept the null hypothesis, suggesting that the Pooled OLS model may be more appropriate for the data.

Table 7: Wald Test:

Test Statistic	Value	df	Probability
F-statistic	1.649722	(6, 85)	0.1435
Chi-square	9.898334	6	0.1290
NullHypothesis: C(8)=C(9)=C(10)=C(11)=C(12)=C(13)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(8)		-11.88697	16.19507
C(9)		4.449258	12.17506
C(10)		17.25081	8.345508
C(11)		-4.516206	5.489242
C(12)		-15.49604	13.59521
C(13)		-2.632242	7.237719
Restrictions are linear in coefficients.			

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Upon conducting hypothesis testing, we accept the null hypothesis and conclude that the Pooled Ordinary Least Squares (OLS) regression model is appropriate for our analysis. This decision is based on the probability value (p-value) of 0.143, which exceeds the commonly accepted significance level of 5%.

• **Conclusion:**

The findings of the model suggest that there exists a positive correlation between the broad money as an independent variable and the exchange rate as a dependent variable. This implies that there are significant challenges in managing money in these countries during the study period. The analysis indicates that the increase in money supply had a negative impact on the market, leading to an upsurge in exchange rates. Furthermore, there was an observed positive association between total capital formation and the increase in exchange rates. This is expected, as the importation of capital goods, such as machinery and equipment across various sectors, heightens the demand for foreign currency, consequently pushing up the exchange rate for foreign currencies. The findings of the study suggest that there exists an inverse correlation between expenditures on education and the exchange rates of foreign currencies. Investment in education results in improved capabilities to compete in the workforce. Particularly in the current era of global interconnectedness and economic liberalization, with multinational corporations operating across the globe, individuals who have received advanced education in fields such as business, engineering, and medicine have greater opportunities for employment in these companies. This influx of skilled workers from these countries leads to an influx of foreign currency into the local economy, whether through remittances from these individuals to their families, savings in foreign currency in local banks, or investments made within the country. This increase in foreign currency reserves leads to a decrease in exchange rates, exerting a downward pressure on them. Therefore, it is imperative to recognize the crucial role of education in these countries as a fundamental driver of economic growth and development. The research findings demonstrate a compelling correlation between the level of education and its impact on mitigating the upward movement of the exchange rate and the devaluation of the local currency. These findings provide strong support for the initial hypothesis of the study. Furthermore, the

study reveals a consistent negative relationship between the interest rate and the exchange rate, aligning with well-established economic theory. When the interest rate is raised, it leads to a decrease in the exchange rate of foreign currencies and an increase in the value of the local currency. This phenomenon occurs due to the inverse relationship between the final consumption of families and the exchange rate. An increase in the interest rate causes a decreased in demand for a goods, thus stimulating local production as a result of the limited income of the people in those countries and increase in saving> which led to increase in investment. This, in turn, leads to a decreased demand for imported goods among most groups, further driving the popularity of local production. Consequently, this positive impact contributes to the strengthening of the local currency against foreign currencies. he exchanges rate of foreign currencies is influenced by various factors, including the relationship between saving and the exchange rate. According to economic theory, there is an inverse relationship between saving and the exchange rate. When saving increases, it leads to higher investment, which in turn boosts the local market by increasing production, exports, and reducing imports. This decrease in imports reduces the pressure on foreign currency within the local market, ultimately resulting in lower exchange rates. In essence, higher saving leads to a more robust local market and a decreased reliance on foreign currency, leading to a reduction in exchange rates.

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