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# Energy Pricing, Investments and Economic Growth in Africa

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**Abstract**
Africa possesses abundant energy resources, yet distorted energy pricing structures and subsidy policies have hindered investment and economic growth. This study examines the impact of energy pricing and subsidy reforms on investment and economic growth across 29 African countries using the Cross-Sectionally Augmented Autoregressive Distributive Lag (CS-ARDL) technique. The findings reveal that energy subsidies, particularly in gasoline, have significant negative effects on investment in the energy sector and overall economic growth. In the short run, subsidies distort resource allocation and create inefficiencies, while long-term analyses suggest that stable governance and consistent policy reforms can mitigate these distortions. The study further highlights that the impact of energy pricing varies across African nations, necessitating context-specific policy approaches. The results indicate that political stability plays a crucial role in fostering economic growth, while subsidy reductions can enhance fiscal sustainability. Based on these insights, the study recommends a gradual phase-out of energy subsidies, improved governance, and the implementation of targeted social safety nets to ensure equitable economic progress. Such policy measures can attract investments in the energy sector and contribute to long-term economic resilience and sustainable growth in Africa.

**Keywords**: Energy Pricing, Subsidy Reforms, Economic Growth, Investment, Africa

## Introduction

Undoubtedly, the African continent possesses immense economic potential in terms of natural resources, its emerging market and growth indicators. However, in most African countries, these potentials remain largely untapped as they are mostly riddled with poverty, unemployment and low growth. The two major causes of the slow economic performance in Africa have been attributed to poor energy policy and inadequate investments in the energy sector (Wolde-Rufael, 2009; Eberhard & Shkaratan, 2012; Parry, Black & Vernon, 2021). Poor energy policy such as energy pricing and subsidy can lead to investment apathy, which can further hamper the growth in key macroeconomic sectors and exacerbate unemployment and poverty (Bushe, 2019; Marutlulle, 2021). Economic theory suggests that proper market pricing affects level of investments. The current energy pricing scenario often involves distorted energy pricing structures, with subsidies creating artificial price signals and leading to inefficient resource allocation. Such distortions not only burden national budgets but also hinder private sector investment and innovation in the energy sector. Although policymakers and stakeholders in the energy sector recommend efficient energy pricing, yet actions towards efficient energy pricing in most African countries have remained low, probably due to poor understanding of the dynamics and implications of these reforms on the economy.

To increase the growth potential in Africa, scholars have advocated proper energy pricing (Okwanya & Abah, 2018). This is particularly necessary because despite the abundance of energy resources, most African countries are still faced with poor access to energy. For

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instance, countries like Nigeria, Angola, South Sudan and the likes have abundant energy resources, yet suffer frequent electricity blackout and poor access to other domestic energy. A major cause of such contrast is the flawed energy pricing in most African countries due to frequent government interventions like subsidies and price controls (Araar & Verme, 2016). Consequently, while consumers enjoyed lower immediate costs, the long-term effects proved detrimental to the country's growth. The underpriced energy led to over consumption, strain on the national grid, and a dearth of funds for infrastructure improvement. Poor pricing also restrict investment in the energy sector due to artificially low returns on investment stemming from the below-market energy prices. Low investment in energy infrastructures results to inconsistent power supplies, causing businesses to face higher operational costs. Businesses are compelled to invest in backup generators and other alternative power sources. This results in higher product prices, rendering them less competitive in the global market, with consequent loss of growth. For instance, Akinlo (2009) found that between 1970 and 2005, inadequate energy supply cost Nigeria approximately 268 billion dollars in potential economic growth.

To enhance economic potential in African countries, it is therefore necessary that energy reforms such as subsidy should be done in such a way that improve growth and productivity. Countries that embark on energy subsidies use more than 20 percent of state budget for such subsidy which often times fails to achieve the desired objectives (Sovacool, 2017; Williams & Ghanadan, 2006). Some countries in Africa have taken in adjusting subsidy programs. For instance, Egypt and Ghana initiated energy subsidy reforms aimed at reducing budget deficit and attracting foreign investments (Dah & Sulemana, 2010). Such adjustment or removal of subsidy, free funds for allocations to other vital sectors like health, education, transportation and infrastructure that enhance economic growth. In Egypt for instance, the government channeled savings from subsidy reductions towards infrastructure projects and social programs, spurring job creation and economic growth (Breisinger et al, 2019; Fattouh & El-Katiri, 2012).

This paper investigates the effect of energy pricing - especially gasoline pricing - on economic growth and investment in Africa. Energy pricing are of interest for two reasons: first, the current pricing mechanisms obtainable in most African countries often fail to reflect the true costs of energy production and distribution, thus, distorting resource allocation and affecting investment decisions in the energy sector. Second, the existing subsidy policies in many of the African countries fail to effectively target those in need and always create market inefficiencies such as black markets and artificial scarcity (Bates, 2019; Acemoglu & Robinson, 2010; Poulton, Kydd & Dorward, 2006).

Previous studies in the literature of energy pricing and subsidy find that the distributive effect of energy subsidy reforms differ across countries and in many cases, energy subsidies are pro-rich in terms of absolute amounts, but fairly benefits the poor in terms of expenditure shares (Araar & Verme, 2016). Klug et al. (2022) also found that electricity tariffs in Africa are deficient and regressive in that they do not effectively target consumers. In a review of related literature, Al-Saidi (2020) concluded that energy subsidies consume a significant portion of government expenditures in some countries and causes fiscal imbalance in most countries with subsidy reform. Parry, Black and Vernon (2021) pointed out that a major side effect of energy subsidy reforms is the overall impact on the environment as subsidy implies under pricing of energy products and increased consumption that tend to exacerbate global warming.

Although previous studies looked at the problem of energy subsidies (Klug et al. 2022; Parry, Black & Vernon, 2021; Bates, 2019), our work contributes to existing literature by examining how energy subsidy affects economic growth and investments in the energy sector in Africa. As addition to existing literature, we integrated investment and energy subsidy variables so as

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to understand the extent energy subsidy and investment in the energy markets affect economic performance in Africa. By understanding the impact of energy pricing and subsidy reforms, policymakers can devise strategies to attract investments in the energy market and unlock Africa's economic potential.

The primary objective of this study therefore is to assess the effect of subsidy reforms for crude oil products on key economic variables of investments, and economic growth in Africa. Our estimates confirm that subsidy in gasoline has negative and significant effect on investment in the energy sector, and economic growth across the selected African countries. This findings underscores the distortionary role of subsidies and the need for reforms that promote sustaible economic growth.

**Literature Review**

Araar and Verme (2016) examined the effect of subsidy reforms of energy and on household welfare in the Middle East and North Africa region. Using a unified model and harmonized household data, the study found that the distribution of subsidies and the welfare effects of reforms vary significantly across countries and products. Energy subsidies is found to benefit the rich in terms of absolute amounts, but are relatively more important for the poor in terms of expenditure shares. The study also found that although subsidy removal hurts the poor the most, however, the cost of compensating the welfare loss for the poor is generally low compared to the budget benefits gained from reducing subsidies.

Al-Saidi (2020) analyzed the extent of energy reforms and the drivers behind energy subsidy reforms in the Gulf Cooperation Council (GCC) countries. In a review of related literature, the study found that energy subsidies constitute a significant portion of government expenditures in some GCC countries. This, they found was due to fiscal imbalances faced by these countries. However, most of these countries have commenced the process of reducing subsidies and replacing them with more targeted support systems. Howbeit, the reforms implemented in most of these countries are still not comprehensive to yield the desired change.

On the effect of energy reforms on the welfare of citizens, a review study of 82 papers by Klug et al (2022) examined the impacts of electricity tariff reform in Africa, with the aim of providing insights into the successes and shortcomings of the three modalities of reform: bill payment method, tariff structure, and tariff rate efforts in the African power sectors. The study found that the use of prepaid meters encouraged residential electricity conservation and limit arrears. Secondly, the study found increasing block tariff structures to be regressive and does not effectively target consumers. The study found limited evidence on the implication of the cost or grid access on the volume differentiated tariffs or subsidies for connection costs. The study also highlighted that electricity demand in Africa is price inelastic across all sectors, emphasizing the need for protections for low-income consumers when implementing tariff increases.

Rentschler (2016) estimated the regional variability of the direct welfare effects of removing fuel subsidies in Nigeria using statistical simulation model. The study found that the removal of fuel subsidies in Nigeria without adequate compensation increased the national poverty rate by an average of 3 to 4 percent. Additionally, the study found that the uniform cash compensation to mitigate effect of subsidy removal, although effective at the national level, failed to mitigate price shocks in 16 out of 36 states and the Federal Capital Territory (FCT), thus, risking livelihoods and public support for energy reforms in Nigeria.

Poor energy policy such as energy pricing and subsidy removal can lead to investment apathy, which can further hamper the growth in key macroeconomic sectors and exacerbate unemployment and poverty (Bushe, 2010). Energy pricing in most African countries is

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characterized by market imperfection occasioned by subsidy. Consequently, pricing, supply and investment in energy are predominantly left in the hand of government and its agencies instead of being determined by market forces. Because energy prices are administratively determined, prices have lagged behind inflation rate, exchange rate, as well as changes in product cost leading to substantial subsidy (Adeola, 2010). The essence of subsidy in most case is to make energy accessible to the poor at affordable price, but the African experience as shown that energy subsidies are key barriers to economic gowth and climate change mitigation (Schnidt, Matsuo & Michaelowo, 2017). The work of Burniaux and Chateau (2014) corroborated the fact that fossil fuel subsidies drain state budget, encourage greenhouse gas emissions and slow economic growth.

Laura and Bassan (2023) recognized that subsidized energy prices continue to form an important social safety net in regions with few functioning social welfare systems, albeit a highly costly and inefficient one, but demonstrated that the reform of energy subsidies can be achieved if accompanied by a set of enabling factors. Schwidt et al (2017) agree with other scholars that fuel subsidy in the electricity sector for example, crowd out investment in electricity infrastructure or diversification, distort investment decision, create barriers to entry for renewable energy development and format institutional deficiencies in the electricity sector.

However, Jun (2016) noted that though fossil fuel subsidy reforms can induce significant distributional shifts and price shocks, subsidy reforms affect poverty rate and that the effect on poverty rates varies significantly across regions. The vast fossil and renewable energy sources in Africa is expected to confer economic advantage to the Africa economy, but remains significantly unexploited as a result of technological, institutional and financial obstacles, of which Mutezo and Mulopo (2021) identify financial obstacle as the most important. Edward,Wagura and Izael (2022) advocated the need to address institutional knowledge gaps and policy gaps as key to unlocking the financial potential of renewable energy and energy efficiency in the continent of Africa. A systematic and well structured subsidy reform is sure to improve the economic land scape of Africa's energy sector. No wonder, International Monetary Fund (IMF) (2014) using the experiences of the Middle East and North Africa, encouraged that subsidy reforms should be backed up by scaling up of social safety nets, implementing of automatic price-setting mechanisms and restructuring of the energy sector.

The main argument in this paper is, while the link between energy policy and economic potential is clear, well-considered reforms in the area of energy pricing and subsidies are crucial for unlocking the continent's immense promise.

**Materials and Method**

The panel data used in the analysis of this study is annual data from 2000 to 2022 for 29 African countries. The countries include Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo Demographic Republic, Congo Republic, Cote d'Ivoire, Nigeria, Sierra-Leone, South Africa, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

The data used are GDP growth rate, GDP per capita, energy pricing, political stability, level of education, infrastructure quality and energy subsidy reforms. The data were obtained from World Development Indicator (WDI), (2023). This approach is in line with Gbatu, Wang, Wesseh and Tutdel (2017) where West Texas Intermediate (WTI) crude oil price was used to stand as a uniform substitute for oil price.

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**Table 1: Nature and Sources of Data**

| Variable | Measurement | Source |
|---|---|---|
| ppgaso | Pump prices of gasoline. Measured in U.S. dollars. | German Agency for International Cooperation (GIZ) (2023). |
| govte | General government expenditure on education expressed as a percentage of GDP. This covers expenditure on education in federal, state and local governments. | UNESCO Institute for Statistics (UIS) (2023). |
| kform | Gross fixed capital formation. This include investment in fixed assets measured in U.S. dollars. | World Development Indicator (2023) |
| | Labor force participation rate is the proportion of the population ages 15 and older that is economically active. | World Development Indicator (2023) |
| lbftot | Labor force participation rate is the proportion of the population ages 15 and older that is economically active. | World Development Indicator (2023) |
| devass | Net official development assistance and official aid received (constant 2020 US$) | World Development Indicator (2023) |
| devass2 | Net official development assistance and official aid received (current US$) | World Development Indicator (2023) |
| polstab | Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism. Estimate ranged from approximately -2.5 to 2.5. | Worldwide Governance Indicators (2023) |
| pop | Total population is the counts of all residents regardless of legal status or citizenship. The v estimates. | World Development Indicator (2023) |
| rulel | Rule of Law captures perceptions of the extent to which agents have confidence in and abide by the rules of society. The value ranged from approximately -2.5 to 2.5. | Worldwide Governance Indicators (2023) |
| gdppc | GDP per capita in constant 2015 US dollar | World Development Indicator (2023) |
| gdpgrt | Annual percentage growth rate of GDP | World Development Indicator (2023) |
| gdppc2 | GDP per capita in constant 2015 US dollar | World Development Indicator (2023) |
| FDI | Foreign direct investment, Data is in constant 2015 US dollar | World Development Indicator (2023) |

We used the Panel Cross Sectional Autoregressive Distributive Lag (CS-ARDL) to estimate the effect of energy pricing and subsidy reforms on economic growth among African countries economic development. The panel CS-ARDL approach is suitable for non-stationary panel data with cross-sectional dependence series. This is because it is efficient in capturing the short-term dynamics of variables and their adjustment to long-run equilibrium (Pedroni, 1999; 2001). The use of the heterogeneous dynamic panel approach is appropriate when dealing with non-

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stationary variables with the same order of integration such as [I(1)], or mixed order of integration such as ([I(1)] and [I(0)]) as long as none of the variables is integrated of [I(2)]. Following the work of Araar and Verme (2016) who examined the effect of subsidy reforms of energy on household welfare in the Middle East and North Africa region, we adopted the model to estimate the effect of subsidy on per capita income and economic growth of 29 African countries thus;

$$LGDPPC_{it} = \alpha_i + \beta_1 \quad LGOTEX_{it} + \beta_2 \quad LKFORM_{it} + \beta_3 \quad LSUB_{it} + \beta_4 \quad LRLBF_{it} + \beta_5 \quad LFDI_{it} + \beta_6 \quad LDEVASS_{it} + \beta_7 \quad POLSTAB_{it} + \beta_8 \quad PPGASO_{it} + \varepsilon_{it} \quad (1)$$

Where:

$\beta_1$ to $\beta_7$ are the coefficients to be estimated, $\alpha_i$ is the unobserved individual-specific effect that captures the time-invariant heterogeneity across cross-sectional units, $\varepsilon_{it}$is the error term. From equation 1 the CS-ARDL model is specified thus:

$$lgdppc2_{it} = \alpha_i + \rho lgdppc2_{it-1} + \sum_{j=1}^{p} \beta_j \Delta lgdppc2_{it-j} + \sum_{j=0}^{q} \gamma_{1j} \text{lkform}_{it-j} + \sum_{j=0}^{q} \gamma_{2j} \text{llbfr}_{it-j} + \sum_{j=0}^{q} \gamma_{3j} \text{ldevas}_{it-j} + \sum_{j=0}^{q} \gamma_{4j} \text{lfdi}_{it-j} ++ \sum_{j=0}^{q} \gamma_{5j} \text{polstab}_{it-j} ++ \sum_{j=0}^{q} \gamma_{6j} \text{ppgaso}_{it-j} + \theta X_t + \varepsilon_{it} \quad (2)$$

Where

$a_i$ is the individual specific fixed effect

ρ is the coefficient of the lagged dependent variable that captures the autoregressive component.

$\beta_j$ is the coefficient of the lagged difference of the dependent variable

$\gamma_{1j}$ …..$\gamma_{6j}$ are the coefficients of the lagged differences or levels of the independent variables.

p and q are the maximum lags for the dependent and independent variables respectively.

$X_t$ is the cross sectional average of all cross-sectional dependent variables at time t, capturing the cross-sectional dependence.

$\theta_t$ is the coefficient of the variables that are cross-sectionally dependent.

$\varepsilon_{it}$ is the error term

**Results and Discussion**

We began the analysis of this study by examining the nature of the data. Table 2 depicts the descriptive statistics and correlation of the variables used in the study. The data comprises 483 observations for each variable. The Table shows that deviation is more in economic growth relative to the other variables used in the model. This implies that economic growth deviates widely from its mean and across countries, suggesting that the growth rate in some countries is more than others. Labour force has the least deviation from its mean. This is because on the average, the labor force participation rate in Africa is low due to the level of high unemployment in the continent. The minimum and maximum values of labor force participation rate show that there is no much difference between the country with the minimum participation rate relative to the one with maximum labour participation rate in Africa. The correlation analysis reveals that the correlation coefficients does not indicate problem of collinearity or multicollinearity among the variables.

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**Table 2. Descriptive Statistics and Correlation Matrix**

| Variable | LDEVAS2 | LFDI | GDPGRT | LGDPPC2 | LGOTEX | LKFORM | PPGASO | POLSTAB | LBFR | SUB |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean | 20.136 | 19.630 | 4.360 | 7.142 | 1.261 | 3.028 | 1.046 | -0.666 | 4.156 | 0.232 |
| Median | 20.261 | 19.909 | 4.441 | 7.058 | 1.265 | 3.037 | 1.060 | -0.552 | 4.188 | 0.000 |
| Maximum | 22.430 | 23.172 | 33.629 | 9.109 | 2.368 | 4.395 | 1.950 | 1.201 | 4.494 | 1.000 |
| Minimum | 16.288 | 10.361 | -36.392 | 5.614 | -0.763 | 0.092 | 0.200 | -2.699 | 3.741 | 0.000 |
| Std. Dev. | 1.052 | 1.991 | 4.443 | 0.892 | 0.478 | 0.397 | 0.346 | 0.780 | 0.191 | 0.423 |
| Observ. | 542 | 542 | 542 | 542 | 542 | 542 | 542 | 542 | 542 | 542 |
| DEVASS | 1.000 | | | | | | | | | |
| FDI | 0.342 | 1.000 | | | | | | | | |
| GDPGRT | 0.195 | 0.040 | 1.000 | | | | | | | |
| GDPPC | -0.154 | 0.316 | -0.114 | 1.000 | | | | | | |
| GOVTE | 0.016 | 0.063 | -0.069 | 0.295 | 1.000 | | | | | |
| KFORM | 0.116 | 0.119 | 0.093 | 0.140 | 0.037 | 1.000 | | | | |
| PPGASO | 0.161 | -0.129 | 0.016 | -0.146 | -0.080 | -0.002 | 1.000 | | | |
| POLSTAB | -0.181 | -0.049 | 0.042 | 0.217 | 0.394 | 0.120 | -0.067 | 1.000 | | |
| LBFR | 0.271 | -0.204 | 0.090 | -0.472 | -0.110 | -0.099 | 0.224 | -0.056 | 1.000 | |
| SUB | 0.213 | 0.227 | 0.049 | 0.100 | 0.132 | 0.071 | -0.358 | 0.007 | -0.02 | 1.000 |

Note: Stata 14, 2024

Next, we checked for the cross section dependence among the variables using the Breusch-Pagan LM, Pesaran (2004) and the Baltagi, Feng and Kao (2012) [BFK hence forth] cross section dependence test in Table 3. The result of the cross-sectional dependence test reveals that there is cross-sectional dependence in all the variables. In this step, we test for slope heterogeneity as proposed by Pesaran and Yamagata (2008), the results prensented in Table 4. This test is designed to ascertain whether the panel series exhibit homogeneous slope coefficient across cross-sectional units. The null hypothesis indicates that the slope coefficients are homogeneous. The result in Table 4 show that both the Delta and adjusted Delta statistics reject the null hypothesis, indicating signicant slope heterogeneity. This implies that the relationship between the independent and dependent variables varies across countries, thus, panel estimates account for such heterogeneity.

After conducting the cross-sectional dependence and the slope heterogeneity test, we examined the stationarity of the variables over the period covered in this research using the Persaran CD test that controls for cross-sectional dependence among the variables. The unit root tests were carried out using the panel unit root with intercept.

Table 5 presents the results from the panel unit root tests. The result in Table 5 indicates that capital formation (LKFORM), foreign direct investment (FDI), political stability (POLSTAB) and development assistance (LDEVAS2) are stationary at level; while per capita income (LGDPPC2), government expenditure (LGOTEX), labour force participation rate (LRLBF) and price of gasoline (PPGASO) are stationary after first difference. The result of the

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stationarity test and cross-sectional dependence test justify the choice of CD-ARDL for the estimation method.

**Table 3: Cross-Sectional Dependence Test**

| variable | Breusch-Pagan LM | BFK | Pesaran CD | Decision |
|---|---|---|---|---|
| fdi | 2483.34*** | 42.17*** | 28.80*** | Cross section dependent |
| | (0.000) | (0.000) | (0.000) | |
| grt | 1719.56*** | 22.84*** | 23.67*** | Cross section dependent |
| | (0.000) | (0.000) | (0.000) | |
| Devass2 | 4697.52*** | 98.23*** | 51.79*** | Cross section dependent |
| | (0.000) | (0.000) | (0.000) | |
| gdpcc | 8632.51*** | 197.86*** | 54.20*** | Cross section dependent |
| | (0.000) | (0.000) | (0.000) | |
| kform | 3032.50*** | 56.08*** | 10.72*** | Cross section dependent |
| | (0.000) | (0.000) | (0.000) | |
| lbf | 6718.75*** | 149.41*** | 26.97*** | Cross section dependent |
| | (0.000) | (0.000) | (0.000) | |
| polstab | 4017.10*** | 81.01*** | -0.82 | Cross section dependent |
| | (0.000) | (0.000) | (0.414) | |
| ppgaso | 8002.91*** | 181.76*** | 83.39*** | Cross section dependent |
| | (0.000) | (0.000) | (0.000) | |
| Rulel | 4394.35*** | 90.56*** | 0.59 | Cross section dependent |
| | 0.000 | 0.000 | (0.554) | |

Note: Stata 14, 2024. Null hypothesis states that there is no cross section dependence or correlation. *** indicates rejection of the null hypothesis at 1 percent level of significance. The Breusch-Pagan LM, follows a chi-square distribution, BFK and Pesaran CD follow standard normal distribution.

**Table 4: Result of Test for Slope Homogeneity**

| Statistic | Value | P-value |
|---|---|---|
| Δ | 6.394*** | 0.000 |
| adj.Δ | 7.497*** | 0.000 |

Note: Stata 14, 2024: Null hypothesis states that there is slope homogeneity. *** indicates rejection of the null hypothesis at 1 percent level of significance.

Table 5 presents the results from the panel unit root tests. The result in Table 5 indicates that capital formation (LKFORM), foreign direct investment (FDI), political stability (POLSTAB) and development assistance (LDEVAS2) are stationary at level; while per capita income (LGDPPC2), government expenditure (LGOTEX), labour force participation rate (LRLBF) and price of gasoline (PPGASO) are stationary after first difference. The result of the stationarity test and cross-sectional dependence test justify the choice of CD-ARDL for the estimation method.

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**Table 5: Pesaran Unit Root Tests**

| Variables ➔ | lgdppc2 | lgotex | lkform | lrlbf | lfdi | ldevas2 | polstab | ppgaso |
|---|---|---|---|---|---|---|---|---|
| **Level** | | | | | | | | |
| Pesaran | -2.243 | -2.457 | -2.622** | -1.533 | -2.847*** | -3.203*** | -2.799*** | -1.819 |
| **First Difference** | | | | | | | | |
| Pesaran | -4.007*** | -4.450*** | - | -2.923*** | - | - | - | -3.77*** |
| Order of integration | I(1) | I(1) | I(0) | I(1) | I(0) | I(0) | I(0) | I(1) |

Note: Stata 14, 2024. The critical values for the Persaran test are -2.54, -2.61 and -2.73 indicate significant level at 10%, 5%, and 1%, respectively. Null hypothesis states that unit root exist. *** and **indicates rejection of the null hypothesis at 1 and 5 percent level of significance respectively.

To account for the cross section dependence, we apply the Westerlund (2007) error correction based panel cointegration tests with bootstrapped P-values. The result of the cointegration test is shown in Table 6.

**Table 6: Result of the Cointegration Test**

| Statistic | Value | Z-value | P-value |
|---|---|---|---|
| Gt | -4.243*** | -11.907 | 0.000 |
| Ga | -11.853 | 0.911 | 0.819 |
| Pt | -37.959*** | -22.498 | 0.000 |
| Pa | -15.872*** | -5.477 | 0.000 |

Note: Stata 14, 2024. The P-values are for test that follows the normal distribution while the robust P-values are for test that follows the bootstrapped distribution. Null hypothesis states that there is no cointegration. *** indicates rejection of the null hypothesis at 1 percent level of significance.

Table 6 shows the Westerlund (2007) cointegration test result. Considering the outcome of the p-value and the robust p-value, all the statistics apart from Ga strongly reject the null hypothesis of no cointegration at 1 percent level of significance. The none rejection of the null hypothesis of the Ga statistics is not surprising because according to Westerlund (2007), the Ga works better in cases of small samples of less than 10 countries. The overall result implies that we can conclude that there exists a long run relationship among the variables.

**Effect of Energy Pricing on Economic Growth in Africa**

We estimate the effect of energy pricing on economic growth in Africa in Table 7. The result in Table 7 shows that one-unit lagged increase in economic growth leads to a decrease of 0.493 units in the current period's economic growth, and this result is statistically significant. Development assistance and price of gasoline have positive and negative effects on economic growth, respectively, with both variables being statistically significant. Political stability plays a significant role in influencing economic growth in the short run with a positive coefficient of 8.296. The variables Lfdi, Lkform and ΔLrlbf do not significantly affect economic growth in the short run. The error correction model (ECM (-1)) coefficient of -0.493 suggests that around 49.3% of the disequilibrium is corrected in one year.

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**Table 7: Result of the CS-ARDL error correction model Estimate: Economic growth**

| Dependent Variables | Δ Economic growth (gdpgrt) |
|---|---|
| **Variable** | **Coefficient (P-Values)** |
| **Short –Run Estimates** | |
| Δgdpgrt(-1) | -0.493*** |
| | (0.000) |
| Δ Lfdi | -0.496 |
| | (0.773) |
| Δ ldevas2 | 4.132* |
| | (0.0829) |
| Δ Lkform | -5.895 |
| | (0.206) |
| Δ Lrlbf | 47.58 |
| | (0.945) |
| Δ Polstab | 8.296** |
| | (0.0101) |
| Δ ppgaso | -11.31* |
| | (0.0881) |
| ECM(-1) | -0.493*** |
| | (0.000) |
| **Long –Run Estimates** | |
| ldevas2 | 3.567* |
| | (0.0609) |
| lfdi | -0.883 |
| | (0.572) |
| lkform | -3.824 |
| | (0.425) |
| lrlbf | -102.6 |
| | (0.805) |
| polstab | 4.874** |
| | (0.0256) |
| ppgaso | -9.011* |
| | (0.0564) |
| **Diagnostic Tests** | |
| Pesaran CD test | 1.27(0.453) |
| Fisher test | 21.85(0.000) |
| RMSE | 0.04 |

Note: Stata 14, 2024. *, ** and *** implies significant at 10%, 5% and 1% level respectively. Values in (.) are P-values

In the long run, the variable ldevas2 shows a positive association with economic growth, while variables like lfdi, lkform, and lrlbf do not seem to have a statistically significant impact. Political stability (polstab) and ppgaso show significant impacts on economic growth in the long run.

The preliminary diagnostic test confirms the validity of the estimates as the Fisher test and the Pesaran test for cross-sectional dependence shows that estimate is corrected for cross-sectional dependence. The root means square error (RMSE) of 0.04 indicates a good predictive power

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of the estimate. Economic growth is significantly influenced by its own lagged values, indicating that past economic growth plays a crucial role in determining future growth. The implication of the outcome of this study indicates that political stability have a significant and consistent impact on economic growth both in the short and long run, suggesting that a stable political environment is conducive for economic development.

**Table 8: Result of the CS-ARDL error correction model Estimate: GDP Per Capita**

| **Dependent Variable:** | **ΔGDP per capita (lgdppc)** |
|---|---|
| **Variables** | **Coefficients (P-values)** |
| **Short Run Estimates** | |
| Δlgdppc2(-1) | -0.204** |
| | (0.0461) |
| Δlfdi | 0.0182** |
| | (0.0368) |
| Δldevas2 | -0.00384 |
| | (0.84) |
| Δlkform | -0.0162 |
| | (0.576) |
| Δlrlbf | -2.98 |
| | (0.593) |
| Δpolstab | 0.0923*** |
| | (0.000) |
| Δppgaso | -0.0289 |
| | (0.412) |
| **Long Run Estimates** | |
| ldevas2 | -0.00769 |
| | (0.725) |
| lfdi | 0.0205 |
| | (0.106) |
| lr_lkform | -1.204*** |
| | (0.000) |
| lr_lrlbf | -1.61 |
| | (0.711) |
| lr_polstab | 0.0515* |
| | (0.0786) |
| lr_ppgaso | -0.079 |
| | (0.181) |
| **Diagnostic Tests** | |
| Pesaran CD test | 1.47(0.351) |
| Fisher Test | 25.85(0.000) |
| RMSE | 0.06 |

Note: Stata 14, 2024. *, ** and *** implies significant at 10%, 5% and 1% level respectively. Values in (.) are P-values

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The significance of political stability in determining economic growth aligns with prior studies that emphasize the role of governance and institutional quality in economic development (Edward, Wagura & Izael, 2022). The negative effect of the price of gasoline indicates that the negative effect of subsiding energy price on economic growth (Laura & Bassan (2023).

**Effect of Energy Pricing and Subsidy Reforms on Per Capital Income in Africa**

On the effect of energy pricing on GDP per capita, the short run result shows that the previous year's GDP per capita has negative effect on current GDP per capita. An increase in foreign direct investment (Δlfdi) tends to improve GDP per capita, while the stability of the political environment (Δpolstab) shows a strongly significant positive impact. Other variables, including development assistance, capital formation, labor force, and gasoline prices, do not significantly affect the short-term GDP per capita.

In the long run, capital formation (lkform) has a strongly significant negative effect on GDP per capita. The political stability (polstab) shows a positive effect on GDP per capita, albeit at a 10% significance level. Other factors, such as development assistance, foreign direct investment, labor force, and gasoline prices, don't significantly influence the GDP per capita in the long run. The Pesaran CD test, which checks for cross-sectional dependence in panels, is statistically insignificant, implying that cross-sectional dependence is not an issue in this model. The Fisher test is significant, confirming the joint significance of the coefficients.

The results suggest that in the short term, foreign direct investments and political stability play pivotal roles in influencing GDP per capita. This underscores the importance of a stable political environment in fostering economic growth and attracting foreign investments. In the long run, while political stability continues to play a crucial role, capital formation significantly affects the GDP per capita negatively. This could imply that investments are perhaps not efficiently deployed, or other external factors might be reducing the returns from such capital formations.

The findings regarding the impact of political stability on economic performance align with a wide array of studies that emphasize the importance of a stable political environment in achieving sustained economic growth (Acemoglu et al., 2010). Furthermore, the positive short-run effect of foreign direct investments has been consistently highlighted in literature, demonstrating the immediate economic boosts they bring in terms of technology transfer, job creation, and infrastructure development (Borensztein et al., 1998). The negative long-run impact of capital formation, however, contrasts with some traditional economic theories but could be reminiscent of the 'Lucas Paradox' where despite abundant capital opportunities, investments might not necessarily flow to areas of scarce capital

**Conclusion**

This study evaluated the relationship between energy pricing, subsidies, and economic growth in African countries. Despite the vast economic potential present within the continent, factors such as distorted energy pricing, primarily influenced by subsidies, have hindered optimal resource allocation, fiscal stability, and entrepreneurial innovation. Using the CS-ARDL regression technique, our analysis confirms a significant negative impact of subsidies on investment within the energy sector, economic growth and employment across African countries. Of notable significance is the effect of gasoline price on investment in the energy sector, which we found to have a marked effect on economic growth. However, it is imperative to note that this effect is not uniform across the continent, with different nations showcasing varied impacts. This variation in outcomes underscores the need for tailored policy recommendations depending on a country's unique economic situation. Furthermore, the robustness of our model, which successfully passed post-estimation tests for serial correlation,

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functional form, and heteroskedasticity, solidifies the reliability of our findings. In light of this, it becomes imperative for policymakers to consider subsidy reforms aimed at phasing out blanket subsidies and implementing price mechanisms reflecting the true cost of energy usage across African countries. This approach can attract investment in the energy sector and enhance the potential of achieving sustainable energy security, thereby fostering growth in Africa.

**Conflict of Interest**

Authors would like to state that there is no conflict of interest.

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