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Energy Price Inflation and Output Growth: Evidence from Selected Countries with High Misery Index in Africa

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Abstract
This study examined the effect of energy price inflation on output growth among selected African countries namely Nigeria, Egypt, South Africa, and Mauritius with high misery indexes. The study covered the period between 1981 to 2020. The Konya Granger causality test and Augmented Mean Group (AMG) estimation techniques were employed. Findings revealed that energy price inflation is a detriment to output growth in Africa. The control variables which included credit to the private sector, per capita income and gross fixed capita formation were seen to improve output growth in Africa. Therefore, policies aimed at ameliorating the effects of energy prices should aim at reducing the effects of imported energy price inflation on economies characterized by a high level of misery.

Keywords: *Energy price inflation, output growth, misery index, per capita income, Augmented Mean Group (AMG) estimator.*

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I. Introduction

Achieving a stable level of economic growth and price level although contradictory remains a goal of macroeconomic policy (Liaqat, Ashraf, Nisar, & Khursheed, 2022). Iqbal et al (2021) note that a rise in energy prices leads to an increase in the general price level and has implications for consumption, standards of living, and output growth. Over the last one year, the price of non-renewable energy, in particular, crude oil prices has risen. Causes of energy price increases include strong demand, restrictions on supply occasioned by political and security problems, natural weather problems, high cost of supplies, and price expectations for oil (Kilian, 2008). Therefore, many developing countries put in place subsidies to ameliorate the effect of energy inflation on households and the economy, but, recent policy reforms have been skewed in favour of subsidy removal as obtained in many developed countries (OECD/IEA, 2021). Although the households and firms may adjust over time to higher prices, the effects on macroeconomic variables such as Gross Domestic Product (GDP), energy consumption, trade deficit, employment, and inflation are dire.

Worldwide, there are fears about the implications of energy price inflation on achieving the Sustainable Development Goals (SDGs) and in particular economic growth. These fears are deep-seated as the coexistence of misery and high energy prices threaten the stability and existence of nations. It does not matter whether a country is an energy importer or energy exporter as the determinants of energy prices are not controllable. Immunity from energy inflation based on the energy dependence status of a country is not guaranteed. Rather, the reaction of a country to energy price increases depends on the conduct of macroeconomic policy.

Theoretically, an increase in energy prices always dampens economic growth but the scenarios are different for oil-importing/oil-exporting countries. The two main strands of thought regarding the relationship between energy inflation and output growth are the pro-growth and anti-growth hypotheses. The arguments of the pro-growth hypothesis and the anti-growth hypothesis are articulated by Echchabi & Azouzi (2017), Nguyen & Nguyen (2020), Okoye et al (2021). The pro-growth strand of thought is based on the notion that energy inflation increases the level of growth. The anti-growth hypothesis supporters are of the view that higher energy prices lead to reduced growth rates in developing countries. (Echchabi & Azouzi, 2017; Nguyen & Nguyen, 2020; Okoye et al., 2021).

There is positive nexus between a rise in energy prices and consumer price inflation. Household spending and income are affected by a sustained rise in energy prices (Kilian, 2008). For firms, most energy-using firms pass higher costs of production initiated by a rise in the cost of energy to their customer but the profits of energy-producing companies grow sharply. While the negative effects of oil price increases have been lessened over the years following the oil boom of the 1970s, recent evidence proves otherwise, especially in the face of the Russian-Ukraine War. Today, energy prices are surging, and globally economic agents are reeling from the pinch of higher fuel costs and the fact that renewable energy sources are not growing fast enough to replace the demand for non-renewable sources of energy thereby placing policymakers at crossroads as to whether the incidence could lead to a worldwide recession.

Therefore, the justification for investigating energy price inflation and output growth rests on the following arguments. First, daily/monthly increases in energy prices in recent times imply that Africa's fragile economic growth is at risk, especially for those countries that have a high misery index. Secondly, energy prices are perceived to be determined by exogenous forces. Given these observations, the question to ask is what effect does energy price inflation have on the output growth in Africa specifically in those countries with high misery index? Are the effects different for energy-exporting countries viz-a-viz energy importers?

This study examines the effect of energy price inflation on output growth in four selected countries with the highest misery indexes in Africa over the period 1981 to 2020. Secondly, the study investigates whether the effects of energy price inflation on output growth are different for oil exporters and oil importers respectively. The Augmented Mean-Group estimates which control for cross-country correlations are used to obtain average responses across nations.

Aside from the introduction, the rest of the paper is structured as follows: Section 2 reviews the energy and misery outlook of the selected African countries; a brief literature review is presented in section 3; section 4 outlines the methodology and data; section 5 analyses and discusses the results while section 6 concludes with policy recommendations.

II. Energy and misery outlook of selected African countries

Africa's population is among the fastest-growing and youngest in the world and this implies an increased energy demand for modern and efficient energy sources. Despite progress in the countries, of interest namely Nigeria, Egypt, South Africa, and Mauritius, efforts to provide access to modern energy services are barely outpacing population growth. As a result, the global population without access to energy is increasing with about 90% of population without access to electricity and almost 50% without access to clean cooking. This is evident in energy poverty.

Sustainable Development Goal 7 deals with energy efficiency and specifically Goal 7.3.1 addresses energy intensity which tracks the progress on energy efficiency. The goal aims at ensuring access to affordable, reliable, sustainable, and modern energy for all. Energy intensity shows how much energy is used to produce one unit of economic output. Energy intensity indicates the exposure of countries to energy price inflation. This is presented in Figure 1. It shows that the energy intensity in South Africa, Nigeria, and Mauritius has been falling over time. However, the magnitude of the fall has been greater for Nigeria since 2003. The least fall in magnitude of energy intensity was experienced by Mauritius. Egypt on the other hand had the least fluctuation over the period as energy intensity oscillated between 1 kWh/$ and 1.25 kWh/$.

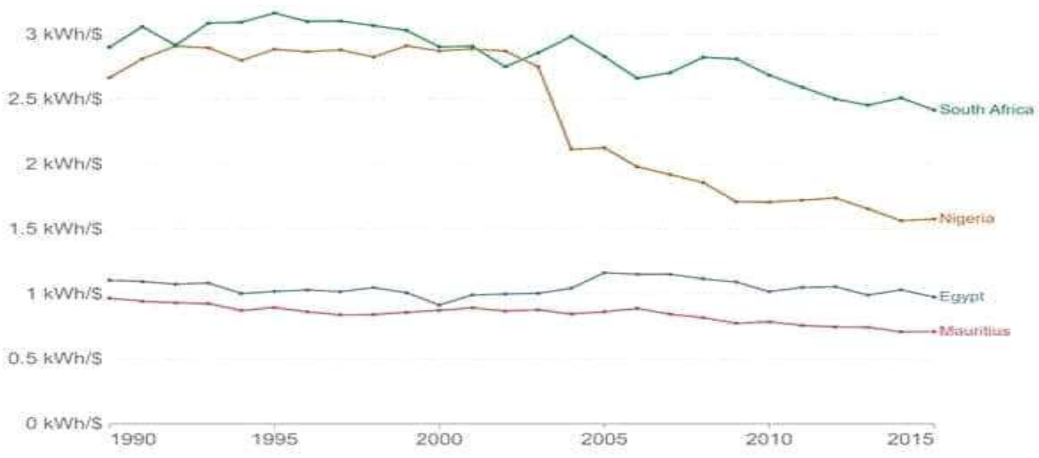

Figure 1: Energy intensity of economies (1990 to 2015)

Source: World Bank, (2022)

From Figure I, it is obvious that overall, South Africa has the highest energy intensity level followed by Nigeria, Egypt, and Mauritius. This implies that South Africa uses more energy to produce a unit of output as compared to the other countries. Intuitively, energy price inflation is likely to affect South Africa and Nigeria which has a high energy intensity more severely than the other countries under study.

The extent to which a country relies on energy imports to meet its energy needs indicates the extent of its dependency (see Figure 2). Dependency is measured by net energy imports (percentage of energy use) which is energy use less energy production. A negative value shows the country is a net exporter while a positive value shows it is a net importer. Evidence on the status of each country under study is shown in Figure 2. In order of magnitude, Nigeria is the largest net exporter of energy, followed by Egypt and South Africa. The highest value of energy imports in Nigeria was -90.58 in 2013, while the lowest value of -196.52 was obtained in 1980. Although South Africa has been relatively stable over time, it had the least value as an energy exporter. Nigeria and most especially Egypt have been declining in their status as energy exporters over time indicating a higher level of dependence on energy imports. Mauritius is the only country in the group that is an energy importer, and its dependence has been increasing over time.

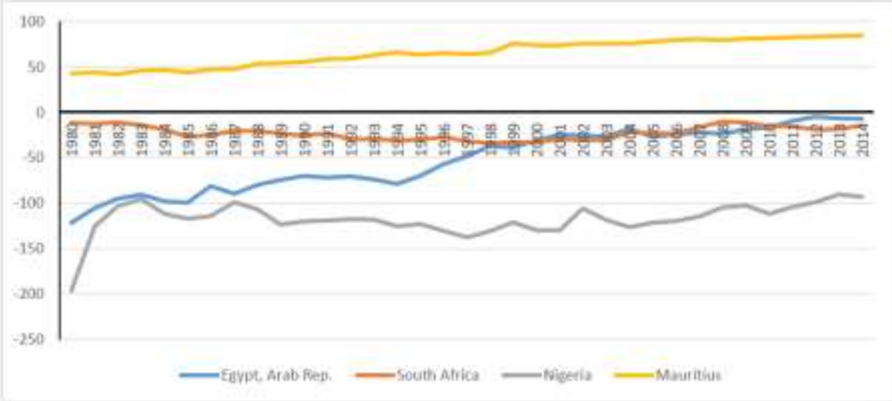

Figure 2: Net energy imports

Source: IEA Statistics, OECD/IEA 2014, (http://www.iea.org/stats/index.asp)

The level of misery experienced in the selected countries of interest are presented in Table 1.

Table 1: Hanke's Misery Index for selected African Countries

	Misery Index
Nigeria	45.6
South Africa	49.3
Egypt	20.9
Mauritius	30.4

Source: Hanke (2021)

Hanke's annual misery index is the sum of unemployment, inflation, and bank lending rate less percentage change in real GDP per capita (Hanke, 2021). A higher index score for a country shows a higher level of misery. Of the four countries under study, South Africa had a misery index of 49.3 which made it the most miserable country of the group. This is followed closely by Nigeria, Mauritius, and Egypt.

III. Data and Methodology

Model Specification

To examine the effect of energy inflation on output growth among the selected countries, the functional form of the model is specified as follows:

$$gdpgr = f(ecpi, gfk, dcps, pky) \quad (1)$$

Where: *gdpgr* = GDP growth rate. *ecpi* = energy consumer price inflation. *gfk* = gross fixed capital formation. *dcps* = domestic credit to private sector and *pky* = per capita income.

Equation (1) is transformed into econometric form as

$$gdpgr_{it} = \beta_0 + \beta_1 ecpi + \beta_2 gfk_{it} + \beta_3 dcps_{it} + \beta_4 pky_{it} + \varepsilon_{it} \quad (2)$$

Re-specifying Equation (2) in natural logarithm form, we have:

$$lngdpgr_{it} = \beta_0 + \beta_1 lnecpi_{it} + \beta_2 lngfk_{it} + \beta_3 lndcps_{it} + \beta_4 lnpky_{it} + \varepsilon_{it} \quad (3)$$

Where β_0 = constant term. $\beta_1, \beta_2, \beta_3,$ *and* β_4 are the regression parameters. ε_{it} = error term. The numbers of countries i = 1, ...4 while t = 1981, ...2020. On a priori, we expect $\beta_1 < 0, \beta_2 > 0$, $\beta_3 > 0, and\ \beta_4 > 0$.

Estimation Techniques

Before estimating equation 3 empirically, some preliminary tests were conducted to ensure that the results were spurious-free. These tests are important in panel analysis and include the cross-section dependence test, slope homogeneity, and the panel unit root test to ensure that the data are stationary.

Test for Cross–Section Dependence

Testing for cross-sectional dependence is an important preliminary test that is carried out before performing a panel data analysis. This is because failure to address this issue may result in a misleading result arising from the use of a wrong panel unit root test. For this paper, the Breusch and Pagan (1980) LM test, Pesaran (2004) scaled LM test, Pesaran (2004) CD test, and Baltagi, Feng, & Kao (2012) bias-corrected scaled LM test was used. The specification of the tests are as follows

Breusch-Pagan's (1980) LM test is specified as

$$LM = \sum_{i=1}^{N-1}\sum_{j=i+1}^{N} T_{ij}\,\hat{p}_{ij}^2 \rightarrow \chi^2 \frac{N(N-1)}{2} \quad (4)$$

Where $\hat{p}_{ij}^2$ represents the coefficient of correlation arising from the residuals of the specified equations

Pesaran (2004) scaled LM test is

$$LM_s = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\left(T_{ij}\hat{p}_{ij}^2 - 1\right) \rightarrow N(0.1) \quad (5)$$

While the Pesaran CD test depends on the mean coefficients of correlation $\hat{p}_{ij}$ and takes the form:

$$CD_p = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N} T_{ij}\hat{p}_{ij} \rightarrow N(0.1) \quad (6)$$

Baltagi et al (2012) Bias – corrected Scaled LM is presented as

$$LM_{BC} = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\left(T_{ij}\hat{p}_{ij}^2 - 1\right) - \frac{N}{2(T-1)} \rightarrow N(0.1) \quad (7)$$

The null hypotheses of these tests are compared with the alternative hypothesis as follows:

$$H_0: \hat{\gamma}_{ij} = cor\left(\omega_{it,}\omega_{jt}\right) = 0 \; for \; i \neq j \quad (8)$$

$$H_1: \hat{\gamma}_{ij} = cor\left(\omega_{it,}\omega_{jt}\right) \neq 0 \; for \; i \neq j \quad (9)$$

The rejection of the null hypothesis shows the existence of cross-sectional dependence. This will necessitate the use of the second-generation econometrics technique. This is because the first-generation econometric techniques relied upon the assumption that there is no existence of cross-sectional dependence and therefore all cross-sectional units of variables in the panel are independent (Shariff & Hamzah, 2015).

Slope Homogeneity Test

This test is important as it is used to determine whether the parameter of interest is homogeneous or heterogeneous. Testing for slope homogeneity is important for the selection of appropriate econometric methods. If the existence of slope heterogeneity is ignored, the analysis carried out will be biased. For this study, the Pesaran and Yamagata (2008) test for slope heterogeneity was employed to test if the effects of energy inflation are the same across the countries of interest. The test is conducted in line with Swamy's (1970) standardized homogeneity test.

$$\tilde{S} = \sum_{i=1}^{N} (\hat{B}_i - \tilde{B}_{WFE})' \frac{X_i' M_T X_i}{\tilde{\delta}_i^2} (\hat{B}_i - \tilde{B}_{WFE}). \quad (10)$$

Where $\hat{B}_i$ represents the pooled ordinary least square estimator, $\hat{B}_{WFE}$ is the pooled weighted fixed effect estimator of slope coefficients. The Δ tests are stated as

$$\hat{\Delta}_{tilde} = \sqrt{N} = \left(\frac{\frac{1}{N}\hat{S}_W - k}{2k} \right). \quad (11)$$

$$\hat{\Delta}_{adj} = \sqrt{N} \left(\frac{\frac{1}{N}\hat{S}_W - E(\tilde{Z}_{it})}{var^{\frac{1}{2}}(\tilde{Z}_{it})} \right) \quad (12)$$

Unit Root Test

The confirmation of the presence of cross-sectional dependence among the variables in the selected countries implies that the application of first-generation panel unit root techniques is no longer sufficient (Chudik, & Pesaran, 2013; Sarafidis, & Wansbeek, 2012). Therefore, Pesaran (2007) and Im, Pesaran, and Shin (2003) proposed the Cross-sectional Augmented Dickey-Fuller (CADF) and the Cross-Section Im, Pesaran, and Shin (CIPS) which are regarded as second-generation unit root test capable of handling panels with cross-sectional dependence issues. The CADF test statistic is calculated thus:

$$\Delta y_{it} = \alpha_i + b_i y_{i,t-1} + c_i \bar{y}_{t-1} + d_i \Delta\bar{y}_t + e_{it} \quad (13)$$

Where: $\bar{y}$ *and* $\Delta\bar{y}$ are the mean of cross-sections of lagged levels and their first differences at time t for the countries under review. Accordingly, Pesaran (2007) states the CADF as:

$$CADF_i = t_i(N,T) = \frac{\Delta y_i' \bar{M}_W y_{i,-1}}{\hat{\sigma}_i (y_{i,-1}' \bar{M}_W y_{i,-1})^{\frac{1}{2}}} \quad (14)$$

Consequently, the CIPS statistic is computed from the estimated t-statistic value of the CADF test in equation (14) as:

$$CIPS = N^{-1} \sum_{i=1}^{N} CADF_i \quad (15)$$

Granger Causality Test

Another aspect of this paper was to investigate the direction of causality between energy inflation and output growth in the African countries that were chosen. This is critical for determining whether energy inflation drives production growth or the other way around. However, caution is needed as energy prices are not determined by the countries under study.

The following bivariate finite-order vector autoregressive (VAR)model was suggested, based on the approach proposed by Kónya (2006) for determining the presence of country-specific granger causality:

$$lgdpgr_{1,t} = \alpha_{1,l} + \sum_{l=1}^{mlgdpgr_i} \beta_{1,i,l} lgdpgr_{i,t-l} + \sum_{l=1}^{mlecpi_i} \gamma_{1,i,l} lecpi_{i,t-l} + \varepsilon_{1,i,t}$$

$$lecpi_{1,t} = \alpha_{2,l} + \sum_{l=1}^{mlgdpgr_i} \beta_{2,1,l} lgdpgr_{i,t-l} + \sum_{l=1}^{mlecpi_i} \gamma_{2,i,l} lecpi_{i,t-l} + \varepsilon_{2,i,t}$$

Description and Sources of data

The study sample is made up of four (4) African countries with high misery index as computed by Hanke's index in 2021. The countries that were considered in this study were Nigeria, South Africa, Egypt, and Mauritius and they had one of the highest misery indexes in 2020. The misery index is the sum of the unemployment rate, the lending rate, and the inflation rate minus the percent change in real GDP per capita of a country. The study period is from 1981 to 2020. The variables of interest include the growth rate of gross domestic product, energy consumer price inflation, gross fixed capital formation, domestic credit to the private sector, and per capita income. Energy CPI data is taken from the World Bank's cross-country database of inflation (https://www.worldbank.org/en/research/brief/inflation-database). Data on GDP growth rate, per capita income, domestic credit to the private sector, and gross fixed capita formation were retrieved from the World Development Indicators (2021) (https://data.worldbank.org).

IV. Results and Discussion

Descriptive Statistics

The descriptive analysis of data for the study as shown in Table 2 indicates that the cross-country mean values for output growth, energy consumer price inflation, gross fixed capital formation (% of GDP), domestic credit to the private sector, and per capita income are 3.592%, 11.623, 24.648%, $51.693 billion, and $3200.857 respectively. Further observations from Table 2 show that Egypt has the highest mean value for output growth (4.828%), followed by Mauritius (4.288%), while South Africa has the least mean value (1.985 %). The lowest minimum value of output growth was reported in Mauritius (-14.894%) while the maximum value was in Nigeria (15.329%), followed by Egypt (9.907%).

For energy CPI, Nigeria has the highest mean value of energy inflation (26.363), followed by Egypt (8.227), while Mauritius has the least mean value of energy CPI (3.797). Also, the maximum value for energy CPI was recorded in Nigeria (216.400) followed by Egypt (52.600). South Africa recorded the minimum value of (-10.636).

The country with the highest mean value of gross fixed capital formation is Nigeria (35.741%), followed by Mauritius (22.637%), while the country with the least mean value is South Africa (18.478%). South Africa has the highest mean domestic credit to the private sector of all the countries investigated ($104.446 billion), followed by Mauritius ($60.189 billion), while Nigeria comes last at $9.283 billion. This low figure for Nigeria shows the weakness of the country's economy in respect of the provision of credit to the private sector.

In terms of per capita income for all the selected African countries. Mauritius's mean value for per capita income is the highest of all the countries investigated ($5176.620), followed by South Africa ($4717.429), while Nigeria recorded the least mean value ($1329.246). Nigeria's level of per capita income is indicative of the level of economic discomfort which encourages misery.

Table 2: Descriptive Statistics

Country	Mean	Std. Dev	Min	Max
GDP growth rate				
Nigeria	3.026	5.453	-13.128	15.329
South Africa	1.985	2.513	-6.431	5.503
Egypt	4.828	1.883	1.125	9.907
Mauritius	4.288	3.641	-14.894	9.742
Panel	3.592	3.773	-14.894	15.329
Energy CPI				
Nigeria	26.363	36.136	-0.656	216.400
South Africa	8.013	5.603	-10.636	26.200
Egypt	8.227	11.675	-4.200	52.600
Mauritius	3.797	6.411	-4.900	22.2003
Panel	11.623	21.220	-10.636	216.400
Gross Fixed Capital Formation				
Nigeria	35.741	19.156	14.169	89.366
South Africa	18.478	4.122	13.717	29.123
Egypt	21.582	6.039	12.446	34.127
Mauritius	22.637	3.735	17.346	30.583
Panel	24.648	12.303	12.446	89.366
Domestic credit to the private sector				
Nigeria	9.283	3.540	4.957	19.626
South Africa	104.226	23.576	58.773	142.422

Egypt	34.378	10.990	22.059	54.931
Mauritius	60.189	26.916	21.519	106.307
Panel	51.693	39.702	4.958	142.422
Per capita income				
Nigeria	1329.246	876.176	270.224	3098.986
South Africa	4717.429	1985.221	1807.996	8810.931
Egypt	1615.919	1012.027	498.559	3669.209
Mauritius	5176.620	3284.669	1027.994	11208.34
Panel	3200.887	2662.184	270.224	11208.34

Cross-sectional dependence

Table 3 reports the cross-sectional dependence test result. The null hypothesis of non-dependence was rejected at 1% and 5% levels of significance respectively. Hence, the results validate the existence of strong cross-sectional dependence among the countries.

Table 3: Cross Section Dependence Test Results

	Test Statistics and Probability				
	lngdpgr	*lnecpi*	*lngfk*	*lndcps*	*lnpky*
Breusch - Pagan LM	18.315***	5.366**	72.156***	79.621****	18.313**
	(0.006)	(0.049)	(0.000)	(0.000)	(0.006)
Pesaran Scaled LM	2.399**	-1.340	17.942***	20.098***	2.399**
	(0.016)	(0.180)	(0.000)	(0.000)	(0.016)
Bias-Corrected Scaled LM	2.348**	4.392***	17.892***	20.047***	2.348**
	(0.019)	(0.002)	(0.000)	(0.000)	(0.019)
Pesaran CD	2.481**	1.867*	6.267***	7.669***	2.481**
	(0.013)	(0.062)	(0.000)	(0.000)	(0.013)

*Note: (i) ***, ** and * represents statistical significance at 1%, 5% and 10% respectively*
(ii) The optimal lags are based on Schwarz Information Criterion (SIC).
(iii) Values reported in parentheses are the probabilities

Slope Homogeneity Test

The incidence of cross-sectional dependency necessitates carrying out the slope homogeneity test and the results are shown in Table 4. The results of the test statistics for both the delta tilde ($\grave{\Delta}_{tilde}$) and adjusted delta tilde ($\grave{\Delta}_{adj}$) were significant at 1%, 5%, and 10%, respectively. As a result, the presence of slope homogeneity is established.

Table 4: Slope homogeneity Test

Delta Test	Test statistics and probability				
	lgdpgr	*lecpi*	*lgfk*	*ldcps*	*lpky*
$\grave{\Delta}_{tilde}$	2.33*	5.67**	4.05***	3.09*	2.45*
	(0.08)	(0.02)	(0,00)	(0.06)	(0.05)
$\grave{\Delta}_{adj}$	3.45**	3.78**	5.70***	2.89*	1.88
	(0.01)	(0.02)	(0.00)	(0.06)	(0.13)

Note: ***, ** and * denotes significance at 1%, 5% and 10% respectively.

Unit Root Test

The panel unit root tests recommended by Pesaran (2007) and Pesaran, Smith & Yamagata (2013) in demonstrating cross-sectional dependence across nations are used after confirming the dependence of data series across countries. The results which are reported in Tables 5 and 6 show that all the variables are stationary at first difference.

Table 5: Cross Sectional Augmented Dickey Fuller unit root test at levels

	lgdpgr	*lecpi*	*lgfk*	*ldcps*	*lpky*	1%	5%	10%
Nigeria	-1.93	-2.4	-3.18	-2.11	-2.76	-5.73	-3.97	-3.26
South Africa	-2.48	-3.14	-2.56	-2.86	-1.78	-5.73	-3.97	-3.26
Egypt	-3.13	-2.55	-2.13	-3.98**	-3.12	-5.73	-3.97	-3.26
Mauritius	-2.23	-2.56	-2.56	-3.33**	-1.78	-5.73	-3.97	-3.26
CIPS	-1.67	-1.35	-1.34	-2.34	-1.99	-1.85	-1.61	-1.49

Note: ***, ** and * denotes significance at 1%, 5% and 10% respectively.

Table 6: Cross Sectional Augmented Dickey Fuller unit root test at first difference

	lgdpgr	*lecpi*	*lgfk*	*ldcps*	*lpky*	1%	5%	10%
Nigeria	-4.33**	-3.12**	-2.18	-3.01**	-2.22	-4.25	-2.91	-2.39
South Africa	-1.78	-2.54*	-3.56**	-1.86	-3.23**	-4.25	-2.91	-2.39
Egypt	-2.43	-2.55*	-3.13**	-1.55	-3.21**	-4.25	-2.91	-2.39
Mauritius	-3.23**	-3.52**	-2.96**	-2.33	-2.67**	-4.25	-2.91	-2.39
CIPS	-2.67***	-3.35***	-3.34***	-2.34***	-1.99*	-2.51	-2.25	-2.12

Note: ***, ** and * denotes significance at 1%, 5% and 10% respectively.

Granger Causality Test Results

Tables 7 and 8 report the results of the Granger Causality Test. The result confirms a unidirectional causality running from energy price inflation to output growth in Nigeria and Mauritius. Bidirectional causality strangely exists between energy price inflation and output growth in Egypt and South Africa.

Table 7: Granger causality test (H_0: $lgdpgr$ does not cause $lecpi$)

Country	Test. Stat.	Bootstrap critical values		
		1%	5%	10%
Nigeria	4.452	16.890	9.108	7.085
South Africa	6.764*	9.361	8.978	6.483
Egypt	4.853*	10.219	7.284	4.523
Mauritius	2.578	12.503	7.670	5.645

Note: ***, ** and * denotes significance at 1%, 5% and 10% respectively.

Table 8: Granger causality test (H_0: lecpi does not cause lgdpgr)

Country	Test. Stat.	Bootstrap critical values		
		1%	5%	10%
Nigeria	6.616*	15.234	8.564	5.345
South Africa	7.135*	11.036	9.467	6.745
Egypt	8.026**	12.223	7.345	4.056
Mauritius	6.826*	10.023	9.456	5.329

Note: ***, ** and * denotes significance at 1%, 5% and 10% respectively.

Regression Result

The effect of energy price inflation on output growth was analyzed using the Eberhardt and Teal (2010) estimation technique. The group-specific country results in terms of the panel and the individual country results are presented in Table 9.

Table 9: Regression Result Dependent Variable: *lngdpgr*

	Group Result	Individual Country Specific Result			
	Panel	Nigeria	South Africa	Egypt	Mauritius
lnecpi	-0.046*	-0.191**	-0.026	-0.038**	-0.102**
	(0.069)	(0.021)	(0.788)	(0.031)	(0.042)
lngfk	0.186**	0.887***	0.214	0.278***	0.822
	(0.048)	(0.000)	(0.337)	(0.004)	(0.358)
lndcps	0.031	0.167	0.392	0.046	0.563**
	(0.617)	(0.552)	(0.178)	(0.326)	(0.021)
lnpky	0.117***	0.480***	0.123	0.064**	0.296*
	(0.004)	(0.000)	(0.352)	(0.012)	(0.072)

Note: ***, ** and * denotes significance at 1%, 5% and 10% respectively.

Group-specific results

Findings from the group-specific results show that the impact of energy inflation on output growth was negative and significant in determining the pattern of output growth among the panel of countries with high misery index. The result shows that a percentage point increase in energy inflation will reduce output growth by 0.046%. The result was significant at $\rho < 0.1$. The findings are in line with Azam (2020) and Ha and Ngoc (2021) that show that energy prices reduce economic growth. These findings imply that an energy price hike hinder output growth and the quest for development in the selected high misery index countries.

The control variables used in the study such as gross fixed capital formation is significant and impacts positively on output growth. From the outcome of the result, a 1 percent increase in gross fixed capita formation increases output by 0.186 percent, indicating that the economy of the high misery index countries is positively affected by large investment size. The result was significant indicating that gross fixed capital formation is an important factor that determines output growth among the countries with high misery index in Africa. The study is in line with (Pasara & Garidzirai, 2020) that confirmed that gross fixed capital engenders output growth in developing countries.

In terms of domestic credit to the private sector, the result shows a positive but insignificant outcome. Specifically, a percentage increase in domestic credit to the private sector raises output growth by 0.031%. The implication of the result indicates that increasing assess to credit to the private sector may boost the output of the African countries that are characterized by a high misery index. The result was however not significant. This shows that despite the importance of domestic credit to the private sector, it does not matter for the pattern of output growth in the selected countries. This is contrary to positive and significant results obtained by Akin, Ikpefan, and Isibor, (2019) and Iheonu, Asongu, Odo, and Ojiem, (2020).

As reported in Table 9, per capita income impacted positively on output growth in the country. The result was also significant at $\rho < 0.1$, indicating that per capita income is an important determinant of the pattern of output growth among the selected countries in Africa. Specifically, the findings indicated that a percentage increase in per capita income will increase output by 0.117%. The finding is supported by Budiyono (2021), and Nizam, Karim, Rahman, and Sarmidi, (2020) who find that a rise in per capita income influences economic growth positively.

Individual country-specific results

From the group and individual country-specific results reported in Table 9, energy inflation impacted negatively on output growth among the four countries. Specifically, a percentage increase in energy prices decreases output growth by 0.191%, 0.026%, 0.038%, and 0.102% for Nigeria, South Africa, Egypt, and Mauritius respectively. Energy inflation was significant in determining output growth in Nigeria, Egypt, and Mauritius but was insignificant in South Africa. It can be deduced from the result that the effect was more severe in Nigeria followed by Mauritius, then Egypt. The implication of the findings shows that energy inflation causes more harm to output growth in countries with high misery indexes. The result was however not surprising as inflation is one of the major indices used in computing the misery index of countries. More so, the high cost of energy in

Nigeria and the high-power outage have led to the collapse of many industries which would have helped in increasing output of the country.

In terms of gross fixed capita formation, the result shows that output growth is affected positively by a rise in gross fixed capita formation. Specifically, a percentage increase in gross fixed capita formation increases output growth by 0.887%, 0.214%, 0.278%, and 0.822% for Nigeria, South Africa, Egypt, and Mauritius respectively. In terms of severity of the impact, the reported result shows that the effect is more in Nigeria followed by Mauritius, and Egypt. The result was significant for these countries except South Africa. This shows that gross fixed capita formation plays a greater role in the behaviour of output growth among the selected countries.

Domestic credit to the private sector impacted positively on output growth in all the selected countries. Specifically, a percentage increase in domestic credit to the private sector raises output growth by 0.167%, 0.392%, 0.046%, and 0.563 for Nigeria, South Africa, Egypt, and Mauritius respectively. In terms of the severity of the impact, the reported result shows that the effect is significant for Mauritius. The result was insignificant for the remaining countries. This shows the limited role of domestic credit on output growth.

A priori economic expectation about the relationship between per capita income and output growth indicates a positive relationship. As reported in all the countries, findings supported the apriori economic expectation for all the selected African countries. From the result, a percentage increase in per capita income raises output growth by 0.480%, 0.123%, 0.064%, and 0.296% respectively for Nigeria, South Africa, Egypt, and Mauritius. The result was significant for all the countries except for South Africa. As reported, output growth rises more in Nigeria followed by Mauritius, South Africa, and Egypt. The significance of the result indicates that per capita income is an important factor that determines output growth in all the selected countries except South Africa.

V. Conclusion and Policy Recommendation

The study investigated the impact of energy price inflation on output growth in four African countries with high misery index namely Nigeria, South Africa, Egypt, and Mauritius for the period covering 1981 to 2020. The presence of cross-sectional dependency and slope heterogeneity was confirmed among the variables in the selected countries. It was further confirmed that energy price inflation dampens output growth. The Konya Granger Causality results showed that energy price inflation drove output growth in all countries studied without distinguishing between net oil importers and net oil exporters. On the other hand, the Augmented Mean Group (AMG) estimation technique by Eberhardt and Teal (2010) showed that energy price inflation was significant in reducing output growth in the group and individual country analysis. However, the result was not significant in the case of Egypt. This points to the importance of energy price inflation for output growth in the countries under study.

In view of this conclusion, this study suggests that policies that help cushion the effects of imported energy price inflation be implemented to grow economies characterized by a high level of misery. Such policies include adopting cheaper and less volatile energy sources.

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