ANALYSIS OF THE IMPACT OF AUTOMOTIVE OIL GAS ON MANUFACTURING PERFORMANCE AMONG FIVE MAJOR INDUSTRIAL AFRICAN COUNTRIES

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Abstract

This study explores the impact of automotive oil gas on manufacturing performance in major industrial countries of Africa using a panel dataset spanning from 1980 to 2020. The study used fixed effect and random effect to establish the degree of the association between automotive oil gas and manufacturing performance among five major industrial African Countries Nigeria, Egypt, South Africa, Algeria and Mauritius. The empirical result from the study revealed that manufacturing sectors responded negatively to changes in the price of automotive oil gas over the sample period. This implies that manufacturing performance in Africa are prone to negative shock in the price of automotive oil gas because they rely heavily on automotive oil gas for operation due to a lack of energy substitute. The study recommends that there is a need for African countries to look for energy substitutes besides automotive oil gas such as renewable energy for the effective operation of their manufacturing sector.

Keywords: Automotive oil gas, fixed effects, random effects, manufacturing performance

Introduction

The manufacturing sector is largely seen as an essential passageway to the economic growth and development of any country. The current demonstration is the commencement of the African Continental Free Trade Area (AfCFTA) of 2018, which aims at providing a distinct market for goods and services in Africa to unlock the manufacturing

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perspective and smooth the progress of industrialization, driving sustainable growth and creating employment. The core advantage of the manufacturing sector is to attract the workforce as well as put them into creative and respectable paying jobs (Signe, 2018).

For instance, the manufacturing sector has changed the United States, and other developed economies into the richest country in the world. The manufacturing sector has placed China into one of the world's fastest-growing economies in the world. These are all illustrations of how manufacturing can assist in generating speedy structural change, drive development, and alleviate poverty and unemployment among other things (Signe, 2018).

In recent times automotive oil gas has been one of the key drivers of economic activity globally, this is due to its marvelous magnitude in the provision of international energy demand. The significance of automotive oil gas exceeds economic aspects and affects social life in general. Most of the productive sectors in African countries depend on the use of automotive oil gas to power their manufacturing plants to meet local and international demand. The heavy dependence on automotive oil gas as input in manufacturing activities, a major fraction of the firm's revenue which would have been directed into investment is used to meet energy shortage in the form of demand for automotive oil gas (Chen, Gummi, Lu & Mu'azu 2020).

The all-embracing use of automotive oil gas makes the various sectors of the economy prone to unanticipated price increases in automotive oil gas (Nwosa & Ajibola, 2013; Loungani, 1986). Fluctuations in the price of automotive oil gas have affected manufacturing performance through diverse transmission channels. On the supply side, the price of automotive oil gas shocks leads to increases in production expenditures, resulting in lower output. In the demand channel, a rise in automotive oil gas results in an increase in the cost of manufacturing output (Jiranyakul, 2016; Suhair & Al-Risheq, 2016).

Many studies have documented the economic effects of automotive oil gas price increases or decreases, and they typically show that for oil-importing developed economies a given automotive oil gas price increase is destructive to macroeconomic indicators, especially

manufacturing performance. Kumar (2009), Jiménez-Rodríguez and Sanchez (2012) and Wang and Zhang (2014) are of the view that a raise in automotive oil gas lowers manufacturing production and, through higher manufacturing costs, affects output and economic growth. According to Bjornland (2009) confirm that the effect of automotive oil gas positively affects the manufacturing performance of a country by improving its revenue or income thereby leading to economic growth. He also affirmed that an increase in the price of automotive oil gas affects manufacturing performance negatively leading to a reduction in its revenue or income and also a rise in the cost of output.

It is therefore against this background that this work intends to explore the impact of automotive oil gas on manufacturing performance among five major industrial African countries. To validate the aforementioned objective the following null hypothesis will be tested.

Research Hypothesis

H_0: There is no relationship between automotive oil gas and manufacturing performance among five major industrial African countries

H_0: There are no other determinants of automotive oil gas among five major African countries

Literature Review

Theoretical Literature

The price of oil affects manufacturing performance in diverse ways. Such as supply and demand channels, wealth effects channels, and real balance transmission channels among others.

Supply and demand channel, the rises in oil prices increase production costs and lead to a contraction in output. This contraction in output increases further due to a resulting reduction in investment, this is from the supply aspect. Hence, on the demand side, an increase in the costs of production, owing to an increase in oil prices, translates into higher product prices. Thus, aggregate productivity falls (Brown & Yucel, 2002).

The theoretical basis regarding the effects of automotive oil gas on manufacturing performance in Africa is that there underlying factors, lower price of automotive oil gas could be a cause that driving manufacturing performance. The lower price of automotive oil gas could be also a response as a result of shock which affects global manufacturing performance. Several empirical revealed that supply and demand factors add to the fall in oil prices, but a larger proportion comes from the supply factors (Hunt, Isard, & Laxton, 2001). This study, therefore, is anchored on supply and demand channel transmission.

Empirical literature

Chen et al. (2020) investigated oil price fluctuations in food prices in high and low-income oil-exporting countries using quarterly panel datasets over the period 2013 – 2019 by applying FMOLS and DOLS for the analysis of the parameters. Results show a positive and significant connection between oil prices and food prices in low-income countries. Other results revealed a negative and significant link between oil prices and food prices in high-income exporting countries.

Gummi et al. (2018) examine the effect of oil price fluctuations on manufacturing performance in Nigeria using an annual time series dataset spanning from 2009 to 2017. The study employed ARDL for the estimation of the parameters. Results from the study show a positive and significant relationship between oil price and manufacturing performance.

Suhair and Al-Risheq (2016) explored the effect of oil prices on industrial production in developing countries using an annual panel dataset spanning from 1970-2002, the study applied fixed effect techniques for the analysis. Results from the findings indicated that oil price has negative and statistically significant effects on industrial production. The study concludes that oil price shock has a significant negative effect on the industrial production of developing countries. The study suggested that among other things improvement in the oil reserve in the developing countries to reduce the weakness to oil shocks.

Jiranyakul (2016) examined the reaction of industrial production to oil prices in Thailand for the period 1993 to 2015. The study employs multivariate test techniques for the analysis. Results from findings indicated a long-run bond between industrial production and oil price. Other results also show a long-run causal relationship running from lending rate, to oil price level. Also, industrial growth does respond to oil price uncertainty.

Taghizadeh-Hesary and Yoshino (2014) explored the economic impact of oil price volatility in developing and emerging countries of Japan, the USA, and China using the annual panel dataset over the period 1973 – 2013. The study employed the LR test for the estimation of the parameters under investigation. The empirical result from the study revealed no relationship linking oil prices and economic growth in China. Other results revealed positive and statistical associations between oil prices and economic growth in Japan and the USA throughout the sample period.

Nwonsa and Ajibola (2013) investigated the effect of gasoline prices on economic sectors in Nigeria by applying an annual time series dataset spanning from 1980-2010. The study employed co-integration and error correction model techniques for the estimation of both short-run and long-run relationships among the variables. The results from the study revealed that gasoline price has positive significant effects on all the variables except for building and construction sectors in the long run. The results of the short-run relationship between gasoline price and other independent variables show that gasoline price affects only the output of the agriculture and manufacturing sectors in Nigeria. The study recommended among other things stable supply of electricity to reduce over-dependence on gasoline as a major source of power.

Berument, Ceylan and Dogan (2010) investigated oil price shocks on the economic growth of Libya, Algeria, Egypt, Djibouti, Morocco and Tunisia using annual panel dataset over the period 1952 to 2005. The study used the Vector Autoregressive (VAR) model for the estimation of the relationship between oil price shock and economic growth. The results of the study revealed that there is a positive and statistically significant association between oil price shock and

manufacturing outputs in Algeria and Libya. Other empirical results from the study show that there is a negative relationship between oil price and output performance in Egypt, Djibouti, Morocco and Tunisia. Papapetrou (2009) investigated the asymmetry effect of oil price changes on industrial production in Greece using an annual time series dataset from 1982-2008. The study employed a regime-switching model (RS-R) and a threshold model (TA-R) to examine both the relationship and the presence of asymmetries between oil prices and industrial production. The findings from both RS-R models suggested that oil prices negatively and significantly affect industrial production when oil prices increase more than 3% monthly. Furthermore, empirical findings from the TA-R model suggested that oil price changes significantly and negatively affect industrial production only when oil price volatility is higher than 0.22% per month.

Jiranyakul (2006) investigated the impact of international oil prices on the industrial production of Thailand by applying annual time series for the period 1990 - 2004 using a Johansen co-integration technique. The result of the study indicated that oil prices significantly and positively affect industrial production. The authors disagree that, in the long run, the manufacturing sector can adjust itself to higher costs of production. However, in the short run, the real money supply, real exchange rate, and international oil prices affect industrial production. Reyes and Quiros (2005) investigated the impact of industrial production and stock returns on oil prices in Granada using a monthly time series dataset spanning from 1963 - to 2004. The study used the Markov switching model and maximum likelihood test. Results from the study show the existence of a negative and statistically significant effect of oil prices on both variables throughout the sample period, but the effect of oil prices on stock returns was higher than on industrial production.

Jiménez-Rodríguez and Sanchez (2012) conducted a study to empirically test the relationship between oil price shocks and real economic activity in the industrialized OECD countries of France, the US, the UK, the Euro area, Norway, Japan, Germany, Italy, and Canada by applying quarterly panel dataset over the period 1972 – 2001. The

study employed a vector autoregressive (VAR) using linear and non-linear models. The results revealed that a rise in oil prices has a negative and significant effect on the economic growth of oil-importing countries excluding Japan. While the effect of oil shocks on GDP growth differs between the two oil-exporting countries in the sample, the increase in oil prices affects the output of the UK negatively and Norway positively.

Lee and Ni (2002) analyzed the effect of oil price shocks on demand and supply in different industries in the US using an annual panel dataset spanning from 1959 – 1997. The study employed a reduced form of vector autoregressive (VAR) and an impulse response function for the estimation of the parameters. Results show that there is a negative significant effect between oil price and industrial output. The result of the study revealed that oil price shocks reduce the supply of oil-intensive industries and reduce the demand of many other industries, especially the automobile industry.

Nevertheless, many of the empirical works focus their study on Individuals and employ less robust techniques of analysis. Thus, this study intends to fill the research gap by employing panel regression techniques to capture more countries for more effective and better results.

Data and Methodology

Data

The data used for this study is secondary data; the dataset was sourced from the statistical bulletin of the Central Bank of Nigeria and the World Bank Indicator (WBI). The study employs a panel dataset for the estimation of the parameters. The data collected cover a period of 40 years. This study examines the impact of automotive oil gas on manufacturing performance among five major industrial African Countries Nigeria, Egypt, South Africa, Algeria and Mauritius over the period 1980 to 2020.

Methodology

Model Specification

This study adapts the econometric model with modification which is in line with the work of Chen et al. (2018) and Gummi (2020).

MPA = f (AOG, EXR, INFR, INR) …….....(I)

Where MPA represent the Manufacturing performance, AOG denotes Automotive Oil Gas, EXR is the Exchange rate, INFR represents the Inflation Rate and INR is the Interest Rate. Thus the equation above can be rested into an econometric model as follows: $MPA_{it}\ \beta + \beta_1 AGO_{it} + \beta_2 EXR_{it} + \beta_3 INFR_{it} + \beta_4\ INR_{it} + \delta_t$ …….(II)

Where β_0 is the Constant term, β_{1-4} represent Parameters to be estimated, δ_t connote the Error term or Disturbance term.

Methods of Data Analysis

The test estimation used for this study includes descriptive and inferential test. Descriptive statistics helps to simplify large amounts of data sensibly by reducing lots of data into simpler summaries (Jaggi, 2012). Descriptive statistics can be numerical and graphical form. Descriptive technique is concerned with summarizing and drawing conclusions via frequencies, percentages, mean, median, maximum, minimum, bar charts, pie charts, graphs, etc (Salvatore & Reagle, 2002; Garba, 2021).

The Inferential technique is concerned with data analysis by testing hypotheses and drawing conclusions based on the statistical significance of the estimated parameters of the model (Salvatore & Reagle, 2002; Garba, 2021). The inferential statistics used in this study includes fixed effect and random effects.

According to Gujarati (2007), if T, which is the number of time series data, is greater than the number of cross-sectional units, the fixed effect is more suitable. This is known as the long panel dataset. The fixed effects, unlike the ordinary least squares, consider heterogeneity across groups and time, for this reason, the estimates from the fixed effects model are more efficient (Toress, 2010).

According to Hauser (2010) argues that the assumption that individual intercepts must be uncorrelated with the error term before random effects can be used is usually violated in the long panel, hence making the random effects model inconsistent. According to him, one of the immediate solutions is to use fixed effects. On the other hand, Gujarati (2007) sums up all these views about the choice of fixed or random effects by stressing that, if the panel is long, that is the number of time series T is larger than the number of cross-sectional units N, there is likely to be little difference in the values of the parameters generated by both fixed and random effects.

Consequently, the choice is based on computational convenience and consequently, he advised that fixed effects are preferable in this circumstance. Since our data is from 1980 to 2020 (i.e. 40 years) and the number of countries under consideration is only five, the choice of the fixed effects model appears appropriate (Omolade & Ngalawa, 2014).
The fixed effects are used to analyze the association of variables that vary over time. Each entity has its characteristics that may or may not influence the predictor variables for instance, being a male or female could influence the opinion toward certain issues; or the political system of a particular country could have some effect on trade or GDP, or the business practices of a company may influence its stock price.

The fixed-effects model controls for all time-invariant differences between the individuals, so the estimated coefficients of the fixed-effects models cannot be biased because of omitted time-invariant characteristics. The Fixed Effect Model (FEM) assumes that something within the individual may impact or bias the predictor or outcome variables and we need to control for this (Oscar, 2007). The fixed effects model can be specified as follows:

$Y_{it} = \beta_1 X_{it} + \alpha_i + \mu_{it}$ ……... (III)

Where: Y_{it} represents the dependent variable, β_1 is the coefficient of the parameters, X_{it} is the independent variables, i represent the entity, t is the time, α_i is the unknown intercept for each entity and μ_{it} rit represented or term.

Random effects model unlike the fixed effects model, the variation across entities is assumed to be random and uncorrelated with

the predictor or independent variables included in the model. The advantage of random effects over the fixed effects model is that time-invariant variables can be included or captured. The Random Effects Model (REM) assumes that the entity's error term is not correlated with the predictors which allows for time-invariant variables to play a role as explanatory variables (Oscar, 2007). The Random Effects Model can be specified as follows:

$Y_{it} = \beta X_{it} + \alpha_i + \mu_{it} + \varepsilon_{it}$ ……..(IV)
Where: represents the dependent variable, β_1 is the coefficient of the parameters, X_{it} is the independent variables, i represent the entity, t is the time, α_i is the unknown intercept for each entity and μ_{it} rit represents error term.

To decide between fixed or random effects one can run a Hausman test where the null hypothesis is that the preferred model is a random effect Model with the alternative the fixed effects. The null hypothesis that individual effects are not correlated with any of the model's regressors was rejected (Oscar, 2007).

Consequently, with systematic differences in the coefficients, a fixed effect model was considered more suitable, thus the choice of fixed effect estimation. That is to say, the null hypothesis of this test is that the difference between the Fixed Effect Model and Random Effects estimations is not significant. If the null is not rejected, then they are not significantly different; in this respect, we use the Fixed Effect estimator since it is efficient. The alternative hypothesis here is that there is a significant difference between Fixed Effects and Random Effects. As a result of this, if the null hypothesis is rejected, it means there is a significant difference between the Fixed Effects and the Random Effects, following this, we use the average estimator (Oscar, 2007). $H_0 = E(X, \mu) = 0$ ……. (V)

$H_1 = E(X, \mu) = 0$ …… (VI)

Results and Discussion

Descriptive Statistics

This section presents the descriptive statistics test to see the nature of the trends among the parameters.

Table 1.1 Descriptive Statistics Test for the Five African Countries

Variable	Obsr.	Mean	Medi.	Std.dev.	Min.Val.	Mx.Val.	Skew.	Kurt.
MPA	203	0.4460	0.3210	0.6183	-1.2801	2.0506	0.7258	3.3863
AGO	203	-0.3958	-0.3468	0.4076	-1.6990	0.1399	-0.8936	3.7576
EXR	205	40.2715	13.3238	62.9905	0.6100	379.000	2.7481	11.7905
INFR	205	11.1070	8.4758	10.3946	-0.6920	72.8355	2.8968	13.8260
INR	205	14.8779	15.0833	4.6683	8.0000	31.6500	0.1687	2.4931

Source: Author's Computation, Eviews 10

Table 1.1 shows the descriptive statistics of the panel dataset covering five (5) African countries with two hundred and five (205) observations for the period of forty years (40). The main statistics are the mean, standard deviation, maximum and minimum values of the variables over the selected number of years. Attention is given to manufacturing performance (MPA) and automotive oil gas (AOG) as the main variables of interest.

The average mean value of the manufacturing performance (MPA) is 0.4460 with a standard deviation of 0.6183 showing a high variation. This implies that a one standard deviation shock in automotive gas oil has a positive or negative effect on manufacturing performance. The average mean value of 0.4460 for manufacturing performance implies that the mean value lies at the lower end of the distribution. The highest value of manufacturing performance is 2% and the lowest value of manufacturing performance is -1%. This implies that the mean value drifts toward the lower end as suggested earlier.

The value of the skewness is 1.4198, indicating that the manufacturing performance is skewed to the right. On the other hand,

the average mean value of the automotive oil gas (AOG) is -0.3958. The value shows that the mean lies at the lower end of the distribution. Comparatively, the mean value of -0.3958 of automotive oil gas falls at the lower end of the distributions, which is an indication that automotive oil gas is relatively lower when compared to the mean value of manufacturing performance.

Fixed Effects Model and Random Effect

This section presents the result of the fixed effect and random effect for the estimation of the effect of automotive oil gas on manufacturing performance in African countries.

Table 1.2 Fixed Effects and Random Effect Model for the Five African Countries

Dependent Variable: LMPA								
Variables	Fixed Effect				Random Effect			
	Coef.	Std. Er.	T-Stat.	P-Value	Coef.	Std. Er.	T-Stat.	P-Value
LAGO	-0.5099	0.1968	-2.5913	0.0103	-0.2074	0.0960	-2.1590	0.0321
EXR	-0.0043	0.0010	-4.2880	0.0000	-0.0011	0.0006	-1.9842	0.0486
INFR	-0.0027	0.0042	-0.6533	0.5143	-0.0082	0.0041	-1.9998	0.0459
INR	0.0503	0.0086	5.8218	0.0000	0.0374	0.0085	4.4457	0.0000
R^2: 0.39, Adj. R^2: 0.36, F-Sta.: 15.04, Prob. F-sta.: 0.0000					R^2: 0.09, Adj. R^2: 0.07, F-sta.: 4.84, Prob. F-statistics: 0.0001			
Hausman test	Chi-square St.		0.0000					

Source: Author's Computation, Eviews 10

Table 1.2 shows the result of the fixed effect and random effect estimation for the five African countries under investigation. The result of the Hausman test revealed that the fixed effects model is more desirable. This is because the probability value of the Hausman test is statistically significant at a 1% level of significance. For this reason, the result of the random effect estimation was rejected which led to the acceptance of the fixed effect result.

The fixed effect estimation result revealed that there is a negative and statistically significant relationship between automotive oil gas and manufacturing performance in African countries. A 1% increase in the price of automotive oil gas will lead to a about 0.51% decrease in manufacturing performance in African countries, justifying the theoretical argument that an increase in the automotive oil gas affects the performance of the manufacturing performance. This implies that for African countries there is an inverse relationship between automotive oil gas and manufacturing performance. This implies that an increase in the price of automotive oil gas decreases manufacturing performance. This is because most of the manufacturing sector in African countries depends largely on automotive oil gas to power their manufacturing plants due to irregular supply from the power holding company (electricity) and inadequate energy substitutes. This conforms with the work of Omolade and Ngalawa (2014), Wang and Zhang (2014).

Conclusion and Policy Recommendation

Conclusion

This study presented evidence of the impact of automotive oil gas on manufacturing performance among five major industrial African countries. Result revealed that there is a negative and statistically significant relationship between automotive oil gas and manufacturing performance among the major industrial African countries. This implies that there is an inverse association between automotive oil gas and manufacturing performance among the five African countries throughout the sample period.

Furthermore, the degree of the coefficient, which is considerably large, indicates the significance of automotive oil gas in determining the manufacturing performance of African countries. The study concluded that automotive oil gas affects the manufacturing performance in the major industrial African countries. The manufacturing sector in African countries reacts negatively to shocks in the price of automotive oil gas. This may be because the African countries rely heavily on automotive oil gas to power their manufacturing plant.

Policy Recommendation

1. The study recommends among other things alternative sources of energy so that an increase in the price of automotive oil gas will have less effect on the manufacturing performance in African countries.
2. There is a need for upcoming researchers to look at other determinants of manufacturing performance in Africa besides automotive oil gas such as exchange rate, foreign direct investment, technology, trade openness, interest rate, gross capital formation and labour force among others.

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