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AUTOREGRESSIVE DISTRIBUTED LAG ERROR CORRECTION MODELING OF SOME MACROECONOMIC INDICES IN NIGERIA

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Abstract
This study models a relationship between gross domestic product, motor vehicle assembly and oil refining in Nigeria between 1981 to 2022. The autoregressive distributed lag error correction model (ARDL-ECM) was introduced to evaluate the relationship existing among the variables under consideration. Annual data from 1981 to 2022 (41 observations) were extracted from the National Bureau of Statistics Bulletin 2021. Pre-estimation tests such as time plots and unit root tests were conducted to determine the presence or absence of unit roots in the series. The result shows a mixed order of integration as motor vehicle assembly was stationary at a level while oil refining and gross domestic product were integrated at first difference. This prompted the application of the Autoregressive Distributed Lag (ARDL) bounds test of cointegration and the analysis shows the presence of a long-run relationship among the variables. Lag 3 was chosen using Akaike Information Criteria (34.02331*). The estimates from the error correction model analysis infer that oil refining had a strong effect on gross domestic product and the combined lags of oil refining and motor vehicle assembly significantly caused own shocks in the short-run. Post estimation test of stability (CUSUM test) shows that the model was stable and the serial correlation test also confirms this assertion that the residuals obtained were serially uncorrelated. Some recommendations were made to reduce macroeconomic instability in Nigeria.

Keywords: Autoregressive, Error correction, Macroeconomics Indices, Distributed Lag.

Introduction

If Nigeria and other emerging nations want to achieve economic stability, they must understand the complex interaction, development, and interconnectedness of their macroeconomic indices. Disequilibrium in endogenous variables and volatility in macroeconomic indicators are the shocks that cause economic instability. This is true in Nigeria and other nations. While certain economic indicators may show sudden swings in the near term, when taken into account with other factors, they usually show stability and predictability in the long run. Most real-life occurrences are as complex as these phenomena. One statistical tool for estimating the strength of a link between variables is the error correction model (ECM). In it, we look at the degree of imbalance between the two variables, how their changes affect each other, and how each variable has changed historically. When working with a collection of concurrent variables, Sim (1980) suggests not distinguishing between endogenous and exogenous variables. The intrinsic volatility of the data makes economic time series prediction problematic. The ability to make well-informed judgements, as well as economic development and investment, are all hampered by unpredictability. To bridge the gap between static equilibrium theory and dynamic empirical models, Sargan (1964) proposed the autoregressive distributed lag (ARDL) model. When looking at the past data of several exogenous variables, the Autoregressive Distributed Lag (ARDL) model may determine the long-run equilibrium connection between one endogenous variable and all of them (Sargan, 1964). Pesaran, et al (2001), states that one multivariate time series model that addresses causality and improves the accuracy of result forecasts is the Autoregressive Distributed Lag-Error Correction Model. This model takes into account corrections for deviations from earlier periods. The results will be more reliable if long-term level changes are included in the data. The economic output, oil refining industry, and automobile assembly sector of Nigeria are the focus of this research.

An important research that looked at the patterns in unemployment, inflation, and public debt in Nigeria from 1985 to 2020 was done by Shuaibu et al. (2021). The data was analyzed using the autoregressive distributed lag model (ARDL) error correction model. To assess the model's performance and predictive power, we used unit root and Granger causality tests (Granger &Weiss, 1983). Unemployment in Nigeria has been dropping in tandem with the country's governmental debt. There is a link between rising unemployment rates and the national debt. It would be wise for the government to reduce public debt and prioritize home debt over international debt if borrowing becomes required. Ajisafe (2016) used data from 1986 to 2014 to examine the correlation between poverty and corruption in Nigeria. Secondary data for the study came from the Country Risk Guide (2012) and the Worldwide Bank Development Indicator (2015). Autoregressive distributed lag model (ARDL) and principal component analysis were used in the development of the poverty index. Evidence suggests that corruption has negative effects on people and communities. The appropriate government agency should act to fight corruption, according to recommendations. Research by Chandio et al. (2019) used the Autoregressive Distributed Lag (ARDL) method with an Error Correction Model (ECM) to examine the wheat output and support price in Pakistan. The effect of wheat support prices on Pakistan's wheat output from 1971 to 2016 is the subject of this research. Every year, researchers in Pakistan may access extensive statistical data via the Pakistan Economic Survey. Autoregressive distributed lag (ARDL) and error correction models were used in the investigation. A favourable correlation between farmed area, support price, fertilizer usage and the increase in wheat production over time was found in the ARDL limits test.

Using the Autoregressive Distributed Lag (ARDL) method with the Error Correction Model (ECM), Guan et al. (2015) examined the connection between urbanization, energy consumption, and GDP growth in Jiangsu, China, in 2015. One statistical tool for finding cointegration is the autoregressive distributed lag (ARDL) bound test. The ARDL error correction model (ARDL-ECM) is used to calculate the short-run and long-run coefficients once the long-run equilibrium has been confirmed. An increased reliance on energy resources is a direct outcome of the urbanization that has propelled Jiangsu's economic progress. We have offered a sustainable answer to the problems caused by urbanization that also guarantees the continuation of economic growth, all while being energy efficient.
Adeleye et al. (2017) used ARDL and ECM methodologies to study the progress of credit and financial reforms in Nigeria. Using yearly data from 1980 to 2016, this research analyses the impact of financial reforms on the expansion of credit in Nigeria. A rise in real interest rates, as gauged by credit growth, increases financial intermediation, according to the autoregressive distributed lag error correction representation and bounds testing method. Additionally, the presentation covers the long-term correlation between domestic credit, the real interest rate, and its regressors.

Aim and Objectives of the Study

In particular, we want to track the variables' historical changes, model and estimate the interplay between Nigeria's gross domestic product (GDP), vehicle assembly, and oil refining, and determine the nature and strength of the relationships between these three variables.

Materials and Methods

This aspect deals specifically with the research design, source and type of data, methods of data analysis and model specification. The type of research design used for the study is the causal-comparative/Quasi-experimental research design which attempts to establish cause-and-effect relationships between variables. Using yearly time series data on GDP, MVA, and ORN from 1981 to 2022, the research examined the effects of oil refining on the economy. The information is derived from the 2022 edition of the National Bureau of Statistics bulletin. Eviews, version 10 (2020 release) from HIS Markit, is used for data analysis. The study relied on ARDL and ECM techniques to achieve its goals. Cointegrated vector autoregressive models, VAMs of the first difference, and mixed order of integration are the approaches to which these terms pertain. We first checked for consistency in the series' means and variances changing over time using a unit root test and an autoregressive distributed lag (ARDL) bounds test. Also, we checked to see whether the variables under study, both internal and external, are in an equilibrium condition over the long run.

Error Correction Model

One way to show how a time series variable is getting closer to equilibrium is by using the error correction model to account for times when it was out of whack. Stock (1987) showed that the error correcting system efficiently estimates disequilibrium. If the vector autoregressive variables show integration of order one or higher, predicting unconstrained parameters in a regression model with nonstationary variables might be challenging. Nevertheless, the inclusion of nonstationary variables raises the probability of cointegrating equations. Ankargren and Lyhagen (2018) found that when it comes to economic time series modelling, the Error Correction Model (ECM) is the most successful strategy.

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Pre-Estimation Test

Asking questions about the study variables' traits and actions is a more reasonable approach to conducting a pre-estimation test. The unit root and ARDL bounds tests were the first steps in the investigation.

Unit Root Test

Time series data analysis becomes more complicated when a unit root is present. Phillips-Perron unit root test and Augmented Dickey-Fuller test were used in the investigation. According to the null hypothesis, all of the variables in question have unit roots. According to the null hypothesis, the equation's root is nonexistent. The null hypothesis is rejected at a 5% significance level if the test statistic of the Augmented Dickey-Fuller (ADF) test is greater than the crucial value. In the absence of such a meeting, we will accept the alternative hypothesis and reject the null. If the null hypothesis is rejected, then the series has no unit root, zero mean, and constant variance across time.

The ARDL Bounds Test

Time series data analysis becomes more complicated when a unit root is present. The Augmented Dickey-Fuller and Phillips-Perron unit root tests were used in the investigation. A ccording to the null hypothesis, all of the variables in question have unit roots. According to the null hypothesis, the equation's root is nonexistent. With an Augmented Dickey-Fuller (ADF) test, we may reject the null hypothesis at the 5% level of significance if the test statistic is greater than the critical value. In the absence of such a meeting, we will accept the alternative hypothesis and reject the null. If the null hypothesis is rejected, then the series has no unit root, zero mean, and constant variance across time.

H_o: $\lambda_1 = \lambda_2 = \lambda_3 = 0$ (No long-run relationship exists)

H_1: $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq 0$ (Long run relationship exist)

Once cointegration is established the Akaike information criteria (AIC) is used to select the order of the ARDL (p, q_1, q_2) model

ARDL Model Specification

A correlation analysis between variables that indicate macroeconomic stability and trade interaction will be conducted using the models mentioned in this article. The VAR and ARDL models, which stand for autoregressive distributed lag, will be examined in this section.

VAR Model

The specification of the regression model with two explanatory variables and a functional k-dimensional VAR (p) which we can write as

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \ldots + \alpha_p Y_{t-p} + BX_t + \mu_t \qquad (1)$$

while

$Y_t = (Y_{1t}, Y_{2t}, Y_{3t}, \ldots Y_{kt})$ is a Kx1 vectors of the endogenous variable

$X_t = (X_{1t}, X_{2t}, \ldots X_{dt})$ is a dx1 vector of exogenous variable

$\propto_1 \cdot \propto_p$ are k x k matrix of the lag coefficient to be estimated.

B is the d x d matrix of the coefficient of the exogenous variable

$\mu_t = (\mu_{t1}, \mu_{t2}, \ldots \mu_{kt})$ white noise process to be estimated with E $(\mu_t) = 0$

If Y_t is not perturbed by exogenous time series of d-dimension

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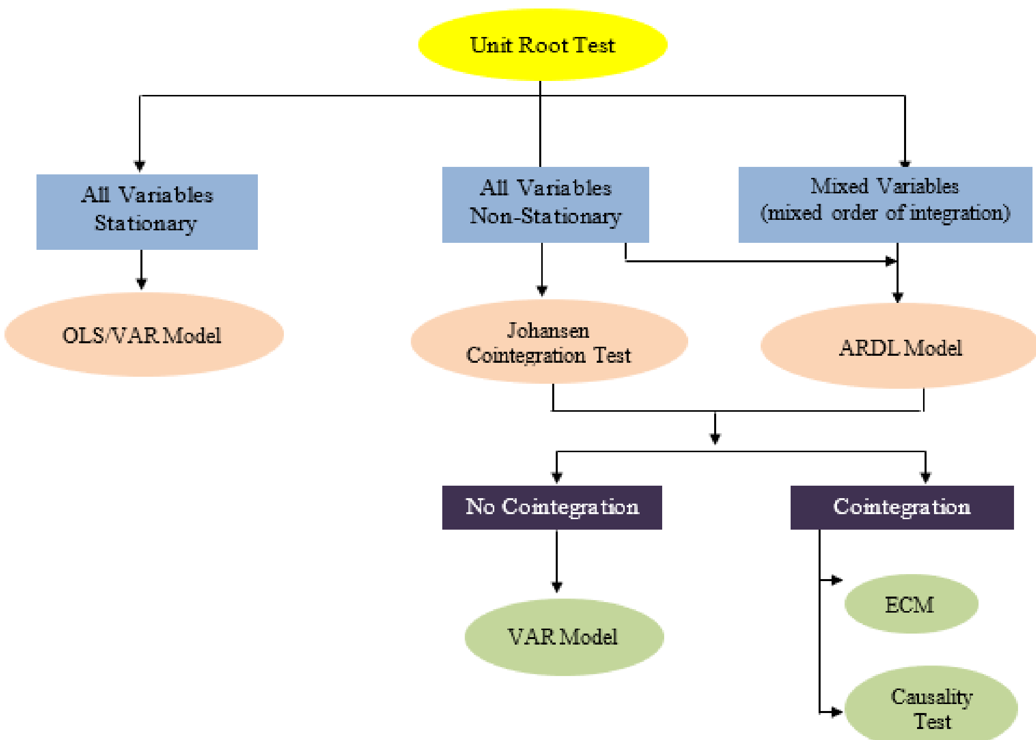
$X_t = (x_{1t}, x_{2t}, \ldots .\, x_{dt})$ Then the VAR model in equation (1) can be specified thus;

$$Y_t = \propto_0 + \propto_1 Y_{t-1} + \propto_2 Y_{t-2} + \ldots + \propto_p Y_{t\,p} + \mu_t \qquad (2)$$

$$Y_t = \propto_0 + \sum_{t-1}^{p} \propto_1 Y_{t-1} + \mu_t \qquad (3)$$



OLS: Ordinary least square
VAR: Vector Autoregressive; ARDL: Autoregressive distributed Lag
ECM: Error Correction Model

Figure 1: Method for Selection Flow Chart for Time Series

ARDL Models

Equation (3) may be derived from equations (1) and (2), which might provide light on the long-term vector link. When estimating I(1) variables, the autoregressive distributed lag model works best when at least one co-integrating vector is present. The purpose of the error correction model (ECM) is to deal with imbalances and variances that are only temporary. Hence, it provides a solid basis for investigating the dynamics and characteristics of the co-integrating series over the long and short terms. Hence, it provides a solid basis for investigating the dynamics and characteristics of the co-integrating series over the long and short terms.

The standard form of the ECM

$$\Delta Y_t = \propto_0 + \propto_1 ECT_{t-1} + \sum_{t=1}^{p} \beta_1 \Delta Y_{t-1} + \mu_t \qquad (4)$$

The ARDL model with the three variables including the ECM term is prescribed as;

$$\Delta GDP = \alpha_1 + \sum_{t=1}^{p} \phi_1 \Delta MVA_{t-1} + \sum_{t=1}^{p} \theta_1 \Delta ORN_{t-1} + \sum_{t=1}^{p} \beta_1 \Delta GDP_{t-1} + \lambda_1 ECT_{t-1} + \mu_{t,1} \quad (5)$$

$$\Delta MVA = \alpha_2 + \sum_{t=1}^{p} \phi_2 \Delta MVA_{t-1} + \sum_{t=1}^{p} \theta_2 \Delta ORN_{t-1} + \sum_{t=1}^{p} \beta_2 \Delta GDP_{t-1} + \lambda_2 ECT_{t-1} + \mu_{t,2} \quad (6)$$

$$\Delta GDP = \alpha_3 + \sum_{t=1}^{p} \phi_3 \Delta MVA_{t-1} + \sum_{t=1}^{p} \theta_3 \Delta ORN_{t-1} + \sum_{t=1}^{p} \beta_3 \Delta GDP_{t-1} + \lambda_3 ECT_{t-1} + \mu_{t,3} \quad (7)$$

Where:

GDP	-	Gross Domestic Product
MVA	-	Motor Vehicle Assembly
ORN	-	Oil Refining
λ	-	Speed of Adjustment
ECT	-	Error Correction Term
μ_t	-	Impulse
P	-	Maximum Lag Length
$\propto$	-	Intercept
Σ	-	Summation
Δ	-	Difference Operator
ϕ, θ, β	-	Short run coefficients

Post Estimation Test

Post-estimation diagnostics reveal coefficient robustness. Diagnostic tests differ by modelling technique. The most frequent diagnostic tests are lag structure analysis, residual diagnostics, and stability diagnostics. The proposed study will use Breusch-Godfrey LM, heteroscedasticity, and CUSUM stability tests. This is because regression models minimize independently and identically distributed residuals. Shrestha, et al (2018) emphasizes the stability diagnostic, which evaluates projected parameter stability across data subsamples.

Results

Descriptive Analysis

Table 1: Summary Statistics of GDP, MVA and ORN

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	GDP	MVA	ORN
Mean	37710.48	54.70914	112.8283
Median	26658.62	26.29305	50.52811
Maximum	72393.67	590.7699	344.7107
Minimum	16048.31	6.409610	19.29784
Std. Dev.	20309.83	96.39589	91.89624
Skewness	0.575311	4.548605	0.827408
Kurtosis	1.704524	24.86834	2.506713
Jarque-Bera	5.128737	958.3465	5.093822
Probability	0.076968	0.000000	0.078323
Sum	1546130.	2243.075	4625.961
Sum Sq. Dev.	1.65E+10	371686.7	337796.8
Observations	41	41	41

GDP, MVA, and ORN statistics are summarized in Table 1. GDP, MVA, and ORN average 3,771,048, 54.70914, and 112.8283, respectively. Minimum GDP, MVA, and ORN are 16,048.31, 6.409610, and 19.29784. GDP maxes out at 72393.67, MVA at 590.7699, and ORN at 344.7107. GDP has platykurtic kurtosis, with a typical skewness of 0.83, below the criterion of 3. MVA has a strong right tail, showing positive skewness and leptokurtic behaviour, with a value of 4.5, above the criterion of 3. The summary data show GDP, MVA, and ORN standard deviations of 20309.83, 96.39589, and 91.89624. Departure from the sample mean. Jarque-Bera statistics evaluate series skewness and kurtosis against a normal distribution. The alternative hypothesis is accepted since the probability value of 0.077 surpasses 0.05. Thus, GDP does not follow a normal distribution, refuting the null hypothesis. Jarque-Bera test was used for analysis. Since its probability value exceeds 0.05, the observable response variable (ORN) does not have a normal distribution. MVA follows a normal distribution.

Time Plot

This was done to show the pattern of the series over time and it is the starting point in the analysis of time series data. Figure 1 (series 03) shows GDP statistics in a temporal pattern and the data shows that GDP has steadily increased, with moderate increases in 1982 and 2015. This shows sustained GDP growth. Motor Vehicle Assembly data shows a rising trend in 1982 (Figure 2) and considerable volatility in 1983. Throughout the measured period, the trend line slope changed very little. Figure 3 (series 01) shows oil refining data rising and may fall after a steady and fast variation in 2013. Most of the trend is upward then a significant fluctuation indicating oil refinery decrease.

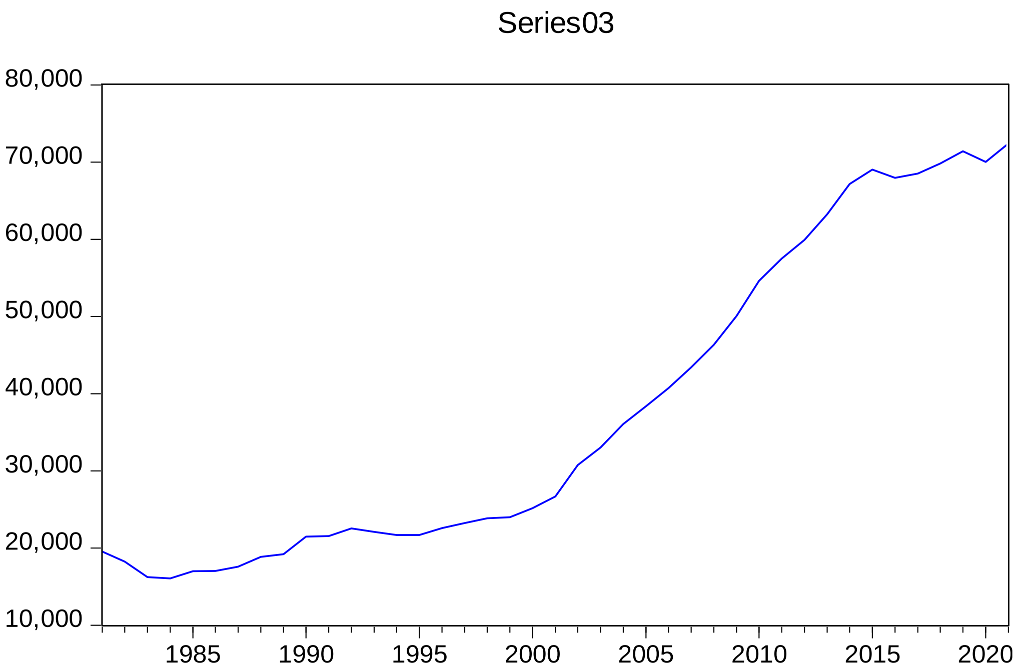


Figure 1 displays a time plot illustrating the raw data for GDP

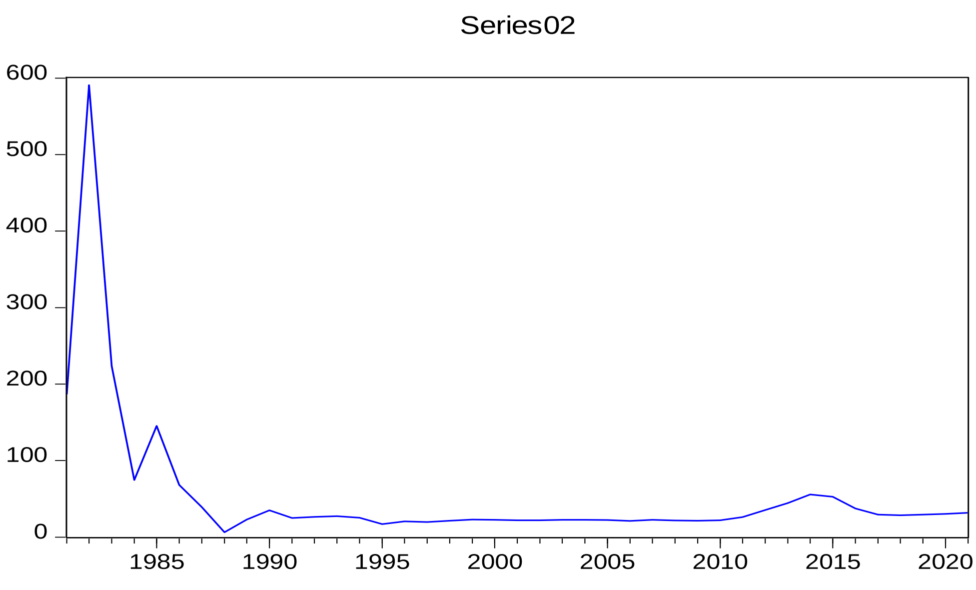


Figure 2 displays a time plot illustrating the raw data for MVA

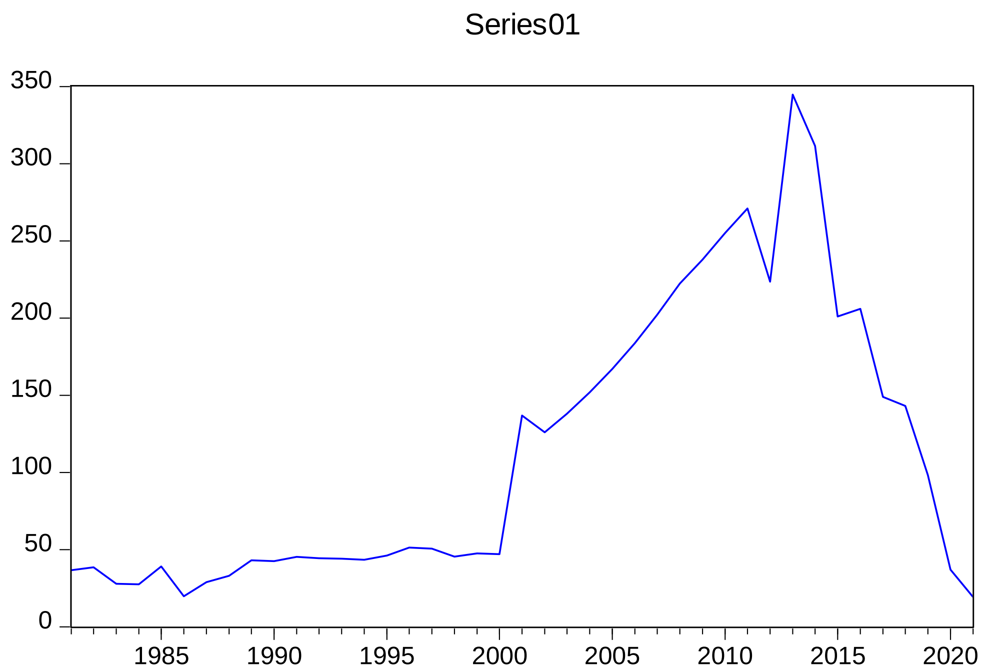


Figure 3 displays a time plot for raw data on ORN

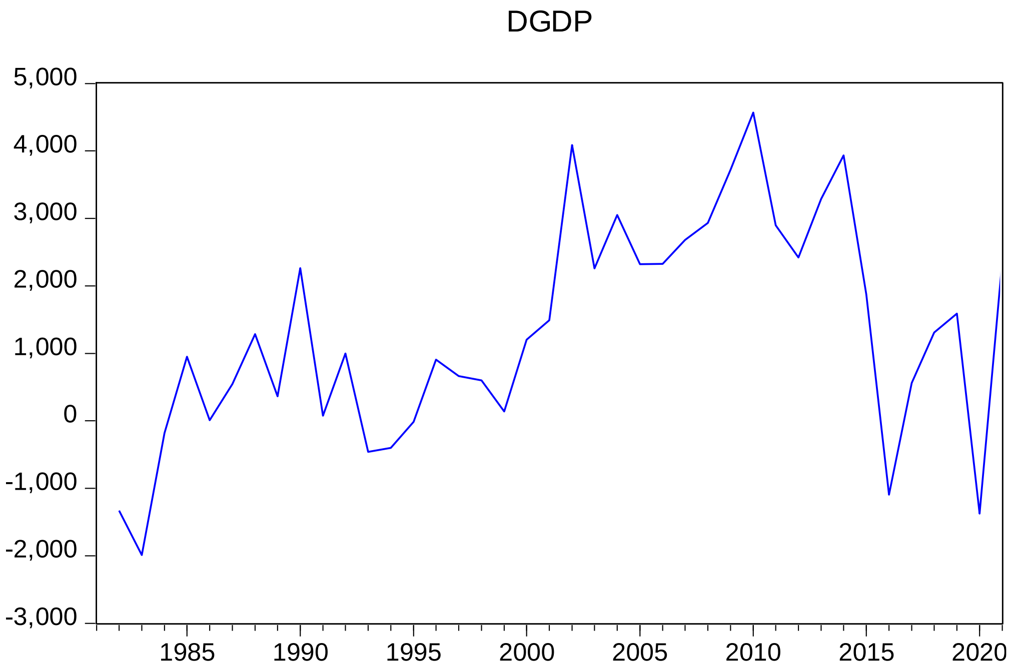
Table 2: Unit Root Test Result at Level

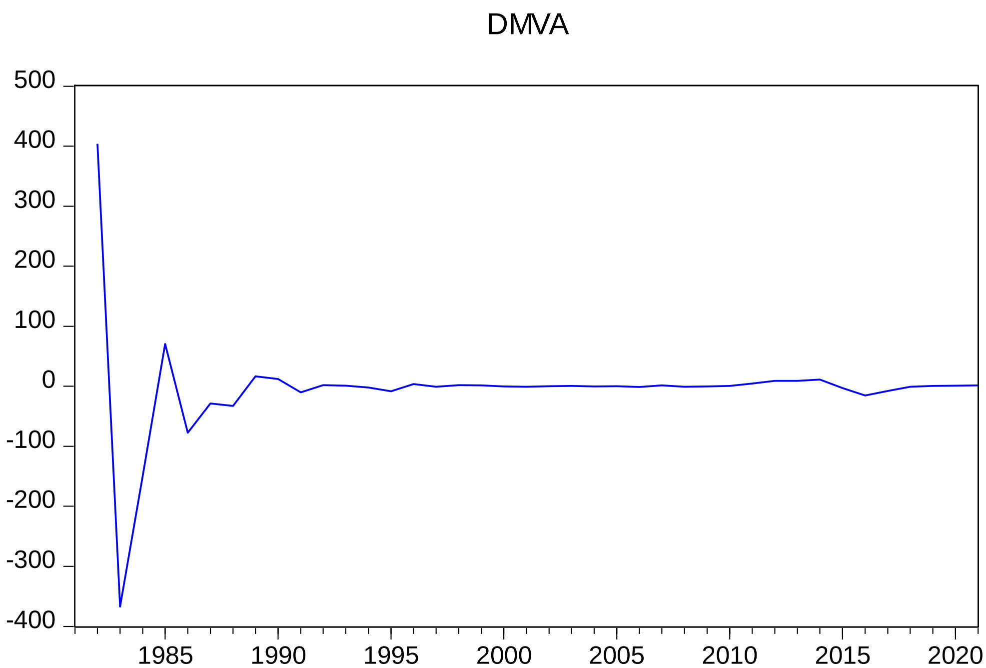
	ADF(LEVEL)			PHILLIP-PERRON(LEVEL)			
Variable	Critical Value 5%	Test Statistic	Prob	Critical Value 5%	Test Statistic	Prob	Decision
GDP	-2.938987	-0.569521	0.9870	-2.936942	1.050947	0.9964	Non Stationary
MVA	-2.941145	-10.18783	0.0000	-2.936942	-3.391853	0.0172	Stationary
ORN	-2.98404	-2.264681	0.1886	-2.936942	-1.337928	0.6025	Non Stationary

Table 3: Unit Root Test at First Difference

	ADF(First Difference)			PHILLIP-PERRON(First Difference)			
Variable	Critical Value 5%	Test Statistic	Prob	Critical Value 5%	Test Statistic	Prob	Order of Integration
GDP	-2.938987	-3.288313	0.0223	-2.938987	3.152798	0.0308	I(1)
ORN	-2.98404	-2.264681	0.1886	-2.936942	-1.337928	0.0000	I(1)

Due to spurious regression, the research variables were tested for unit root using the Augmented Dickey-Fuller and Phillips-Perron tests. MVA, GDP, and ORN showed stationarity at the level and first difference, respectively, according to the Augmented Dickey-Fuller and Phillip-Peron unit root tests. Figure 4 shows no trend in the differenced series time plot.





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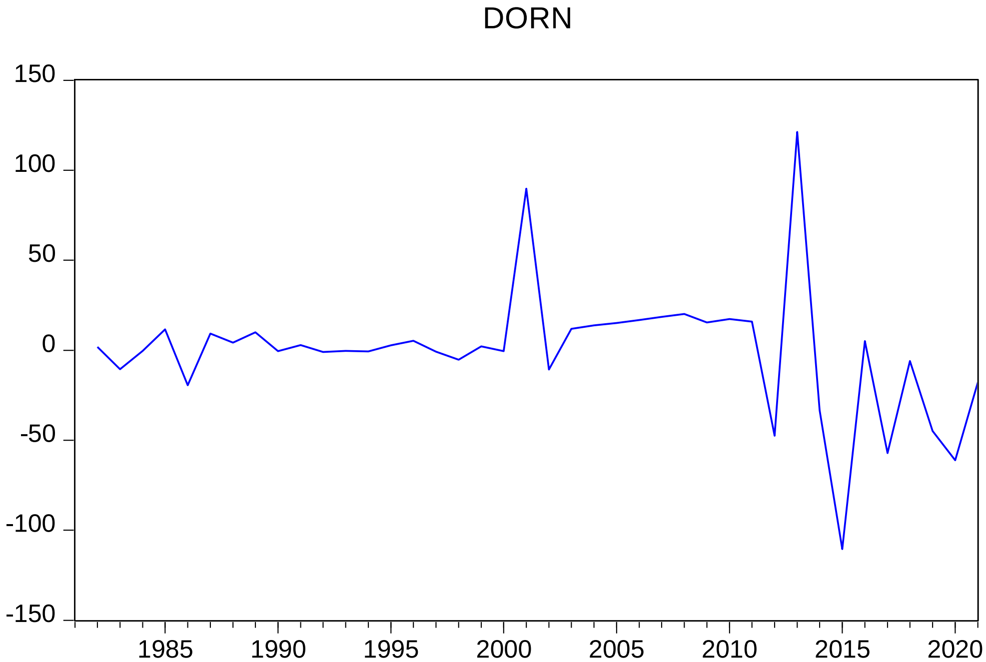

Figure 4: Time plot for the difference GDP, MVA and ORN

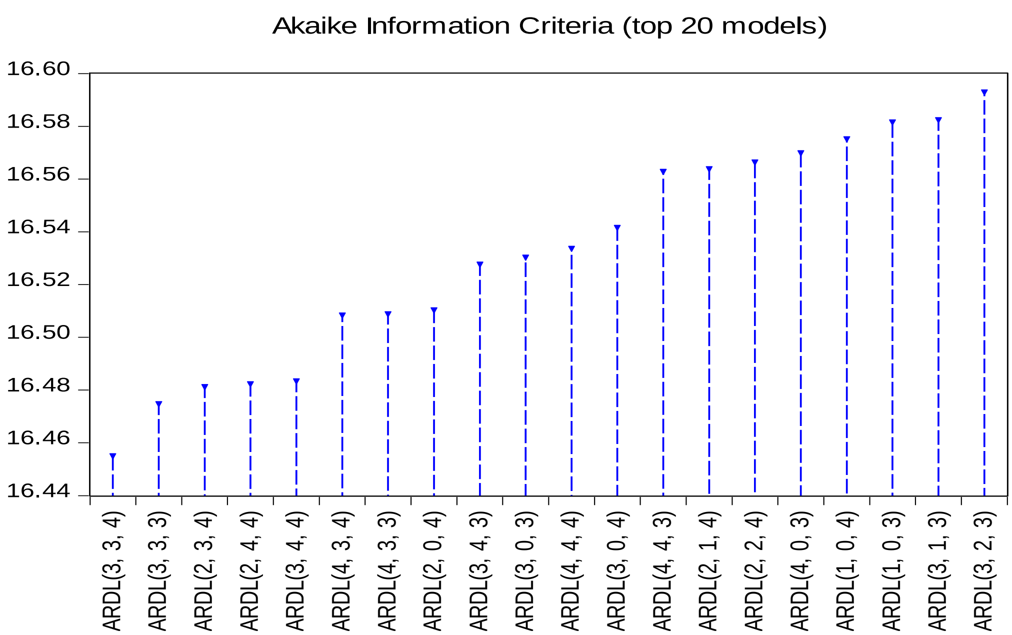

Figure 5: Akaike Information Criteria Graph for GDP

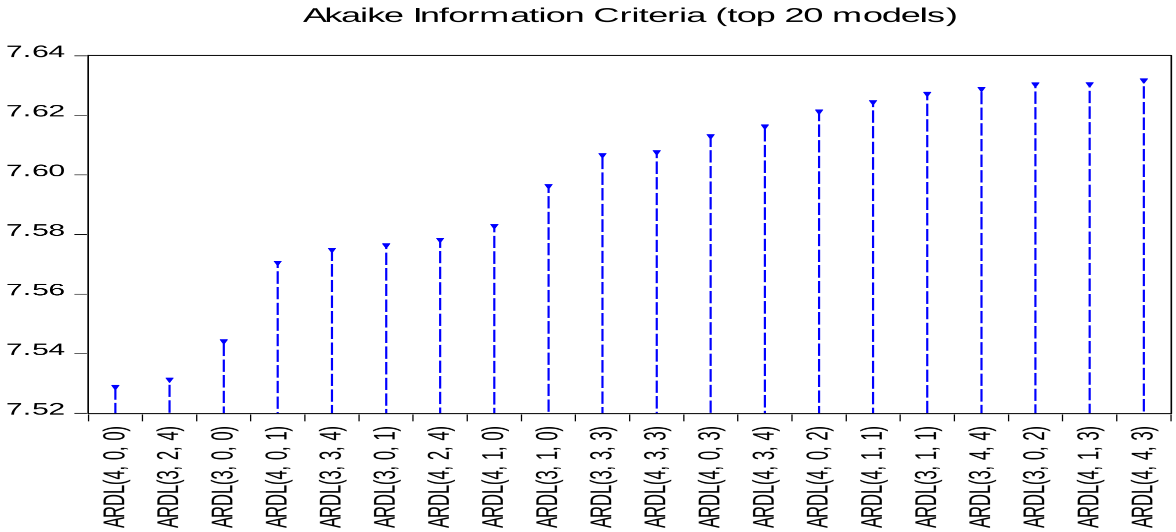

Figure 6: Akaike Information Criteria Graph for MVA

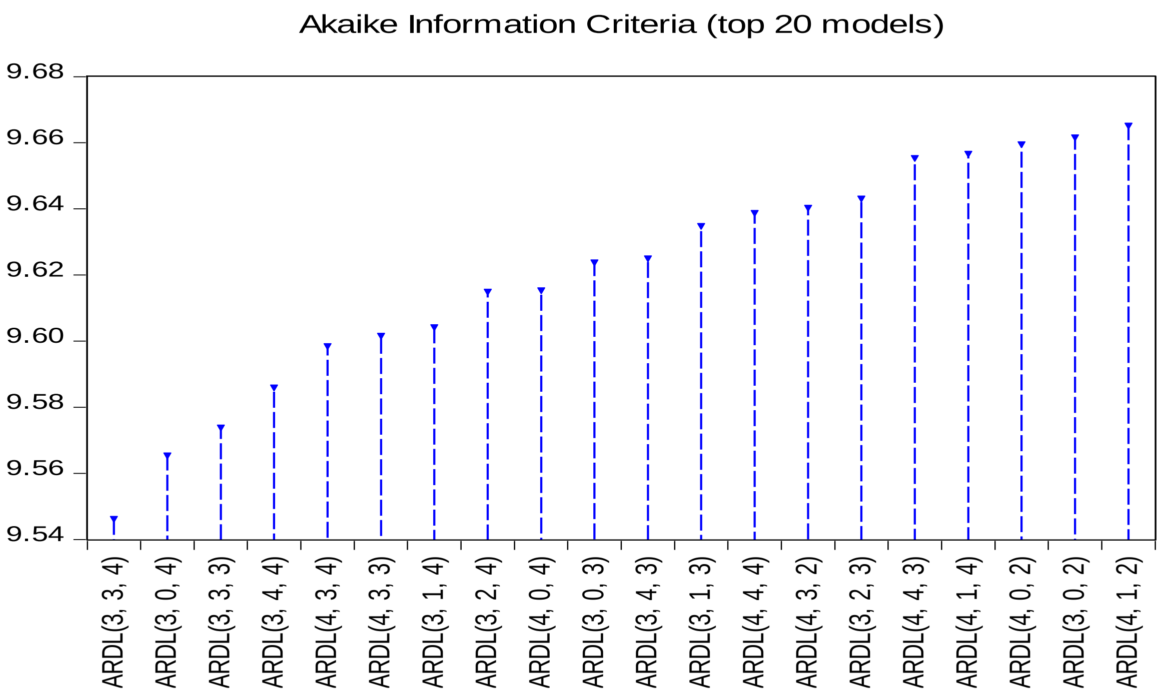

Figure 7: Akaike Information Criteria Graph for ORN

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Figure 5 shows that the ARDL (3,3,4) model with the least AIC is best for assessing GDP and other variables. Figure 6 shows that the ARDL (4,0,0) model is best for assessing MVA's connection because it demonstrates the smallest AIC criterion. With (ORN) as the dependent variable, the Autoregressive Distributed Lag (ARDL) model with a lag order of (3,3,4) was best for the study since it was identified as the order with the least AIC (figure 7).

Cointegration Test

The Cointegration test determined if the variables were in equilibrium over time. Due to the mixed order of integration from the Augmented Dickey-Fuller test, the ARDL bounds test for Cointegration was performed and the results are shown in table 4.

Table 4: ARDL Bounds Test for Cointegration using (3,3,4), (4,0,0), (3,3,4) models

Variable	Test Statistics	Value	Signif	1(0)	I(1)
GDP	F-Statistic	7.198954	5%	3.79	4.85
MVA	F-Statistic	5.096210	5%	3.79	4.85
ORN	F-Statistic	14.55279	5%	3.79	4.85

The bounds test shows a long-term link between GDP, MVA, and ORN, as shown in Table 4. This conclusion is confirmed by the F-statistic value of 7.198954, which surpasses 4.85. The F-statistic of 14.55279 for ORN surpasses 4.85, indicating a long-run cointegrating association. When MVA is the dependent variable, the F-statistic of 5.096210 exceeds 4.85, indicating cointegration. After proving a long-term link between GDP, MVA, and ORN, the autoregressive distributed lag error correction model (ARDL-ECM) must be estimated.

Estimating Short and Long-Run Coefficients Using ARDL (3,3,4) Model

Table 5: Error Correction Estimation for ARDL (3,3,4) Model, GDP as dependent variable

ARDL Error Correction Regression
Dependent Variable: D(GDP)
Selected Model: ARDL(3, 3, 4)
Sample: 1981 2022
Included observations: 38

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-939.7836	392.6272	-2.393577	0.0249
D(GDP(-1))	-0.541102	0.201534	-2.684915	0.0129
D(GDP(-2))	0.279248	0.167495	1.667202	0.1085
D(MVA)	-31.76552	11.87318	-2.675401	0.0132
D(MVA(-1))	-9.404863	6.228110	-1.510067	0.1441
D(MVA(-2))	-9.626611	2.899706	-3.319858	0.0029
D(ORN)	21.53166	4.194614	5.133169	0.0000
D(ORN(-1))	45.28470	6.587074	6.874781	0.0000
D(ORN(-2))	35.17460	8.613689	4.083570	0.0004
D(ORN(-3))	9.461547	6.664403	1.419714	0.1686
CointEq(-1)*	-0.098075	0.020276	4.837003	0.0001

R-squared	0.809224	Mean dependent var	1522.848
Adjusted R-squared	0.735849	S.D. dependent var	1479.213
S.E. of regression	760.2509	Akaike info criterion	16.34695
Sum squared resid	15027518	Schwarz criterion	16.82587
Log-likelihood	-291.4185	Hannan-Quinn criteria.	16.51579
F-statistic	11.02857	Durbin-W Watson stat	1.984068
Prob(F-statistic)	0.000000		

Table 6: Estimated Long Run Coefficients Using ARDL (3,3,4) Model
Dependent Variable: GDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MVA	226.3397	130.9368	1.728618	0.0967
ORN	42.86422	43.10890	0.994324	0.3300

EC = GDP - (226.3397*MVA + 42.8642*ORN)

Table 5 shows a 0.81 coefficient of determination (R^2), this indicates that oil refining and motor vehicle assembly account for 81% of GDP variability. Other variables account for 19% of the variance. An R-squared value above 50% suggests good similarity. Table 5 shows the error correction term is -0.098. Under the premise that no other variables change, this means that the previous period's departure from stable equilibrium is corrected at 9.8%. The preliminary study shows that both the first and second oil refining delays are statistically significant at 0.05. These delays have probability values of 0.0000 and 0.0004, both below 0.05. These restrictions greatly affect GDP. Motor vehicle production at lag 1 did not significantly affect GDP. P-values of 0.0967 and 0.3300 for MVA and ORN showed no persistent influence on GDP in the long (table 6).

Effect of Gross Domestic Product and Oil Refining on Motor Vehicle Assembly.
Table 7: Vector Error Correction Model DMVA as Dependent Variable.

ARDL Error Correction Regression
Dependent Variable: D(MVA)
Selected Model: ARDL(4, 0, 0)
Case 3: Unrestricted Constant and No Trend
Sample: 1981 2021
Included observations: 37

ECM Regression
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.572926	1.998261	2.288453	0.0293
D(MVA(-1))	-0.143920	0.077780	-1.850354	0.0741
D(MVA(-2))	-0.125262	0.046551	-2.690851	0.0115
D(MVA(-3))	0.056633	0.036985	1.531259	0.1362
CointEq(-1)*	-0.480656	0.119024	-4.038301	0.0003

R-squared	0.803988	Mean dependent var	-1.157799
Adjusted R-squared	0.779487	S.D. dependent var	19.78089
S.E. of regression	9.288876	Akaike info criterion	7.420601
Sum squared resid	2761.063	Schwarz criterion	7.638292
Log-likelihood	-132.2811	Hannan-Quinn criteria.	7.497347
F-statistic	32.81386	Durbin-Watson stat	1.785687
Prob(F-statistic)	0.000000		

Table 8: Estimated Long Run Coefficient Using ARDL (4,0,0) Model

Dependent Variable: MVA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP	0.000229	0.000217	1.058714	0.2982
ORN	0.054437	0.048599	1.120119	0.2716

EC = MVA - (0.0002*GDP + 0.0544*ORN)

Table 7 data yields an R^2 of 0.8 which according to these statistics, oil refining and gross domestic product account for 80% of motor vehicle assembly variations, while other omitted variables contribute for 20%. This match is good since R-squared surpasses 50%. Table 7 also shows an error correction term of -0.48. Under the premise that no other adjustments occur, this means that the preceding period's departure from stable equilibrium is being corrected at 48%. Short term analysis at 0.05 percent show that only the second lag of MVA delay is statistically significant. This delay has probability value of 0.0115. Motor vehicle manufacture at lag1 and lag 2 did not significantly affect GDP over time. On the contrary, GDP and ORN with p-values of 0.2982 and 0.2716 respectively were statistically not significant in causing MVA in the long run (Table 8).

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Table 9: Vector Error Correction Model DORN as Dependent Variable.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	37.60017	10.53692	3.568422	0.0016
D(ORN(-1))	-1.113793	0.187272	-5.947463	0.0000
D(ORN(-2))	-0.868904	0.197163	-4.407029	0.0002
D(MVA)	0.899468	0.307564	2.924490	0.0074
D(MVA(-1))	0.254015	0.192708	1.318129	0.1999
D(MVA(-2))	0.244827	0.084039	2.913261	0.0076
D(GDP)	0.021401	0.004266	5.016430	0.0000
D(GDP(-1))	0.017625	0.005504	3.201951	0.0038
D(GDP(-2))	-0.012934	0.004481	-2.886443	0.0081
D(GDP(-3))	0.007115	0.003914	1.818052	0.0816
CointEq(-1)*	-0.047422	0.006895	6.877251	0.0000
R-squared	0.705598	Mean dependent var		-0.219866
Adjusted R-squared	0.592367	S.D. dependent var		37.63470
S.E. of regression	24.02832	Akaike info criterion		9.438116
Sum squared resid	15011.36	Schwarz criterion		9.917038
Log-likelihood	-163.6051	Hannan-Quinn criteria.		9.606958
F-statistic	6.231467	Durbin-Watson stat		2.092843
Prob(F-statistic)	0.000083			

Table 10: Estimated Long Run Coefficients Using ARDL (3,3,4) Model
Dependent Variable: ORN

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MVA	-10.44109	43.69565	-0.238950	0.8132
GDP	0.055678	0.205479	0.270967	0.7887

EC = ORN - (-10.4411*MVA + 0.0557*GDP)

The R^2 in Table 9 was 0.71 which shows that gross domestic product and car assembly changes account for 71% of oil refining volatility. Note that this association is strong and significant. The remaining 29% was explained by factors not in the model. The error correction term coefficient (-0.047422) shows that the disequilibrium in the system can be corrected at an adjustment of 4.7 percent if all factors remain the same. Increasing the second lag of GDP by one unit will raise ORN by 0.012934. The early findings also show that the GDP delays of 3,201951 and -2,886443 (for the first and second lags, respectively) significantly affected oil refining trends. The oil refining business was affected by its delay, especially owing to the first and second delays. With long-term p-values of 0.8132 and 0.7887, MVA and GDP are not statistically significant (table 8). In both the post-estimation and stability tests, the residuals show no serial correlation and fall within the 5% confidence range.

Discussion

The graph for raw data on GDP (Figure 1) indicates a steady growth of GDP. While that for MVA fluctuates drastically implying a partial or total neglect of the sector. However, ORN recorded a jump in 2000 followed by a drop in 2015 indicating its volatility. In the long run, MVA and ORN do not influence GDP, which is in line with the findings of Abiodun (2014), who asserts that motor vehicle assembly do not impact the manufacturing capacity utilization of Nigeria's economy. It can be seen from Table 7 that in the short run, MVA is affected by its own delay (second lag). But in the long run, the correlation decays when MVA is held constant. This finding agrees with Akpan et al. (2016), that there is a lack of a level playing ground for local manufacturing industries to compete.

Conclusion

This research examines Nigeria's GDP, oil refining, and vehicle assembly using the autoregressive distributed lag model. This study seeks to determine the variables' overall trend, examine and predict the association between Nigeria's GDP, motor vehicle assembly, and oil refining, and assess their causation. The ARDL-ECM study shows a steady upward trend in GDP growth across the examined period. However, MVA and ORN growth fluctuated. The finding strongly suggests a time-varying link between ORN and GDP. Operational studies and Management Value Analysis development in earlier eras greatly affect GDP volatility, both now and in the future, according to studies. The combination of ORN and MVA delays created major and immediate problems. Since own shocks determine impulses, econometric models should include lagged endogenous elements as exogenous variables. The government must invest more in industry, particularly oil refining and motor vehicle assembly, to boost output and reduce imports.

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