Minus Effect of Petroleum Products Pump Prices on Macroeconomic Indicator in Nigeria: A Unit Root Approach

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Abstract
This study examined the minus effect of petroleum products pump prices on macroeconomic indicator proxy by GDP in Nigeria during the period 1980 – 2016. Time series data such as Gross Domestic Product (GDP), pump prices of Premium Motor Spirit (PMS), Dual Purpose Kerosene (DPK), and Automotive Gas Oil (AGO) were obtained from Central Bank of Nigeria (CBN) Statistical Bulletin, National Bureau of Statistics (NBS) and Petroleum Pricing Regulatory Agency (PPRA). Unit root test, Cointegration test and Error Correction Model (ECM) techniques were used to estimate the model while granger causality test was used to check the causal relationship of the variables. The results of the finding revealed that PMS and DPK have negative and significant effect on GDP but AGO has a negative and insignificant effect on GDP. This implies that, the lower the petroleum products pump prices, the higher the

GDP. The results further revealed that there was evidence of unidirectional causality running from GDP to PMS as well as DPK to GDP while there exist a bi-directional causality running from AGO to GDP and GDP to AGO. Based on these findings, the researchers recommend that federal government should revive the domestic refineries and also encourage local production of petroleum products, thereby reducing importation of refined petroleum products, unemployment, bunkering and black market in the system, hence, sustainable economic growth will be achieve.

***Keywords**: GDP, PMS, DPK, AGO, ECM*

Introduction

After a century of search for crude oil in Nigeria, crude oil was discovered in the year 1956 at Oloibiri, Bayelsa State (Dharam, 1991). From crude oil, sub-crude oil (Petroleum products) products are derived which is sufficiently used by industries and households. With crude oil deposit in Nigeria, coupled with the carrying capacity of her refineries, crude oil and petroleum products are among the most valuable natural resources abundantly available in Nigeria. Petroleum products derived from crude oil include; Premium Motor Spirit (PMS) or Petrol, Dual Purpose Kerosene (DPK) or Kerosene, Automotive Gas Oil (AGO) or Diesel, Natural Gas, Bitumen/Asphalt etc. Currently, Nigeria is the ninth world producer and sixth world exporter of crude oil (Ehinomen & Adeleke, 2012). According to World Bank Report (2010), Nigerian economy is heavily dependent on petroleum products, which account for over 95 percent of export earnings and about 85 percent of government revenues.

In the middle of 1980's, consumption of petroleum products grew tremendously as a result of rapid growth in the number of automobiles, industries, households, rural-urban migration, economic and political developments. Basically, PMS and AGO are used in road transportation, industries, power generation, private vehicles etc, while DPK is used in household cooking, production of insecticides and other pest control products by industries. In all, PMS is the most frequently consumed petroleum products in Nigeria by both firms and common households. Because of the need and frequent usage of petroleum products in Nigeria today, its price(s) has become core (paramount) in determining industrial output, household standard of living and national economic growth. Olorunfemi (2010) stated that various Nigerian governments have increased pump prices of petroleum products for more than ten (10) times between the year 2000 and 2012, meaning average of twice increase in pump prices of petroleum products within the aforementioned peri

Therefore, the effect of pump price increase of petroleum products to the growth and development of the Nigerian economy cannot be overemphasized. Mainly because the pump prices of petroleum products are critical to production cost, inflation and the welfare of the Nigerian citizens at large. Hence, this study is set to examine the effect of increase in pump price of petroleum products on Nigerian economic growth.

The remaining part of this paper include: empirical literature; methodological approach; results and discussion; and conclusion.

Empirical Literature

Akinlo and Apanisile (2015) examined the impact of the volatility of oil price on economic growth in 20 sub-Saharan African countries from the period of 1986-2012. These countries were divided into group A and group B. Group A consists of 10 oil exporting countries, while group B consists of non-oil exporting countries in sub-Saharan Africa. The estimation of panel a model consisting of the oil exporting countries shows that the volatility of oil price has a

positive and significance effect on the economic growth of oil exporting countries. The result of panel B consisting of non-oil producing countries shows that the volatility of oil price also has a positive and insignificant impact on economic growth.

Aliyu (2009) assessed the impact of oil price shock and real exchange rate volatility on real economic growth in Nigeria on the basis of quarterly data from 1986Q1 to 2007Q4 using a vector error correction model. Results from ADF and PP tests show evidence of unit root in the data and Granger pairwise causality test revealed unidirectional causality from oil prices to real GDP and bidirectional causality from real exchange rate to real GDP and vice versa.

Alley, Asekomeh, Mobolaji and Adeniran, (2014) investigated the oil price shocks and Nigerian economic growth. After appropriate robustness checks, the study finds out that oil price shocks insignificantly retards economic growth while oil price itself significantly improves it.

Al-mulali and Sab (2010) in a study employed Vector Error Correction Model (VECM) to examine the impact of total trade value, oil price, and inflation rate on Qatar's GDP and found that a positive link exists between crude oil price and GDP.

Amagoh, Odoh and Okuh (2014) in their multivariate study of the implications of pump prices of petroleum products change on some economic variables reveals that PMS has significant impact on all economic variable studied. The AGO has significant impact on only GDP and Per capita GDP while DPK only has significant impact on GDP per capita.

Bildiricia and Ersin (2015) investigated the causality analysis among biomass energy consumption, oil prices and economic growth in Austria, Canada, Germany, Great Britain, Finland, France, Italy, Mexico, Portugal and the U.S. by using the autoregressive distributed lag bounds testing (ARDL) method, Granger causality and Toda and Yamamato non-causality test. The data set covers the 1970-2013 periods. The result revealed that biomass energy is affected by economic growth and the oil price.

Dogah (2015) employed a restricted VAR model and Johansen Co-integration test to investigate the impact of oil price shocks on the macro economy of Ghana- a developing oil importing economy. The findings reveal that oil price shocks have significant negative impact on output and economic activities in Ghana.

Gunu and Kilishi, (2010) examined the relationship between oil price shocks and the Nigeria economy: A variance autoregressive (VAR) model. The results showed that oil prices have significant impact on real GDP, money supply and unemployment.

Hamilton (1983) in his study on the impact of oil price on the economy of U.S since World War II using a data set of between 1948 and 1972 confirmed that there is a negative and significant relation between oil price changes and GDP growth.

Gounder and Bartleet (2007) examined oil price shocks and economic growth in Venezuela using the Vector Autoregressive (VAR) methodology based on quarterly data. Three oil price measures were considered, following the various theoretical implications that oil price shocks have on economic growth. The authors analysed the short-run impact of oil price shocks in a multivariate framework which traced the direct economic impact of oil price shocks on economic growth as well as indirect linkages.

Lee, 1998 in Oriakhi and Iyoha (2013) opined that the proponents of the Renaissance growth model confirmed that both oil price changes and its volatility have negative effects on economic growth, though in different ways.

Mark, Olsen and Mysen (1994) applying the asymmetry-in-effects theory of economic growth found that an oil price increase has a negative effect on future GDP growth in Africa, while the effect of an oil price decrease is ambiguous.

Nwosa (2013) examined the effect of gasoline price on economic sectors in Nigeria from 1980 to 2010. The objectives of the study are to examine the long and short run relationship between gasoline price and sectorial output in Nigeria. Six sectors (agriculture; manufacturing; building and construction; wholesale and retail; transportation and communication) of the economy were examined. The long run regression estimate showed that gasoline price is a significant determinant output in all sectors examined with exception to the building and construction sector while the short run error correction estimate revealed that only output of the agriculture and the manufacturing sectors of the Nigerian economy is affect by gasoline price increase in the short run.

Ocheni (2015) examined the impact of fuel price increase on the Nigerian economy in 2014. The study adopted a survey research design approach to evaluate the level of effect the fuel price increase has on the Nigeria economy. Finding revealed that there is a significant relationship between the recent increases in fuel prices and economic growth in Nigeria. It was also discovered that the Nigeria economy is not developing because of the effect of fuel price hike on purchasing power and finally the finding showed that there is significant relationship between increase in pump price of petroleum and food security.

Onwuka, Chiekezie and Igweze (2013) examined the relationship between Petroleum Product Prices and the Growth of Nigeria Economy. This study asserted that the causes of price instability is attributed to scarcity caused by refinery maintenance and rehabilitation problem, low capacity utilization, supply, and demand inequality. The political change that Nigeria went through, which turned over the administration and endured a lingering economic down turn is enough reason to cause price instability of oil products in Nigeria.

Oriakhi and Iyoha, (2013) examined the consequences of oil price volatility on the growth of the Nigerian economy within the period 1970 to 2010. The study find out that out of the six variables employed, oil price volatility impacted directly on real government expenditure, real exchange rate and real import, while impacting on real GDP, real money supply and inflation through other variables, notably real government expenditure.

Qianqian, (2011) applied the co-integration and error correction model to specifically measure the impact of oil price on the economy. The results showed that there exist long-run equilibrium relationship between the oil price and the China's output, the consumer price index, the total amount of net exports and the monetary policy.

Raymond (2010) looked at the effect of price changes of petroleum products in the short and long run and the factors responsible for the changes itself also found that petroleum products prices have significant effect on the economy in the long run.

Stephen (2015) using the Pearson Product Moment correlation coefficient to examine impact of fuel price increase on the Nigerian Economy. The result revealed that there is a significant relationship between the recent increases in fuel prices and economic growth in Nigeria.

Yazdana, Ehsanb and Sadr (2012) investigated the causal relationship between oil prices and economic growth in Iran over a period from 1980 to 2010 and their results show that oil price is not Granger-causes for economic growth.

Methodology

In this study, a systematic time series econometrics approach is used to analyse the minus effect of petroleum products pump prices (PPPP) on macroeconomic indicator proxy by gross domestic product (GDP) in Nigeria during the period 1980-2016. In order to arrive at a robust result and unbiased analysis, the researcher employed a secondary data obtained from Central Bank Nigeria (CBN) Statistical Bulletin, National Bureau of Statistics (NBS), and Petroleum Pricing Regulatory Agency (PPRA). Such data includes; Gross Domestic Product (GDP), pump prices of Premium Motor Spirit (PMS), Dual Purpose Kerosene (DPK) and Automotive Gas Oil (AGO). The Augmented Dickey Fuller (ADF) unit root test is used to verify the stationarity of the variables and Johansen (1989) cointegration approach to determine the number of cointegration equations between the variables. Error correction model (ECM) is also used to check the speed of adjustment from short-run to long-run equilibrium while granger causality is used to check the causal relationship between endogenous and exogenous variables.

i. Model Specification

The exogenous variables are pump prices of Premium Motor Spirit (PMS), Dual Purpose Kerosene (DPK) and Automotive Gas Oil (AGO) while the endogenous variable is Gross Domestic Product (GDP). The model is stated as follows:

GDP = F (PMSPRICE, DPKPRICE, AGORICE)

Thus, the functional relationships between endogenous and the exogenous variables in the study are stated as follows:

GDP = F (PMSPRICE, DPKPRICE, AGOPRICE) + e_t

Hence, the mathematical form of the model is thus:

$GDP = b_0 + b_1PMSPRICE + b_2DPKPRICE + b_3AGOPRICE + e_t$

Where:

GDP = Gross Domestic Product

PMSPRICE = Pump Price of Premium Motor Spirit

DPKPRICE = Pump Price of Dual Purpose Kerosene

AGOPRICE = Pump Price of Automotive Gas Oil

b_1, b_2, b_3 = Estimators

b_0 = Constant

e_t = error term

The parsimonious error correction model is stated as thus:

$D(GDP) = b_0 + b_1D(PMSPRICE_{t-1}) + b_2D(DPKPRICE_{t-1}) + b_3D(AGOPRICE_{t-1}) + b_4ECT_{t-1} + e_t$

Where:

ECT = Error Correction Term

ii. A Priori Expectation

The a priori expectation is that petroleum products pump prices should have a negative effect on GDP. This implies that a decrease in pump prices of PMS, DPK, and AGO will, all things being equal, lead to an increase in GDP. Hence, $b_1, b_2, b_3 < 0$.

Table 1: A priori Expectation

Exogenous variables	Symbols	Hypothesis	Expected sign
Premium Motor Spirit Price	PMSPRICE	Premium Motor Spirit Price has a negative relation with GDP.	-
Dual Purpose Kerosene Price	DPKPRICE	Dual Purpose Kerosene Price has a negative relation with GDP.	-
Automotive Gas Oil Price	AGOPRICE	Automotive Gas Oil Price has a negative relation with GDP.	-

Source: Authors' Computation (2018)

Results and Discussion

This part covers the descriptive statistics analysis and discussion of results of the study such as unit root test, Johasen cointegration test, error correction model and granger causality test.

i. Descriptive Statistics

Descriptive statistics are used to describe the basic features of the data in a study. It is also used to present quantitative descriptions in a manageable form. The results of the descriptive statistics are presented in the table 2 below:

Table 2. Descriptive Statistics

	GDP	PMSPRICE	DPKPRICE	AGOPRICE
Mean	19607.81	32.90030	43.45554	50.81041
Median	4189.250	11.00000	6.000000	9.000000
Maximum	101489.0	145.0000	240.0000	230.0000
Minimum	49.60000	0.153000	0.105000	0.110000
Std. Dev.	30745.45	38.41907	60.19891	69.67798
Skewness	1.600897	1.042899	1.467900	1.307600
Kurtosis	4.067166	3.208167	4.516304	3.436391
Jarque-Bera	17.56009	6.773904	16.83206	10.83747
Probability	0.000154	0.033812	0.000221	0.004433
Sum	725489.0	1217.311	1607.855	1879.985
Sum Sq. Dev.	3.40E+10	53136.90	130460.7	174780.7
Observations	37	37	37	37

Source: Authors' Computation (2018)

Shown in **table 2** above is the descriptive statistics on average prices of petroleum products and GDP. The result indicates that average prices of petroleum products i.e. price of petrol (PMS), price of kerosene (DPK) and price of diesel (AGO) stood at 32.90 43.45 and 50.81

Naira respectively, and GDP is 19607.81 Billion Naira. This implies that the prices of petroleum products grow at an average price of 32.90, 43.45 and 50.81 Naira correspondingly while GDP revolves at 19607.81 Billion Naira annually between 1980 and 2016. The maximum prices of the PMS, DPK and AGO within the study period were 145, 230 and 240 Naira respectively, and GDP is 101489 Billion Naira.

The result in **table 2** further revealed that the standard deviation of prices of petroleum products i.e. price of petrol (PMS), price of kerosene (DPK) and price of diesel (AGO) stood at 38.41, 60.19 and 69.67 Naira correspondingly and GDP is 30745.45 Billion Naira. This depicts the annual deviation of petroleum products pump prices and GDP.

ii. Unit Root Test

Time series data are prone to spurious regression, to ensure their stationarity, Unit Root Test is carried out. The result is presented in the table 3 below.

Table 3. Unit Root Test Result

Variable	ADF test statistics	5% critical value	Order of integration
D(GDP)	-5.603841	-3.544284	1(2)
D(PMSPRICE)	-5.134945	-3.544284	1(2)
D(DPKPRICE)	-5.467609	-3.548490	2(2)
D(AGOPRICE)	-6.230489	-3.544284	1(2)

Source: Authors' Computation (2018).

The result of the ADF test as presented in **table 3**, shows that the endogenous variable (GDP) and the exogenous variables (PMS, DPK and AGO) are integrated of order one, lag two, 1(2) except DPK with 2(2), all at 5% level of significance. That is, they are integrated of the same order excluding DPK. In other words, GDP, PMS and AGO are found to be stationary at first difference while DPK is found to be stationary at second difference. Thus, the model follows integrating process. Therefore, the null hypothesis of unit root is not accepted because the probability of the t-statistic is significant and the ADF test statistic for difference one (1) is more negative than the critical values at 5% level of significance.

iii. Johasen Cointegration Test

The result of the test is presented in the table below:

Table 4. Johasen Cointegration Result

Date: 07/27/18 Time: 18:28
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments
Trend assumption: Linear deterministic trend
Series: GDP PMSPRICE DPKPRICE AGOPRICE
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.815260	103.9804	47.85613	0.0000
At most 1 *	0.596140	44.87229	29.79707	0.0005
At most 2	0.251636	13.13822	15.49471	0.1098
At most 3	0.081957	2.992901	3.841466	0.0836

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Authors' Computation (2018).

The result in **table 4** above indicates the presence of 2 cointegrating equations at 5% level of significance for the GDP model and therefore confirms the existence of long-run equilibrium relationship between GDP and its exogenous variables (PMSPRICE, DPKPRICE and AGOPRICE). The conclusion is based on the values of trace statistic against their critical values at 5% significance level.

iv. Error Correction Model

The parsimonious error correction model results are presented in the table 5 below:

Table 5. Parsimonious Result of GDP Model

Dependent Variable: GDP
Method: Least Squares
Date: 07/27/18 Time: 22:11
Sample (adjusted): 1986 2016
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PMSPRICE	-565.0816	114.4380	-4.937885	0.0001
DPKPRICE	252.5564	131.5062	1.920491	0.0673
D(DPKPRICE(-3))	-787.1629	200.0049	-3.935717	0.0007
AGOPRICE	535.0433	80.89796	6.613804	0.0000
D(AGOPRICE(-3))	451.2600	146.8292	3.073367	0.0054
D(AGOPRICE(-5))	-136.1694	154.0580	-0.883884	0.3859
ECM(-1)	-0.397364	0.194528	-2.042709	0.0527
C	1624.926	1297.175	1.252665	0.2229

R-squared	0.987529	Mean dependent var	23383.33
Adjusted R-squared	0.983733	S.D. dependent var	32303.35
S.E. of regression	4119.991	Akaike info criterion	19.70273
Sum squared resid	3.90E+08	Schwarz criterion	20.07279
Log likelihood	-297.3922	Hannan-Quinn criter.	19.82336
F-statistic	260.1810	Durbin-Watson stat	1.538287
Prob(F-statistic)	0.000000		

Source: Authors' Computation (2018).

The satisfactory results obtained from unit root and cointegration tests motivated the estimation of an error correction model. From the parsimonious error correction model result, the exogenous variables (PMS, DPK and AGO) explained 98% change in GDP, hence, the model has a good-fit as the coefficient of determination (R-squared) is significantly high with no autocorrelation as suggested by Durbin-Watson (D.W) statistic. The overall regression is highly significant and the error correction model (ECM) coefficient is negatively signed and significant. This implies that about 40% deviation from the long-run equilibrium relationship between GDP and its determinants are corrected every one year.

v. Granger Causality Test Result

The result of the test is presented in the table below:

Table 6. Granger Causality Test Result

Pairwise Granger Causality Tests
Date: 07/27/18 Time: 18:20
Sample: 1980 2016
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
DPKPRICE does not Granger Cause AGOPRICE	35	2.80735	0.0763
AGOPRICE does not Granger Cause DPKPRICE		3.40165	0.0466
GDP does not Granger Cause AGOPRICE	35	14.3666	4.E-05
AGOPRICE does not Granger Cause GDP		4.13140	0.0260
PMSPRICE does not Granger Cause AGOPRICE	35	1.23030	0.3065
AGOPRICE does not Granger Cause PMSPRICE		13.6956	6.E-05
GDP does not Granger Cause DPKPRICE	35	1.47511	0.2449
DPKPRICE does not Granger Cause GDP		4.71757	0.0165
PMSPRICE does not Granger Cause DPKPRICE	35	0.39249	0.6788
DPKPRICE does not Granger Cause PMSPRICE		12.4821	0.0001
PMSPRICE does not Granger Cause GDP	35	2.85057	0.0736
GDP does not Granger Cause PMSPRICE		3.90630	0.0311

Source: Authors' Computation (2018).

The causality test result in **table 6** above shows that there is unidirectional causality between GDP and PMSPRICE as well as DPKPRICE and GDP while there exist a bi-directional causality between GDP and AGOPRICE as explained by the probability values. That is, GDP granger causes PMSPRICE and PMSPRICE does not granger causes GDP but DPKPRICE granger causes GDP and GDP does not granger causes DPKPRICE. This simply implying that GDP can be used to predict the future behaviour PMSPRICE and DPKPRICE can also be used to predict the future behaviour GDP of Nigeria. More so, GDP granger causes AGOPRICE and AGOPRICE also granger causes GDP. This implies that both GDP and AGOPRICE can be used to predict the future behaviour of each other.

The result in **table 5** above revealed that PMSPRICE at current period and DPKPRICE at lag 3 have significant negative effect on GDP while AGOPRICE at lag 5 also has an insignificant negative effect on GDP. This meets the a priori expectation that a decrease in petroleum products pump prices leads to an increase in GDP and vice versa. This contradicts the findings of Al-mulali and Sab (2010), and Akinlo and Apanisile (2015) who found that petroleum products pump prices have positive and significant effect on gross domestic product. But the result confirms the findings of Amagoh, Odoh and Okuh (2014), Dogah (2015), Oriakhi and Iyoha (2013), and Hamilton (1983) on the effect that petroleum products pump prices and GDP are negatively and significantly related. The implication of this is that PMS and DPK are the

most popularly used petroleum products by both the rich and poor people in the society unlike the AGO that is mostly used by firms and/or upper class individuals. Hence, changes in pump price of AGO has an insignificant effect on GDP.

Conclusion

The major aim of this study is to examine the minus effect of petroleum products pump prices on macroeconomic indicator of Nigeria proxied by GDP during the period 1980-2016 using Error Correction Model (ECM). Analysis from the estimation suggests that all the variables were stationary at first difference except AGOPRICE that is stationary at second difference. More so, there is a long-run relationship between petroleum products pump prices and GDP. Petroleum products pump prices have significant negative effect on GDP. This implies that as petroleum products pump prices rises, GDP will fall and vice versa. Therefore, the researchers recommend that in order to enhance sustainable economic growth in Nigeria, federal government should revive the domestic refineries and also encourage local production of petroleum products, thereby reducing importation of refined petroleum products, unemployment, bunkering and black market in the system.

The results from the estimation also suggest that there is evidence of causality running from GDP to PMSPRICE and DPKPRICE to GDP. That is, GDP granger cause PMSPRICE and DPKPRICE granger cause GDP, indicating two different unidirectional causality. There is also existence of bi-directional causality running from GDP to AGOPRICE and AGOPRICE to GDP, implying that both cause each other.

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APPENDIX 1

ADF TEST ON GDP

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.603841	0.0003
Test critical values:	1% level	-4.243644	
	5% level	-3.544284	
	10% level	-3.204699	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 07/27/18 Time: 21:10
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-0.986218	0.175990	-5.603841	0.0000
C	-2932.099	1755.333	-1.670395	0.1046
@TREND(1980)	304.8441	94.00635	3.242804	0.0028

R-squared	0.495395	Mean dependent var	208.5517
Adjusted R-squared	0.463857	S.D. dependent var	6345.506
S.E. of regression	4646.292	Akaike info criterion	19.80734
Sum squared resid	6.91E+08	Schwarz criterion	19.94066
Log likelihood	-343.6285	Hannan-Quinn criter.	19.85336
F-statistic	15.70798	Durbin-Watson stat	2.012467
Prob(F-statistic)	0.000018		

Source: Authors' Computation (2018).

APPENDIX 2

ADF TEST ON PMSPRICE

Null Hypothesis: D(PMSPRICE) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.134945	0.0010
Test critical values:	1% level	-4.243644	
	5% level	-3.544284	
	10% level	-3.204699	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PMSPRICE,2)
Method: Least Squares
Date: 07/27/18 Time: 21:03
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PMSPRICE(-1))	-1.182523	0.230289	-5.134945	0.0000
C	-3.512461	3.240409	-1.083956	0.2865
@TREND(1980)	0.430859	0.158259	2.722489	0.0104

R-squared	0.463843	Mean dependent var	1.205286
Adjusted R-squared	0.430333	S.D. dependent var	11.87637
S.E. of regression	8.963842	Akaike info criterion	7.306091
Sum squared resid	2571.215	Schwarz criterion	7.439407
Log likelihood	-124.8566	Hannan-Quinn criter.	7.352112
F-statistic	13.84200	Durbin-Watson stat	1.620188
Prob(F-statistic)	0.000047		

Source: Authors' Computation (2018).

APPENDIX 3

ADF TEST ON DPKPRICE

Null Hypothesis: D(DPKPRICE,2) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.467609	0.0004
Test critical values:	1% level	-4.252879	
	5% level	-3.548490	
	10% level	-3.207094	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DPKPRICE,3)
Method: Least Squares
Date: 07/27/18 Time: 21:04
Sample (adjusted): 1983 2016
Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DPKPRICE(-1),2)	-1.476465	0.270038	-5.467609	0.0000
C	-4.247757	4.740242	-0.896106	0.3771
@TREND(1980)	0.341636	0.217281	1.572325	0.1260

R-squared	0.506443	Mean dependent var	1.778824
Adjusted R-squared	0.474601	S.D. dependent var	17.13780
S.E. of regression	12.42224	Akaike info criterion	7.960951
Sum squared resid	4783.672	Schwarz criterion	8.095630
Log likelihood	-132.3362	Hannan-Quinn criter.	8.006880
F-statistic	15.90469	Durbin-Watson stat	1.476723
Prob(F-statistic)	0.000018		

Source: Authors' Computation (2018).

APPENDIX 4

ADF TEST ON AGOPRICE

Null Hypothesis: D(AGOPRICE) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.230489	0.0001
Test critical values:	1% level	-4.243644	
	5% level	-3.544284	
	10% level	-3.204699	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(AGOPRICE,2)
Method: Least Squares
Date: 07/27/18 Time: 21:05
Sample (adjusted): 1982 2016
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(AGOPRICE(-1))	-1.096966	0.176064	-6.230489	0.0000
C	-6.038709	3.114185	-1.939098	0.0614
@TREND(1980)	0.695227	0.176507	3.938812	0.0004

R-squared	0.548145	Mean dependent var	0.356571
Adjusted R-squared	0.519904	S.D. dependent var	11.77656
S.E. of regression	8.159863	Akaike info criterion	7.118148
Sum squared resid	2130.668	Schwarz criterion	7.251464
Log likelihood	-121.5676	Hannan-Quinn criter.	7.164169
F-statistic	19.40955	Durbin-Watson stat	2.054282
Prob(F-statistic)	0.000003		

Source: Authors' Computation (2018).