

An Econometric Approach to the Economic Impact of Petroleum Oil Price Fluctuation in Kenya

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Abstract
Oil prices in Kenya have been fluctuating over time hence raising the question as to its impact on the economic performance, this paper examines the economic impact of oil prices in Kenya on an econometric perspective. In carrying out the analysis a Vector Auto Regressive (VAR) Model was estimated, as a standard behavior with time series Data stationarity test was carried out followed by the determination of the short run as well as the Long run Dynamics of the model following co-integration analysis, before the estimation of the VAR model. The study found out that oil price fluctuation has a negative significant impact on the economic performance in Kenya. We strongly recommend that the government should adopt appropriate policy measures to manage oil price since despite the fact that they are determined exogenously there is a lot of debate to mismanagement within the sector.
Key words:- Oil prices, Economy, Inflation, co-integration Analysis, VAR Model

1.0 Introduction

Petroleum oil consumption is generally regarded as a major determinant of economic activities in a country. The recent fluctuation in oil prices brings concern about possible slowdowns in the economic growth of both developed and developing economies. Since 1980's Kenya has under taken major macro economic reforms aimed at improving economic performance in the country. These reforms have included reforming the energy sector so as to make it competitive, efficient as well as attracting investment in the sector.

This paper analyses the impact of oil price fluctuations on economic performance in Kenya, it expounds on the role of oil prices on macroeconomic performance in the country adopting Vector Auto Regressive (VAR) model

During the past fifteen years the Kenyan economy has been subjected to exceptional fluctuations that have actually hindered its performance. Unless appropriate policies are put in place so as to alleviate these macro economic problems the countries economic prospects of Vision 2030 will just remain a dream.

The purpose of this study is to establish the economic impact of petroleum oil fluctuation on economic performance in Kenya; this was done by analyzing the trend of oil prices as well as other macro economic variables on the economic growth in the country. The study adopts VAR model to estimate the relationship between dependent and independent variables.

1.1 Problem Statement

Kenya for the past twenty years or so have had serious fluctuations in economic activities which have had a lot of set back to its economic performance, the ever raising inflation, fluctuation in international oil prices, fluctuation in exchange rates among others have been experienced over the years. Oil prices especially to petroleum oil importing countries like Kenya have acted as a major economic burden since pricing of this crucial commodity is determined entirely by the oil exporting countries, in fact there is the latest hypothesis that the Saudis control the petroleum market in the world today, since most activities are depended on the availability and amount of petroleum consumed. The level of petroleum consumed in a country depends on several factors which among them include its prices, the level of economic activity, inflation among others, most of this factors have been constantly fluctuating in Kenya. To be able to draw policy measures on petroleum and the energy sector as a whole, as well as the macro economic policies, it is necessary to establish the interrelationship between the macroeconomic variable and petroleum oil price flutuation. This paper therefore sought to establish this relationship in Kenya adopting VAR model.

1.2 Petroleum sector in Kenya

Petroleumoil has been and is still the most important source of commercial energy in kenya. Petroleum fuels are imported in form of crude oil for domestic processing in changamwe(Mombasa) and also as refined products, it is mainly used in the transport, commercial and industrial sectors. Fluctuations in international prices have directly affected domestic prices in the country. For instance, the international price of Murban crude oil rose by

aproximately 46% from US$ 62.05 per barrel in December 2006 to US$ 90.60 per barrel in December 2007 and about US$140 per barrel in August 2008, before plummeting to less than US$ 50 by March 2009. Total quantities of petroleum imports registered a growth of 16.4% to stand at 3 691.8 thousand tonnes in 2007. The total import bill of petroleum products rose by 7.1% in 2007 compared to 8.9% in 2006. Total domestic demand for petroleum products also rose by about 2.8% that is from3 131.5 thousand tonnes in 2006 to 3 218.3 thousand tonnes in 2007(see table 1.2). Trends in the sale or consumption of petroleum oils indicate that retail pump outlets and road transport constitute the largest consumer of petroleum oils followed by aviation and power generation (see table 1.1). Kerosene as a cooking and lighting fuel is equally important especially for the rural and urban poor households and sometimes used as a substitute to wood fuel. Tax policy measures on kerosene have far reaching implications on its consumption and household welfare. Kerosene has other implications on air pollution, health impacts on the poor and security concerns particularly when used to adulterate other fuels. However this does not affect its consumption in the country.

Table 1.1 Oil Sales

period	Light diseal oil	Jet oil	Fuel oil	Motor spirits	Illuminating kerosean	Heavy Diseal oil	LPG	Aviation	Total fuels
2010	97.6	44.8	43.4	38.8	25.0	1.7	6.1	0.15	257
June	97.6	44.8	43.4	38.8	25.0	1.7	6.1	0.15	257
jully	109.9	47.4	38.8	41.3	21.5	2.2	4.1	0.14	264.9
Aug	97.3	54.7	39.0	40.6	20.1	2.1	6.20	0.15	260.1
sept	107.7	46.6	43.2	41.9	21.9	2.1	5.6	0.08	269.2
Oct	104.6	50.0	51.8	42.1	22.8	1.9	4.8	0.15	278.1
Nov	99.6	50.4	42.2	42.8	21.3	2.5	4.2	0.14	263.1
Dec	114.8	53.8	50.3	53.3	20.7	2.1	4.0	0.17	299.1
2011									
Jan	107.1	57.2	48.1	42.4	21.3	2.3	5.4	0.19	283.8
Feb	107.4	52.4	47.4	42.4	19.0	2.7	4.1	0.17	275.5
Mar	121.4	72.4	61.6	47.9	23.6	2.5	5.8	0.05	335.2
Apr	106.1	50.8	54.0	43.7	23.9	2.1	5.3	0.13	285.9
May	107.2	51.9	61.5	46.2	20.7	2.2	5.5	0.14	295.3
Jun	106.5	46.3	47.0	44.0	20.8	1.9	5.3	0.21	272.0

Source, Ministry of Energy

Table 1.2 murban adnoc prices 2006-2011 **US$BBL**

Month/Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
January	62.15	54.85	92.25	48.85	77.50	95.55
February	60.95	58.75	95.10	44.95	74.20	103.60
March	60.85	62.10	102.20	47.55	78.30	112.55
April	67.50	67.60	109.35	45.85	84.80	120.70
May	68.50	68.40	125.75	60.15	77.85	113.60
June	68.85	69.70	134.00	71.65	74.80	112.15
July	73.00	73.70	137.35	66.95	73.00	113.95
August	72.70	71.75	117.50	72.75	74.60	
September	63.25	78.55	98.05	69.10	75.90	
October	59.35	81.80	69.25	69.25	81.50	
November	59.70	91.75	51.40	78.60	85.65	
December	62.05	90.60	42.10	76.10	91.85	

Source, Ministry of Energy

1.3 Theoretical Frame.

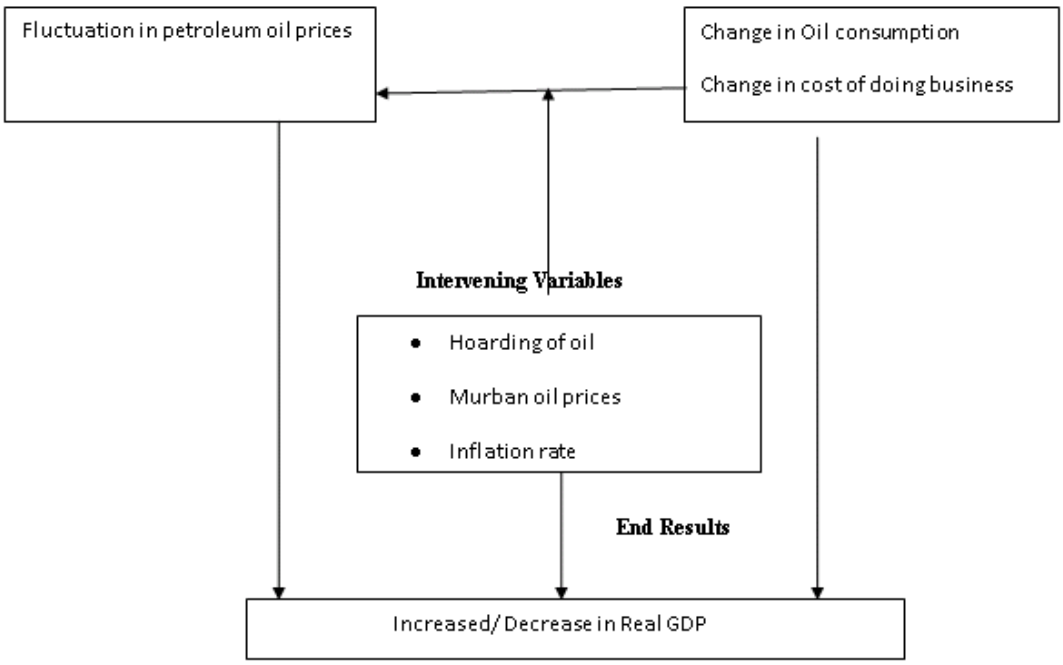
This study analyses the relationship between oil price fluctuation and economic performance in Kenya. The oil consumption amount is determined by the Willingness to Pay by the consumer. The Willingness to Pay (WTP) is an economic theory that aims to determine the amount of money that a consumer is willing to use for the energy product; this indicates the value that the consumer attaches for the energy product. The consumers' WTP is becoming a popular concept and is now one of the standard approaches used by researchers and economists to place a value on goods or services for which no market-based pricing mechanism exists {koss (2001) and Gill et al. (2000)}.

Existing Literature have suggested that there are two approaches used to analyze the consumers' willingness to pay. These are;- the direct approach, which involves taking a survey through a structured questionnaire of consumers' WTP specified prices for hypothetical services, also referred as Contingent Valuation Method (CVM). Next is the indirect approach that involves observing consumers' behavior and modeling of behavior based on the approximate expenditure in terms of time and money to obtain the goods or services and infer about WTP through measurement of revealed preference {Kristrom and Laitila (2003), Raje et al. (2002), Cookson (2000)}. The revealed preferences approach derives WTP values indirectly from the actual market behavior of individuals.

This study estimates a VAR model to determine the macroeconomic relationship between oil price consumption and economic performance in Kenya.

1.4 Conceptual Frame

There are several factors that determine the level of economic activities in a country, this include inflationary situations, exchange rates, monetary as well as fiscal policies among others. How ever the amount of oil consumption plays a major role in determining the level of activities, the question therefore is to determine the macroeconomic relationship between oil prices and economic performance. This is diagrammatically presented as follows.



2.0 Methodology

This study adopts the following Vector Auto Regressive model as proposed by Sims (1980)

$$Z_t = \mu + \sum_{i=1}^{p} A_i Z_{t-1} + \varepsilon_T : \quad \varepsilon_t \approx i.i.d(0,\Omega)$$

Where Z_t is a (Kx1) Vector of variables, μ is a (Kx1) Vector of Intercept terms, A_i is a (KxK) matrix of coefficients, p is the number of lags adopted, ε_t is a (KxK) of Vector error terms for t=1,2,3,……,T. also ε_t is independently and identically distributed i.e (i.i.d) with zero mean and a (KxK) constant Variance- Covariance matrix { $E(\varepsilon_t) = 0$, $E(\varepsilon_t \ \varepsilon_t^{'}) = \Omega$ }

2.1 Data Sources and Definition of Variable

This study adopted secondary data from Kenya National Bureau of statistics (KNBS) and the Central Bank of Kenya (CBK) data base. The dependent variable is Gross Domestic Product (GDP), while the independent variables incorporated in the model include, Murban oil prices (OP) representing import prices, Inflation (Inf) rates and Real Exchange Rates (REER).

3.0 Findings

3.1 Unit Root Test

The Augmented Dickey Fuller (ADF) Test was adopted in this study to test for unit root. The results in table 1 shows that the Null hypothesis of no Unit root was rejected at 10%

3.2 Stability Test

While interpreting the long run VAR model it is assumed that the sample coefficients remain stable over the study period since the inference drawn might be invalid if it so happens that the sample coefficients were indeed not stable. The study adopted the plot of CUSUM test and CUSUM sum of squares test as propounded by Brown et al (1975). Figure 1.1 shows that there were no statistically significant error and that the model was properly specified, otherwise instability would have been seen by movement of residue plot outside the critical lines.

3.3 Co-integration Analysis

To estimate the existence of short run as well as the long run association between the variables, the study used the Johansen and Juselius (JJ) multivariate cointegration technique. The results in Table 1.2 indicate that when two lags are adopted the null Hypothesis of no cointegration is rejected at 10% significance level. This therefore provide a precedence to conclude that there exist a long run association between the oil prices and the independent variables included in the study, hence giving a go ahead to estimate the VAR model

3.4 Discussion of Findings

After the establishment of the existence of a long run association we proceeded to estimate the VAR model. These results are presented in table 1.3. The test statistics are satisfactory. The goodness-of-fit variable (R^2) show that the exogenous variables account for 76.73% of the variations economic performance in the short run. The

DW statistic is approximately 2.0 and larger than R^2, implying that the regression is not spurious[1]. From the diagnostic test statistics, the null hypotheses of the absence of residual autocorrelation, normality, misspecification and heteroscedasticity in the residual cannot be rejected. The evidence here indicates that the macroeconomic variables (Oil performance, Real exchange rate and Inflation rate) are all having statistical significant impact on performance of the economy. It is evident that oil prices have a negative impact on the performance of the economy which conforms to findings in other countries that import oil. Therefore concluding that oil prices play a major role the performance of Kenya's economy hence calling for adequate macroeconomic management in relation to this sector.

Table 1.4 presents the wald test of significance which indicate that the variables are significant and there is no statistical problems of Auto correlation and multi-colliniarity hence satisfying our finding.

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[1] According to Granger and Neshold, an $R^2 > d$ (dw) is a good rule of thumb to suspect that the estimated regression is spurious. The estimated regression in this study reveal a non spurious regression as R^2 (0.7673)< d (2.0039)

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Appendix

Table 1.1 Unit root tests for residuals

****
Based on VAR regression of GDP on:
GDP(-1) GDP(-2) GDP(-3) GDP(-4) OP
INFL REER C
56 observations used for estimation from 2007M5 to 2011M12
****

	Test Statistic	LL	AIC	SBC	HQC
DF	-6.9848	-56.9798	-57.9798	-58.8604	-58.3046
ADF(1)	-4.8313	-56.9788	-58.9788	-60.7400	-59.6282
ADF(2)	-3.8650	-56.9777	-59.9777	-62.6195	-60.9519
ADF(3)	-3.6417	-56.7182	-60.7182	-64.2406	-62.0171
ADF(4)	-3.1092	-56.7180	-61.7180	-66.1210	-63.3417
ADF(5)	-2.7381	-56.7180	-62.7180	-68.0016	-64.6664
ADF(6)	-2.4547	-56.7179	-63.7179	-69.8821	-65.9911
ADF(7)	-3.2548	-53.7870	-61.7870	-68.8318	-64.3849
ADF(8)	-2.8183	-53.7869	-62.7869	-70.7123	-65.7096
ADF(9)	-2.5393	-53.7807	-63.7807	-72.5867	-67.0281
ADF(10)	-2.3526	-53.7613	-64.7613	-74.4479	-68.3334
ADF(11)	-1.9384	-53.5514	-65.5514	-76.1186	-69.4482
ADF(12)	-1.7980	-53.5507	-66.5507	-77.9985	-70.7723

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Table 1.2 Co-integration with no Intercepts or Trends in the VAR

Co-integration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

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56 observations from 2007M5 to 2011M12. Order of VAR = 1.
List of variables included in the co-integrating vector: GDP
List of I(0) variables included in the VAR: OP INFL REER
List of eigenvalues in descending order: .040825
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Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	2.4593	4.1600	3.0400

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Use the above table to determine r (the number of co-integrating vectors).
Co-integration with no intercepts or trends in the VAR
Choice of the Number of Co-integrating Relations Using Model Selection Criteria
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56 observations from 2007M5 to 2011M12. Order of VAR = 1.
List of variables included in the co-integrating vector: GDP
List of I(0) variables included in the VAR: OP INFL REER
List of eigenvalues in descending order: .040825
****

Rank	Maximized LL	AIC	SBC	HQC
r = 0	-76.3548	-79.3548	-82.4711	-80.5713
r = 1	-75.1252	-79.1252	-83.2803	-80.7472

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AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Table 1.3: OLS Estimation of a Single Equation in The Unrestricted VAR

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Dependent variable is GDP
56 observations used for estimation from 2007M5 to 2011M12

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Regressor	Coefficient	Standard Error	T-Ratio[Prob]
GDP(-1)	.89944	.14283	6.2974 [.000]
GDP(-2)	.0048291	.19205	.025144 [.980]
GDP(-3)	.0073766	.19250	.038321 [.970]
GDP(-4)	.8530E-4	.14709	.5799E-3 [1.00]
OP	-.0042568	.0067912	-.62681 [.034]
INFL	-.012422	.014618	-.84980 [.040]
REER	.011249	.0064774	1.7367 [.008]

****

R-Squared .79269 R-Bar-Squared .76730
S.E. of Regression .94804 F-stat. F(6, 49) 31.2261[.000]
Mean of Dependent Variable 4.3286 S.D. of Dependent Variable 1.9653
Residual Sum of Squares 44.0406 Equation Log-likelihood -72.7338
Akaike Info. Criterion -79.7338 Schwarz Bayesian Criterion -86.8226
DW-statistic 2.0039 System Log-likelihood -72.7338

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A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

Table 1.4 Wald Test of Restriction(s) Imposed on Parameters

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Based on VAR regression of GDP on:
GDP(-1) GDP(-2) GDP(-3) GDP(-4) OP
INFL REER
56 observations used for estimation from 2007M5 to 2011M12

****

Coefficients A1 to A7 are assigned to the above regressors respectively.
List of restriction(s) for the Wald test:
A1+ A2+ A3+ A4+ A5+ A6+ A7=2

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Wald Statistic CHSQ(1)= 239.2899[.000]

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Figure 1.1 Plot of Cumulative Sum of Recursive Residuals