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Energy and Economic Growth: Does a Rise on Commercial Energy (Fuel Price) Have an Impact On Economic Growth? Evidence for Zambia

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Cecilia Mulenga*
Department of Economics
Information and Communication University
Ceciliamulenga1@gmail.com

Abstract

The Energy Regulation Board (ERB) *recently announced a rise on commercial energy i.e. fuel prices effective October 14th, 2016. A litre of Petrol costing K13.70 up from K9.87 whiles a litre of Diesel costing K11.40, an increase from K8.59.****In addition to this, the IMF struck an alarmist note in its 1st November assessment of Zambia's economy. The Fund pointed to recurrent electricity shortages, low exports and weak domestic demand as the main culprits of the economy's underperformance. Is a raise on commercial energy be regarded as one of the contributing factor to Zambian recent economic outlook?***

Purpose – *The paper aims at analysing econometrically (long and short run) the aforementioned commercial energy adjustment's response to economic outlook of Zambian economy, combining it with other independent variables such as inflation and unemployment rate. It will further analyse the stability of domestic economy which emerges as the result of price adjustments made on commercial energy using population and trade balance data.*

Methodology *- The paper employs macroeconomic models which include, Phillip, Kinked-Demand and Solow to analyse the situation on four variables thus; fuel, inflation, unemployment and economic growth (GDP) and evaluate further econometrically using panel method (in time series), the impact of the change to the economy (GDP) in a short and long run terms through granger causality and cointegration tests (unrestricted).*

Findings *- The examined results indicate long run valid relationship among all variables. Short run association ship on the other hand turned out to be significant only on three variables, thus fuel, unemployment and GDP. Cost Push inflation fallouts as a result of increase price on oil due to cost of production from raw materials, currency devaluation and expected/unexpected changes in current laws and regulations.*

Originality/Value *– The 2016 adjustment on fuel price in Zambia brought about concerns and reputed it being the reason to current economic fluctuations on industrial and economic productivity/efficiencies thereby, affecting inflation and growth instability. To support this concern, the paper, calls for solution at macro level using 2001-2016 statistical data on average fuel prices and economic growth. No study in Zambia has yet been conducted to define the impact of this change on the economy in econometric sense, and relates it to macro determinants in time series perspective.*

Keywords - Commercial Energy -Fuel, Inflation, Economic Growth.

1. INTRODUCTION

Analyses of energy problems according to Sabhes C, (2011) have attracted inter-displinary interests, and researchers from various fields have left their impressions on these studies. Energy issues according to Sabhes have been analysed from an economic perspective for more than a century now and one of the reasons were dramatic increase in oil prices in the 1973-1974 (Edward 2003) that highlighted the importance of energy in economic development of the country. Since then, researchers, academics and even policymakers have taken keen interest in energy studies and that is why energy economics has emerged as a recognised branch on its own. Commercial energy in his study included energy that is traded wholly or almost entirely in the market and therefore would command a market price. Examples include coal, oil, gas and electricity.

However, basing the study on the above conceptual perspective, the Energy Regulation Board (ERB) in times of Zambia paper announced a rise on commercial energy (fuel price) effective October 14th, 2016. On the other hand, the IMF Zambia struck an alarmist note in its 1 November assessment of Zambia's economy. The Fund pointed to recurrent electricity shortages, low exports and weak domestic demand as the main culprits of the economy's underperformance. Additionally, Zambian current situation according to Zambia_BG-2016 WEB also included that the electricity-supply deficit which began in June 2015, had affected manufacturing and other businesses. As the result, operating costs have increased as firm have had to invest in diesel generators and this increased costs has passed on to consumers.

Nevertheless, some previous studies according to IMF (www.oilprice.com) indicate that import bills usually go up when oil prices increase thus commercial energy, and more surprisely GDP often goes up too. In short, there is a positive correlation that when commercial energy prices go up, GDP goes up and when energy prices go down, GDP goes down.

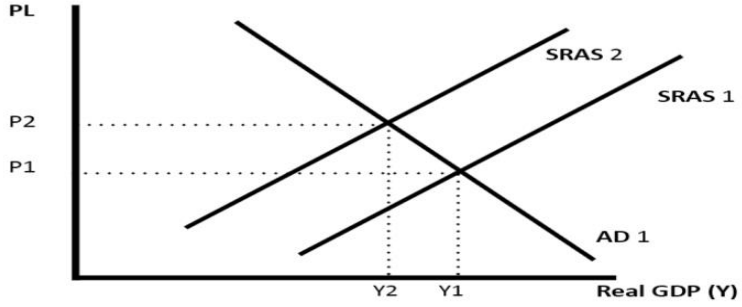
The main interest of the paper is to investigate the correlation of commercial energy price – in this case gas, and GDP in developing countries like Zambia basing the supposition that higher gas prices are generally positively associated with good global conditions using 2001 – 2016 statistcal data. More so, determine the gas price volatility on Zambian Economic growth.

2. THEORITICAL REVIEW

2.1 Cost-Push Inflation

Study according to Tejvan (2011), reviewed that cost push inflation occurs when we experience rising prices due to higher costs of production and higher costs of raw materials. Cost push inflation is determined by supply side factors.

Figure 1.0



Aggregate supply curve shifts to the left, causing higher price level and lower real GDP.

For cost-push inflation to take place, demand for the affected product must remain constant during the time the production cost changes are occurring. To compensate for the increased cost of production, the producers raise the price to the consumer to maintain profit levels while keeping pace with expected demand.

According to Tejvan, the long term solution to cost push inflation could be better supply side policies which help to increase productivity and shift the AS curve to the right. But, these policies is believed to take a long time to have an effect.

According to Tejvan (2011), causes of Cost Push Inflation include;

1. Higher Price of Commodities. A rise in the price of oil would lead to higher petrol prices and higher transport costs e.g. *year 2006-08 and 2015-16 case of Zambia*
2. Imported Inflation. Devaluation will increase the domestic price of imports. Therefore, after a devaluation we often get an increase in inflation due to rising cost of imports, e.g. depreciation of Kwacha currency e.g. *year 2015-16, case of Zambia*

Cost push inflation could be caused by a rise in oil prices or other raw materials. Imported inflation could occur after depreciation in the exchange rate which increases the price of imported goods.

Additionally, many studies indicate that a combination between Phillips curve (1914-1975), mark-up pricing demonstrate the positive relationship between inflation and real GDP. The illustration proved positive relationship for Zambian economy in the year 2015-2016 for only three variables; fuel price, inflation and GDP.

Expected Causes of Cost-Push Inflation

In support of Keynesian theory according to Alan S. (2008), other activities other than cost of production on oil can lead to high inflation. These include;

- Sudden change in government decisions such as changes in current laws and regulations i.e. Higher Taxes, which include higher VAT and Excise duties on goods can increase the prices of goods.

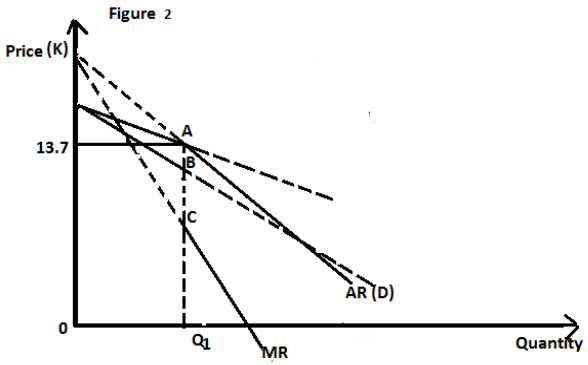
Cost-Push vs. Demand-Pull

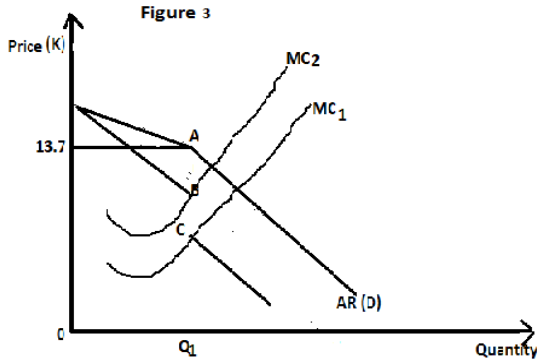
The opposite of cost-push inflation, where increased production costs drive the price of a particular good or service up, is demand-pull inflation. Demand-pull inflation includes times when an increase in demand is experienced and production cannot be increased to meet the changing need. In these cases, product costs rise as a reflection of the imbalance in the supply and demand model.

2.2 Market Behaviour

2.2.1 **The Kinked Demand Curve - Analysis Price and Cost Output AR1 P1 AR2.**
This theory starts with assumption that firms are settled on a price P1 and quantity Q1. At price D1 the demand curve is elastic above P1 and it is demand inelastic below P1 Q1

- Raising price above P1 (i.e. above K13.7): Likely reaction of other firms is to hold their prices. This will cause an elastic demand response for this firm and results in lost sales and falling total revenue Q1 P2 Q2
- Cutting price below P1 – the likely reaction of other firms is to follow the price reduction. Demand likely to be relatively inelastic – little benefit in terms of extra sales and total revenue Q1 P2 Q2 P3 Q1





In figure 1, assume the price of a litre of unleaded petrol is now prevailing at K13.8. This is the price charged by all three firms in Lusaka. If one of the three firms put their price up to K13.9 a litre, what would happen next? Most people would buy their petrol from one of the other two firms. The price-raising firm will experience a large proportionate drop in sales relative to the proportionate rise in price, and so a drop in revenue.
It will have found that the demand for its petrol following the price rise was very **elastic**. This is because the other two firms knew that they would gain extra sales if they left their price at K13.8, so they did not follow the price rise.

What if one of the firms decided to cut its price to K13.7p a litre? Most consumers would try and buy their petrol from the cheaper firm. The other two firms know this is going to happen following the price cut, so they match the price cut. Assuming that overall demand is unlikely to rise substantially, all three firms will find that the rise in demand for their petrol is proportionately small compared with the proportionate fall in price, so their revenues fall. Demand is very **inelastic** following a price cut.

- The Kink! Price and Cost Output AR1 P1 AR2 • If demand is relatively elastic following a price rise and relatively inelastic after a price fall – we create a kink in the oligopolists demand curve (AR).

In the real world, when the government increase petrol duties every year in the Budget, oil price rose substantially, causing all petrol retailing firms to raise their price. Notice, though, that when the price does rise, it then settles at the higher price for a while at **all petrol stations**. Basically, the kinked demand curve model still holds, it's just that the kink (point A) has shifted up a bit. All this price rigidity means that firms do not compete on price, so they have to resort to **non-price competition**.

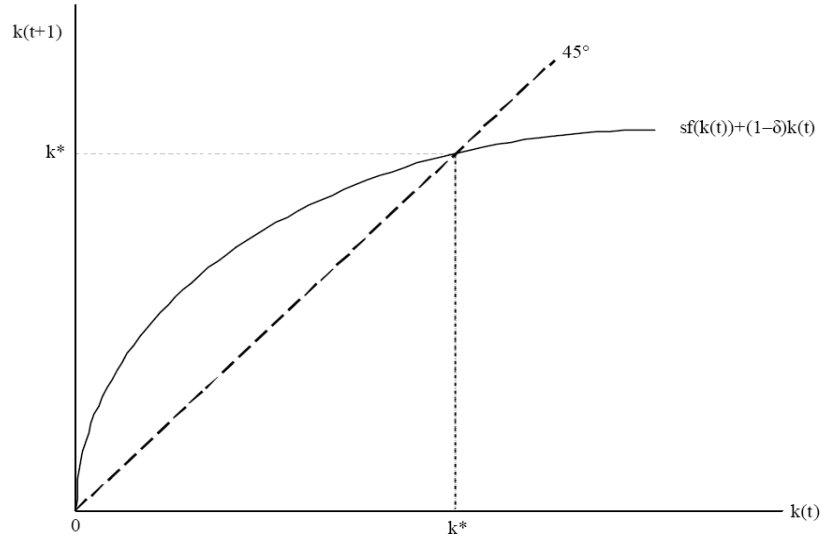
In conclusion, one of the key predictions of the kinked demand curve model is that prices will be rigid or "sticky" even when there is a change in the marginal costs of supply (this is assuming that firms in the market are profit seeking) MR1.

2.3 **Solow Model in Discrete time Plus increase in fuel price**

❖ **Consider an Equilibrium without Population and Technological Progress (Steady-state)**

By definition, a steady-state equilibrium without technological progress and population growth is an equilibrium path in which k (t) = k^* for all times (t) (Daron A, 2011).

Figure 4. **Steady state**



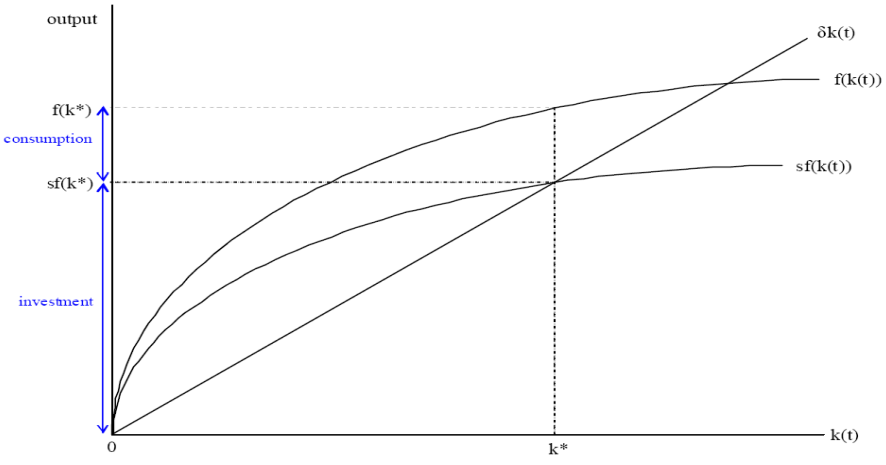
>>Steady State economy; Population and Technology Progress, Daron A, 2011

The (positive) intersection gives the steady-state value of the capital-labor ratio k^*, therefore, F (k^*)/k^* = ϑ/s

Alternative visual representation of the steady state: intersection between *d*k and the function sf (k) are useful because:

- Depicts the levels of consumption and investment in a single figure.
- Emphasizes the steady-state equilibrium sets investment, sf (k), equal to the amount of capital that needs to be "replenished", *d*k.

2.3.1 **Figure 5. Consumption and Investment in Steady State**



Steady state, Consumption and Investment Daron A, 2011

Assuming equilibrium without population growth and technological progress;

$y^* = f(k^*)$ then Consumption is given by $c^* = (1 - s) f(k^*)$

Note;

In the basic Solow growth model, the highest level of steady-state consumption is reached for S_{gold}, with the corresponding steady state capital level k^*_{gold} such that;

$$f'\left(k^*_{gold}\right) = \delta$$

Where k^*_{gold} and is the corresponding steady-state golden rule capital stock.

2.3.2 The Golden Rule: Figure 6

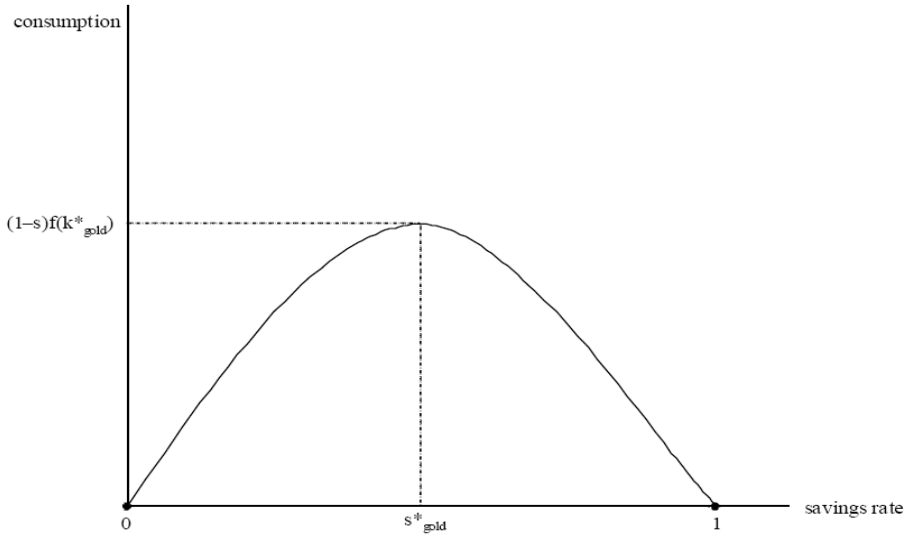


Figure: The 'golden rule' signifies level of savings rate, which maximizes steady-state consumption.

- When the economy is below k^*_{gold}, higher saving will increase consumption; when it is above k^*_{gold}, steady-state consumption can be increased by saving less.
- In the latter case, capital-labour ratio is too high so that individuals are investing too much and not consuming enough (dynamic inefficiency).
- However, such dynamic inefficiency will not arise once consumption-saving decisions are endogenised.

Therefore, assuming a steady-state path and that part of the extra income from the increasing commercial energy prices is invested in the domestic economy, the impact on the rate of change in the real GDP will be similar to the growth of the saving rate according to Solow model in both short and long run terms.

3. EMPIRICAL METHODS OF MULTIVARIATE VARIABLES

3.1 Panel Methods

Multivariate, refers to the modelling of data that are often derived from longitudinal studies, wherein an outcome is measured for the same individual at multiple time points (repeated measures), or the modelling of nested/clustered data, wherein there are multiple individuals in each cluster. A multivariate linear regression model would have the form

$GDP_{it} = Y = \alpha + \beta_1 X_{it} + \beta_2 X_{it} + \varepsilon_{it}$ (1)

Where GDP_{it} is equal to Y (Output), which is the size of gross domestic product in country i in year t; X_{it} is the independent variables (Fuel : Inflation) in year t; α is the intercept; β_1 is the slope parameter; ε_{it} is the error term.

The hypotheses on parameters and error terms will usually tested by:

3.2 Long run Analysis

- Vector Autoregressive models VAR(p) models

VAR models (vector autoregressive models) is used for multivariate time series. The structure is that each variable is a linear function of past lags of itself and past lags of the other variables.

A VAR model in this case, describes the evolution of a set of *k* variables (called *endogenous variables*) over the same sample period (*t* = 1..., *T*) as a linear function of only their past values. The variables are collected in a *k* × 1 vector y_t, which has as the i^{th} element, $y_{i,t}$, the observation at time "t" of the i^{th} variable. For example, if the i^{th} variable is GDP, then $y_{i,t}$ is the value of GDP at time *t*.

A *p-th order VAR*, denoted **VAR (*p*)**, is

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + e_t, \quad (2)$$

3.3. **Short Run Analysis – Granger Causaulity**

The **Granger causality test** in this case will be used to analyse for short run cointegration among the variables under scrutiny. Granger Causality test is a statistical hypothesis **test** for determining whether one time series is useful in forecasting another. Y is said to be Granger-caused by x if x helps in the prediction of y, or equivalently if the coefficients on the lagged x's are statistically significant.

$$B_1 = \beta_2 = \ldots = \beta_t = 0 \quad (3)$$

For each equation. The null hypothesis is that x does *not* Granger-cause y in the first regression and that y does *not* Granger-cause x in the second regression (Granger, 1969)

3.4 Diagnostic Tests -Pooling tests

- If the homogeneity assumption over the coefficients is established and establishes the presence of unobserved effects, by comparing residuals with the alternative of group (time) specific effects in the error term. Therefore, diagnostic test such as heteroscedastic, Normality and serial correlation would be determined.

4 RESULTS AND DISCUSSION

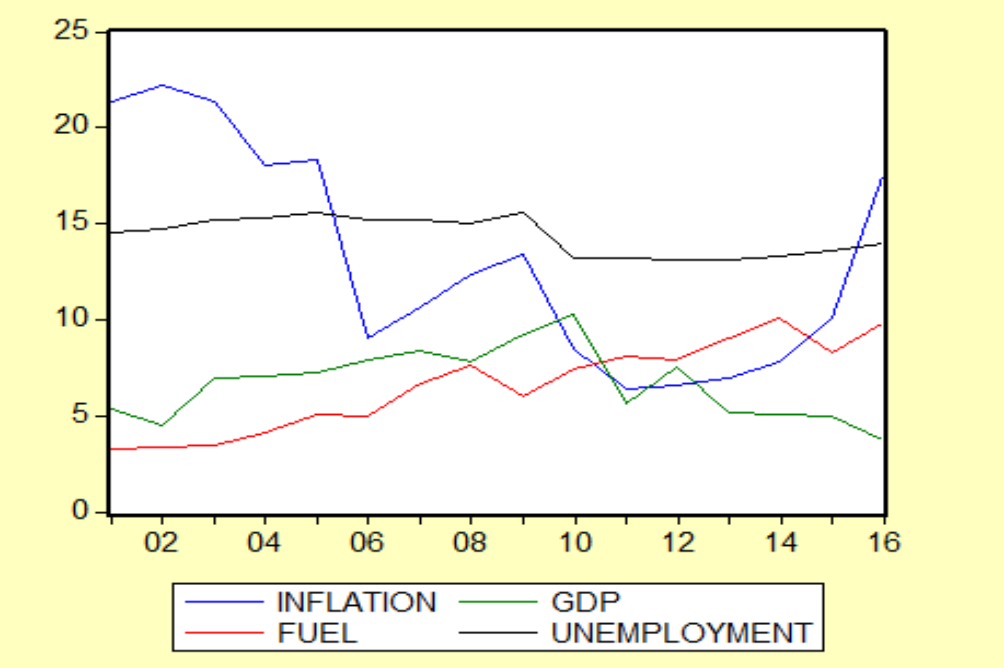
Hypothesis Testing

- Alternative Hypothesis (H_A) – Exports contribute to economic growth.
- Null Hypothesis (H_0) – Exports do not contribute to economic growth

TESTING FOR LEAST ORDINARY SQUARE (OLS)

In this test, the variables were examined through graphical inspection of their time series plots using regression analysis. The variables are gross domestic product (y) and explanatory variables being average fuel prices, inflation and unemployment rate for the period 2001 - 2016.

Figure 7: ***2001-2016, Zambian Economic Outlook on GDP, Inflation, Fuel price and unemployment rate***



Inflation Rate averaged 10.09 percent from 2005 until 2017, reaching an all time high of 22.90 percent in February of 2016, thereby recording the high average percent of 17.43 for the year 2016. Results originated from world bank statictical data nad Energy Regulation Board (ERB) annual statistical data.

Table 1

Panel Data Results

Residue Test	P-Value
Heteroskedasticity	0.814
Serial Correlation	0.282
Normality	0.005
OLS-Fitnes	
R 2	0.501
Prob(F Statistic)	0.03

For 95% confidence level,, a p-value of less than 0.05 indicates statistically significant model. And without serial correlation however, not normally distributed.

Representation

GDP= C(1)*INFLATION+ C(2)*FUEL + C(3)*UNEMPLOYMENT + C(4)
GDP = -0.2990*INFLATION– 0.3652*FUEL + 1.0823*UNEMPLOYMENT-2.4167

4.2 ADF (Unit Root Test):

4.2.1Testing for Unit Root

In this test all variables were taken into consideration i.e. GDP, inflation, unemployment rate and Fuel price. The analysis test the level of integration of the variables and the purpose was to determine

whether the variables follow a non-stationary trend; i.e. follow the order of 1 denoted as I(1) or whether the series are stationary, follow the order of 0 denoted as I(0).

Table 2: Augmented Dickey Fuller (ADF) Test Results.

	Intercept	Constant with Trend & Intercept	Comment
Levels(lag2)	**-3.122	**-3.829	hypothesis accepted
ADF t-statistic	-0.568	-1.028	
Prob	0.584	0.334	
1st Difference			
Lag 2	**-3.148	**-3.873	Hypothesis accepted
ADF t-statistic	-1.528	-2.142	
Prob	0.165	0.069	
2nd Difference			
Lag 2	**-3.180	**-3.927	Hypothesis Rejected
ADF t-statistic	-3.209	-3.023	
Prob	0.015	0.023	

Notes: *** indicates significance at 1% level
** indicates significance at 5% level
* indicates significance at 10% level

Note: The null hypothesis of a unit root is rejected in favor of the stationary alternative in this case 2nd Difference in that test statistic is more negative than the critical value as well probability of less than 5%.

The results obtained from **table 4.2.1** provide strong evidence in both intercept and 1st difference (with and without trends) and that variables are non-stationary, meaning they are integrated at an order of 1. The trend indicates that null hypothesis cannot be rejected for any of the variables under examination.

The second differences, reject the unit root, which means that they are integrated and stationary at an order of 0, i.e. I (0) at the 95 per cent confidence level.

4.3 Johansen Cointegration Test: Three Variables

The test checks whether variables Fuel, GDP, unemployment rate and Inflation are cointegrated or have a long run association ship.

We test whether they are cointegrated – that is, whether a linear function of these is I (0). An example of a linear function is GDP = a_0 + a_1Fuel + a_2Inflation + u_t, when u_t = [GDP - a_0 - a_1Fuel] might be I(0) from the relationship

The test in this analysis assumes no trend in the series with a restricted intercept in the cointegration relation (the test is computed using assumption 2 in the dialog, Intercept (no trend) in CE – and test VAR).

The cointegration test was directly performed cointegration, however, observations were not sufficient to extract p values, therefore decision was made based on Likelihood tests that were less than critical values. But for argument purposes, VAR unrestricted was conducted which produced enough evidence to indicate long run relationship among the variables.

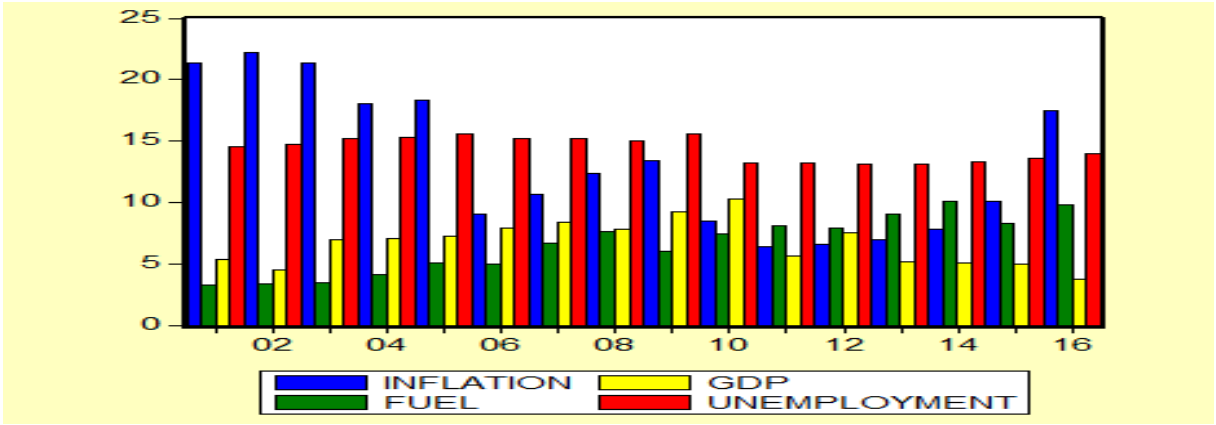
Table 3: Vector Auto-regression Test Analysis and Results – Long run relationship

Vector Auto Regression (VAR - UNRESTRICTED)		
	p-value	Comment
C1(GDP)	0	significant - good sign and cointegrated
C2(INFLATION)	0	significant - good sign and cointegrated
C3(FUEL)	0	significant - good sign and cointegrated
C4(UNEMPLOYMENT)	0	significant - good sign and cointegrated

VAR unrestricted produced non-significant results (a good sign) that in-tells long run association ship as well as indicates that GDP variable depends on either fuel, unemployment rate or inflation and they move together in a long run.

We can therefore, conclude that all variables have a long run relationship, meaning they move together in a long run and affecting not only inflation and economic growth but also unemployment rate, see figure 8 below

Figure 8: Effect of High Fuel Price on GDP, Inflation and Unemployment rate - Long run.



- **We can therefore, conclude that in long run, the higher inflation leads to fuel adjustments which as well in return declines GDP thus result to increases in interest in unemployment rate by day. Check below short run analysis;**

Table 4: Granger Causality

Granger Causality Test results – Lag 3

Null Hypothesis:	Obs	F-Statistic	Probability
FUEL does not Granger Cause INFLATION	13	0.17837	0.90727
INFLATION does not Granger Cause FUEL		4.53427	0.05502
GDP does not Granger Cause INFLATION	13	1.84450	0.23972
INFLATION does not Granger Cause GDP		1.70308	0.26484
UNEMPLOYMENT does not Granger Cause I	13	0.34790	0.79249
INFLATION does not Granger Cause UNEMPLOYME		0.36183	0.78325
GDP does not Granger Cause FUEL	13	0.39286	0.76294
FUEL does not Granger Cause GDP		7.67055	0.01778
UNEMPLOYMENT does not Granger Cause F	13	0.20849	0.88699
FUEL does not Granger Cause UNEMPLOYMENT		2.96767	0.11909
UNEMPLOYMENT does not Granger Cause	13	17.5409	0.00225
GDP does not Granger Cause UNEMPLOYMENT		3.49234	0.08995

- **If P > 5% then H (o) (Null hypothesis cannot be rejected)**

Evidence of short run association-ship also existed among variables in three levels only, thus inflation >>fuel (in support of demand-pull inflation in lag 1)), Fuel>>GDP and unemployment rate>>GDP all move together in short run and run one way.

In Summary

- Results from regression analysis-OLS were significant and without serial correlation, hence could not deny relationship among variables under scrutiny.
- Evidence from ADF (unit root test) produced positive results with an indication of no unit root/interference in variables under analysis.
- Long run analysis via VAR-unrestricted produced significant results in all variables, meaning that independent variables could significantly affect dependant variable GDP and that variables are correlated.
- Evidence of short run association-ship also existed among variables in three levels only **,** thus inflation >>fuel (in support of demand-pull inflation), Fuel>>GDP and unemployment rate>>GDP move together in short run and run one way

5.0 CONCLUSION

The empirical findings lead to a conclusion that there is sufficient empirical evidence to support long run relationship among the variable under scrutiny i.e. GDP, fuel price, inflation and unemployment rate. Therefore, on the basis of annual data extending from 2001 to 2016, the results suggest that the variables under consideration are cointegrated, meaning share a linear common trend and move together in the long term, indicating a strong relationship. Moreover, short term association ship exist as a results of effect on inflation which in return impacts fuel price thereby affecting both unemployment rate and decline demand on GDP. These variables move together in the short run and run one way.

Additionally, from the analysis under study (short run), **demand-pull inflation** arose as the result of increase in aggregate demand of macro-economy such as households, businesses, government purchases and depreciation of local exchange rates which reduces price of exports and raises price of imports, as a result, purchasing power of imports decreases while the buying of exports by foreigners increases, thereby raising the overall level of aggregate demand. At firm level, production increases due to increased demand, i.e. the cost to produce each additional output increases and this in return increases the cost of production. However, in support of Keynesian theory, other activities other than cost of production can lead to high inflation as well. These include; sudden change in government decisions such as changes in current laws and regulations i.e. Higher Taxes.

Kinked demand curve theorem also added that in prevailing market, raising fuel price above the floating price causes an elastic demand response and results in lost sales and falling total revenue for that firm. Therefore, the firm seeking profits from the commodity usually experience rigid or “sticky” price that results to change in the marginal costs of supply.

Lastly, a steady-state path in accordance with Solow model would only be applicable when part of the extra income from the increasing commercial energy prices is invested in the domestic economy, leading to the rate of change in the real GDP which then results to growth of the saving rate and in return produces positive indicator in Economic Trade Balance.

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