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Statistical Relationship of Petrol Price and Inflation in South Africa

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Abstract: The study applied statistical methods to obtain the relationship between the petrol priceand inflation. Since the prices of petrol 93 and petrol 95 differ, separate relationships were sought. In determining the relationship between petrol price and inflation, a time series model for the petrol price and inflation was developed. The study used secondary data sourced from the Department of Energy, South Africa. The data for petrol price was obtained from the published report that is from the Department of Energy and Statistics South Africa (Stats SA) while for inflation data, stats SA provided them. The Pearson's correlation coefficient was used to measure the strength of the statistical association between petrol and inflation. For petrol 93 and 95, the correlation coefficients were found to be 0.055 and 0.059. This means that a weak but positive relationship between inflation and petrol price was found. Based on the study it is concluded that inflation has a minor impact on the petrol price.

Key words: Inflation, petrol price, seasonality, trend, based

INTRODUCTION

Petrol price in South Africa fluctuates unpredictably as is the case with inflation due to the unstable political landscape and alleged corruption. Almost every household in the country is dependent on petrol price for one or other things, mainly transport. The micro-enterprises on which the poor depend on are dependents on transport to collect items from wholesales or manufacturing companies. The inflation on the other hand is related to petrol price. Thus, when petrol price rises and when inflation rises, people are affected. The more sufferers are the poor as they are affected by any or both of these items. The high fuel price can be observed within the macroeconomic framework. Price of goods is determined by the role of transport. South Africa is highly dependent on transportation for goods. South African's economy almost totally relies on a road-based transport system which is affected by fuel price. The cost of these services increases as the fuel prices increases. In South Africa, Mashamba (2016) explained that the fuel price is influenced by inflation, fuel levies, transportation and delivery cost, rand (or currency) value and wholesales margins, among others.

Inflation is often defined as a rise in the general level of the price of good and services in the economy over a period of time (Lagasse, 2000). According to Rangasary (2017), when the inflation rate is too high, price increase significantly. This usually has a negative impact on the consumer. The inflation rate reflects the annual percentage change in the consumer price index which is the rate change in the price of a good (such as petrol) and service by consumers. The study was investigating the association between the petrol price and inflation. Inflation and petrol price have been rising continually over the years in South Africa. However, the statistical relationship between those two variables is important. An understanding of the relationships of economic factors enable better practice. For strategic level, factors that affect the inflation may be curbed where possible. However, in this study, it may encourage buyers to make options that can enable sustain ability of resources around their livelihoods.

Purpose of this study: This study sought to apply statistical methods to obtain a relationship between the petrol price and inflation (for both 93 and 95 petrol categories). The objectives were two-fold. One was to determine the relationship between petrol price and inflation. The other was to develop a time series model for the petrol price and inflation.

Petrol price: Petrol prices for South Africans are adjusted based on import parity pricing principle. Since, the 1950's, South African fuel prices have been based on the import parity pricing principle which links the domestic price of products to the importer cost of the product. The import parity price of petrol was based on the In-Bound Landed Cost (IBLC) formula. This formula was implemented in the 1950's and was used to calculate the retail prices for fuel until April, 2003 (Rangasamy, 2017). Since, 2003 April, the Basic Fuel Price (BFP) replaced the international component in the IBLC formula. BFP is also based on the import parity pricing principle. The change

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to BFP was made in order to provide a more accurate estimate of the international price of petroleum. The international price element in the formula was calculated by considering the current petroleum price on the market and the cost linked with transportation. According to Heyden and Tseda, petrol price is composed of two elements, international BFP and domestic BFP. The international element is based on the cost of the importer to buy petrol from an international refinery and transport it to South Africa. It includes the international petrol price in rand, transport, insurance costs and costal storage fees. Price of petrol is determined by the oil prices and the exchange rate. The domestic price of petrol is determined by transport cost, government taxes, levies and the retail and wholesale margins are added to the BFP. The BFP contributes about 61% of the petrol price. Government taxes account for 25% and margin for wholesales and retails makes up almost 14% of the price.

Inflation: According to Lagasse (2000), inflation means a continued increase in the prices of goods and services in an economy over a period of time. When the general price level increases, each unit of currency buys fewer goods and services. As a result, inflation reflects a reduction in the buying power per money unit of money. It also leads to a loss of real monetary value in the currency (or medium of exchange) and unit of account within the economy. A principal measure of price inflation is the inflation rate, the annual percentage change in a general price index which would usually be the Consumer Price Index (CPI) over time. Svensson (2003) explains that inflation affects economies in various positive and negative ways. The negative effects of inflation include an escalation in the opportunity cost of holding money and uncertainty over future inflation which may discourage investment and savings, among others. If inflation is quick, shortages of goods as consumers may buy in bulk with the concern that prices may increase in the future. On the other hand, positive effects include reducing unemployment due to nominal wage rigidity. This, according to Abel and Bernanke (2005), may enable the central bank more scope in executing monetary policy, inspiring loans and investment and eluding the inefficiencies associated with deflation which is the opposite of inflation.

Therefore, inflation forces people to buy fewer items than they used to manage as they cannot afford as they usually had. There is also reduced savings as people would have less money than before and this, therefore, leads to reduced investment which in turn reduces the general economic growth level. Munyeka (2014) also enlightens that inflation brings about inefficiencies that lead to misallocation of resources and a general decline in macro-economic performance. When there is higher inflation, there are several possibilities. There may be an increase in the economic growth rate because as depreciation raises, the tax paid is reduced. The effect is often a decrease in the growth rate. As the money supply increases, so do the nominal interest rates. Tax credits on depreciation may be reduced and this would often result in an increase in the cost of capital (Hodge, 2005).

Oil price a determinant of inflation: If the oil price increases, it may lead to a higher interest rate which limits consumer expenditure. It also slows down global economic growth because of the high oil price reduces disposable income. Nkomo (2006) explains that many sectors of the economy tend to be affected as expenditure on the good is reduced. Increasing oil price will trigger inflation. The increase in input cost reduces non-oil demand and lower investment. The oil price increment leads to upward nominal wage levels. Nigeria's wage, together with reduced demand, may lead to higher unemployment (Akpan, 2009). World oil sales are denominated in US dollars (Nkomo, 2006). This means that any change in the currency value affects the OPEC's (Organization of Petroleum Export Countrie's) decision. Since, the crude oil is purchased in US dollars, the dollar-rand exchange rates for crude oil and fuel prices in the US dollar against other major currencies contribute to increasing fuel prices.

Correlation between inflation and petrol price: Inflation can be caused by a higher petrol price and in fact, the oil price seems to be connected to inflation (Arinze, 2011). The increase in the petrol price causes the inflation rate to increase. It means that there is a positive relationship between oil price and inflation. The change in petrol price on inflation can be seen through the increase in the consumer price index. The higher petrol price drives the consumer price index to increase. Cologni and Monera (2005) also highlight that the oil price has an effect on inflation and output growth. The higher oil price causes higher inflation and lower output growth. Many countries (such as France, Germany and the US) reacted to the problem by increasing the interest rate to overcome inflation.

Effects of inflation in some countries: In 2003, LaBlane and Chin conducted a study to determine the effects of inflation in some countries. The oil price changes on inflation for the United Kingdom, United States, Germany, France and Japan by employing Philips Curve parameter estimates. The results show that oil price increase that occurred at the time caused inflation in the US, Japan and Europe. The oil price had increased by 10% and an increase in the oil price cause inflation to increase around 0.1-0.8% in the US and Europe. Moreover, in Europe, the oil price had a larger effect on inflation compared to the US.

MATERIALS AND METHODS

Data collection: The study used secondary petro, price data and inflation rate quantitative data sourced from the Department of Energy in South Africa and Statistics South Africa (Stats SA). The data were presented monthly for the data period from 2014-2018 and thus, stretching for 60 months.

Data analysis: Petrol price and inflation data are published in the time interval. Time series model was applied and comment on the trend and seasonal patterns. Correlation analysis was applied to show the strength of the petrol price and inflation. Linear regression was applied to establish the relationship between petrol price and inflation in petrol which the price was the dependent variable while inflation was the independent variable. Pearson's correlation coefficient was determined to measure the strength of this statistical association. The sample correlation coefficient, denoted by r, ranges between negative 1 and positive one and quantifies the direction and strength of the linear association between two variables.

The correlation between two variables can be either be negative or positive with positive correlation implying that all variables are positively influencing one other while the negative correlation implies the inverse proportionality between the variables. When r = 0, then there is no association between the variables. The sign of the correlation coefficient indicates the direction of the association and the magnitude of the correlation coefficient indicates the strength of the associate.

Bivariate regression analysis, also known as method of least square regression was used to establish the relationship. It involves two variables denoted by X and Y where one is the independent variable while the other is the dependent variables (DJs Research Ltd., 2016). In this study, inflation is the X variable while the petrol price is Y variables. The simple linear regression equation is as follows:

$$\hat{Y} = b_0 + b_1 X + \varepsilon \quad (1)$$

Where:

$\hat{Y}$: The predicted or expected value of the outcome
X : The predictor variable
b_0 : The estimated Y-intercept
b_1 : The estimated slope
ε : The error term

Tools that were used in this study are Microsoft Office and all statistical analysis was performed on IBM Statistical Package for the Social Sciences (SPSS).

RESULTS AND DISCUSSION

Scatter plots: The data that was collected and used in this study was based on South African inflation and petrol price over the year from 2014-2018. The scatter plots for two of those variables (inflation and petrol price) are studied, i.e., scatter plot for inflation relative to 95 petrol price and inflation relative to 93 petrol price (Fig. 1 and 2). Scatter plots are used to show the relationship between two variables. Scatter plot sometimes is referred to as correlation plots as they show how two variables are correlated.

Correlation analysis: Pearson's correlation coefficient (r) was determined to measure the strength of the relationship between the two variables inflation and petrol prices. Table 1 gave the Pearson's correlation coefficient between inflation and 93 petrol price. It showed a weak but positive relationship between inflation and 93 petrol price (r = 0.055). Table 2, on the other hand, gave the Pearson's correlation coefficient between inflation and 95 petrol price. It also presented a weak and positive relationship between inflation and 95 petrol price (r = 0.059).

Simple linear regression analysis: From Table 3, assists in explaining the details of Fig. 1 that were presented earlier. A simple linear regression for 93 petrol price and inflation was obtained with the 93 petrol price being the predicted variables (dependent) while the inflation being predictor variables (independent). The line of best-fits:

$$\hat{y} = 623.808 + 16.746x$$

Table 4 assists in explaining the details of Fig. 2 that were presented earlier A single linear regression for 95 petrol price and inflation was obtained with the 95 petrol price being the predicted variables (dependent) while the inflation being the predictor variables (independent). The line of best-fits:

$$\hat{y} = 638.485 + 17.956x$$

Time series analysis: Time series analysis often seeks to understand the underlying force leading to a particular trend in the time series data. There are various types of time series which are descriptive analysis, spectral analysis and forecasting. This study made use of descriptive analysis.

Table 1: Model summary, 93

Model	R	R^2	Adjusted R^2	SE of estimate
1	0.055[a]	0.003	-0.014	116.05008

a. Predictors: (Constant), inflation

Table 2. Model summary, 95

Model	R	R^2	Adjusted R^2	SE of estimate
1	0.059[a]	0.004	-0.014	114.36086

a. Predictors: (Constant), inflation

Table 3: Linear regression model for petrol 93 price and inflation

Model	Unstandardized coefficients B	SE	Std coeff Beta	t-values	Sig.	95% confint for B lower bound	95% confint for B lower bound
1 Constant)	623.808	22.923		27.2	0.000	577.922	669.693
Inflation	16.746	40.192	0.055	0.417	0.678	-63.706	97.198

a. Dependent variable: petrol_price_93

Table 4: Linear regression model for petrol 95 price and inflation

Model	Unstandardized coefficients B	SE	Std coeff Beta	t-value	Sig.	95% confint for B lower bound	95% confint for B lower bound
1 (Constant)	638.485	28.589		27.2	0.000	593.268	683.703
Inflation	17.956	39.606	0.059	0.453	0.652	-61.325	97.237

a. Dependent variable: petrol_price_95

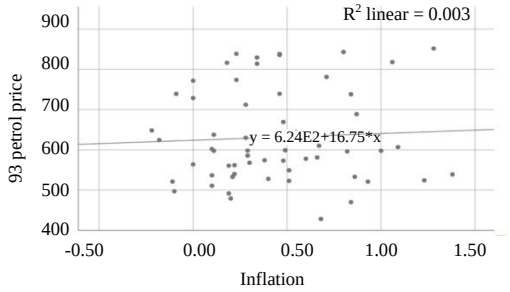

Fig. 1: Petrol 93 price and inflation; Scatter plot for South Africa petrol_price_93 and inflation for years 2014-2018

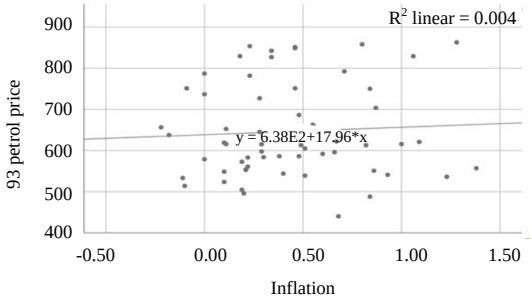

Fig. 2: Petrol 95 price and inflation; Scatter plot for South Africa petrol_price_95 and inflation for years 2014-2018

Trend: The trend is an upwards and downwards shift in data over time. Trend analysis explains patterns in data over time, a trend an able one to do some forecasts by studying the previous and the current trend. The graphs below show the trends for inflation and petrol price in South Africa for the year 2014-2018. There is quite a number fluctuation even there is a decreasing trend for both inflation and petrol price and can be seen from the trend line. The trend line equation for inflation is given by INFL = -0.004TIME+0.5546. This indicates that the rate of inflation over the years in the study was decreasing. The trend line equation for petrol prices is given by:

$$\mathbf{PETR\_93 = -0.0512TIME + 2809.87\ (93\ petrol\ price)}$$

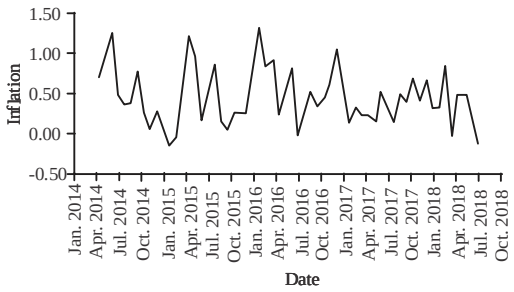

Fig. 3: Trend of inflation

$$PETR\_95 = -0.0511TIME + 2820.1\ (95\ petrol\ price)$$

Use of a straight line shows an indication that petrol price over the years is decreasing for both petrol categories and this is not the case in reality. We should suspect some error in one aspect of the procedures.

Upon observing the graphs displaying the relationships of petrol (93 and 95) prices, the linear models given earlier are wrong mathematical models for the relationships. If there was more value to these relationships, quadratic shapes are evident and could have been fitted on the relationships.

Seasonality: Seasonality refers to periodic change. It is a property of a time series analysis in which the data experience some regular and change that re-occur every calendar year. A season many refer to a time period is denoted by the calendar. The data on inflation and petrol price was studied monthly from the years 2014-2018. The seasonality was studied for both inflation and petrol price. Figure 3 shows that inflation starts to rise from January, 2014 and falls in March, 2014. The lowest season is December, 2014 and August, 2016 and the highest season is February, 2014 and 2016. The inflation remains constant from August, 2018 until October, 2018.

Figure 4 shows that the 93 petrol prices began to rise from January, 2014 and falls out in September, 2014. The lowest season is February, 2015 and March, 2016 and the highest season is March, 2014 and September, 2018.

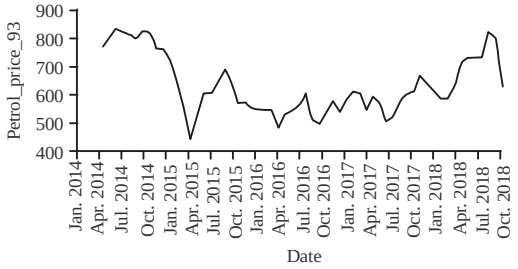

Fig. 4: Trend of petrol 93 price

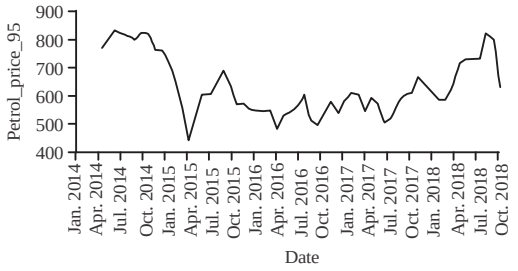

Fig. 5: Trend of petrol 95 price

Figure 5 shows that on 95 petrol price, there is a rise from January, 2014 and falls on September, 2014. The lowest season is February, 2015 and March, 2016 and the highest season is March, 2014 and September, 2018. Based on the study analysis made, the slopes of both regression lines are both positive as $PRICE_{93}$ = 16.746INFL+623.81 Table 3 and $PRICE_{95}$ = 17.956INFL+638.49 Table 4. This simply shows that the two variables (inflation and petrol price) have an increasing trend and thus grow in the same direction. In other words, when inflation increases, the petrol price also increases. This shows that the relationship between inflation and petrol price is important.

Hence, the statistical relationship between inflation and petrol price is somewhat weak but positive. It is clearly evident that in South Africa as is the case everywhere else, an increase in inflation leads to an increase in petrol price for both 93 and 95 types, in different but almost similar patterns.

CONCLUSION

The statistical relationship between inflation and petrol price were investigated using secondary data. The correlation coefficient was used to compare the relationship between the variables. The coefficient of negative or positive one shows perfect strong relationship and coefficient of zero shows no relationship between the variables. From the statistical analysis, the correlation coefficients were found to be 0.055 and 0.059 means a weaker relationship between inflation and petrol price between. Based on the study inflation had a minor impact on the petrol price.

REFERENCES

Abel, A. and B. Bernanke, 2005. Macroeconomics. 5th Edn., Pearson, New York, USA.,.

Akpan, E.O., 2009. Oil price shocks and Nigeria‘s macro economy. Proceedings of the Annual Conference on CSAE Conference, Economic Development in Africa, March 22-24, 2009, University of Oxford, Oxford, England, pp: 1-25.

Arinze, P.E., 2011. The impact of oil price on the Nigerian economy. J. Res. Nat. Dev., 9: 211-215.

Cologni, A. and M. Monera, 2005. Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G-7 countries. University of Milan, Bicocca, Milan, Italy.

DJs Research Ltd., 2016. Bivariate regression analysis. DJs Research Ltd., Marple, England.

Hodge, D., 2005. Inflation and growth in South Africa. Cambridge J. Econ., 30: 163-180.

Lagasse, P., 2000. Monetarism. The Columbia Encyclopedia, 6th Edn., Columbia University Press, New York, USA.

Mashamba, T.P., 2016. Time series modelling of South African economic indicators. M.Sc. Thesis, Sefako Makgatho Health Sciences University, Ga-Rankuwa, South Africa.

Munyeka, W., 2014. The relationship between economic growth and inflation in the South African economy. Mediterr. J. Social Sci., 5: 119-129.

Nkomo, J.C., 2006. The impact of higher oil prices on Southern African countries. J. Energy South Afr., 17: 10-17.

Rangasamy, L., 2017. The impact of petrol price movements on South African inflation. J. Energy South Afr., 28: 120-132.

Svensson, L.E., 2003. Escaping from a liquidity trap and deflation: The foolproof way and others. J. Econ. Perspect., 17: 145-166.