

Analysing the Pass-through Effects of Oil Prices on Inflation in South Africa: Granger-causality Approach

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Abstract

Since February 2000, South Africa has been relying on an inflation-targeting framework focused primarily on achieving low and stable inflation. In this context, a challenge is how the monetary policy will achieve and maintain price stability in the midst of volatile prices of imported oil and exchange rates. It is therefore against this background that the paper aims to ascertain the pass-through effects of international oil prices on inflation in South Africa. The effect of oil prices fluctuations is also expected to pass-through producer prices and exchanges rate. From the findings, it is evident that there is a bi-directional causal relationship between oil prices and inflation. These findings are deduced from granger-causality test which confirms a causality that runs from oil price to inflation, vice versa. The OLS model ascertained that a rise in oil price lead to a rise in both producer prices and inflation, but causing the rand to depreciate. To this end, the fact that oil prices are exogenously determined, the South African government should implement a price control policy to stabilize domestic prices that may rise due to fluctuations in oil prices. This would minimize the pass-through effects from oil prices to the overall inflation in South Africa.

Keywords: Oil prices; exchange rates; producer prices; inflation; South Africa

INTRODUCTION

Oil is said to be one of the most important commodities used in any modern industrial economy. A number of studies support this notion as they emphasize that oil has many economic uses around the world. These include amongst others studies such as Duma, (2008); Bendi, (2008); Chris, (2010) and Sukati, (2013). These studies concede that oil is crucial for the global economy as it can be used as a major input in producing petroleum products such as petrol, diesel, paraffin and fuelling transportation. However, a common view amongst these studies is that if the cost of intermediate input (oil) rise, so should the cost of

the end output. This implies that producers are likely to respond to a rise in oil prices by increasing the prices of the final product.

McCarthy (2000) also emphasizes that a rise in oil prices lead to a rise in the production costs in firms that uses oil as a major input in their production processes and this will results in a rise in prices of the end products. Similarly, Kojima (2011) emphasises that an increase in oil prices has a negative effect on oil-importing countries making their input costs greater. Kojima (2011) studied the vulnerability of oil importing countries in selected African countries and finds that the vulnerability increased to 82% over a five year period ending in 2008. Africa had the highest share of countries in which rising oil prices worsened the vulnerability of oil price shocks.

The Department of Minerals and Energy (DME) (2010) shows that the rise in oil demand as an energy source has resulted in South Africa's growing dependence on external sources for its domestic crude oil needs, within a substantial increase in world oil prices. In it 2014 annual survey, the Energy Information Agency (EIA) shows that in South Africa, over 96% of the crude oil requirements was imported, the bulk of which were supplied by Saudi Arabia (45.8%), Iran (33.7%), and Nigeria (16.6%), (EIA, 2014).

From the survey, it is evident that South Africa is almost entirely dependent on imported oil and that makes the country's economy to be more vulnerable to changes in oil prices. It is against this background that this paper seeks to explore the pass-through effects of international oil prices on inflation in South Africa. This is achieved by investigating the theoretical underpinnings of granger-causality test in determining the causal linkage between crude oil prices, exchanges rates, producer prices and inflation rates. To this end, the paper aims to answer the following related questions; does a change in oil price generate inflation in South Africa? If so, what is the magnitude of the response?

Apart from section one, the remainder of the paper is structured as follows; section two reviews previous studies on the effects of oil prices on inflation both internationally and in South Africa. Section three outlines the research methodology used in the paper. Section four presents research results. Section five provides conclusion together with recommendations.

LITERATURE REVIEW

The first part of this section reviews previous studies on the effects of imported oil prices on inflation in international countries. The second section reviews the effects of oil prices on producer prices and inflation in South Africa. The purpose of reviewing these studies is to gain more insight about the effects of oil prices on inflation and other macroeconomic variables such as producer prices and exchange rates.

The Effects of Oil prices on inflation: International Experiences

The price of oil and inflation are often seen as being connected within a cause and effect framework. There is a common view amongst various studies that as oil price fluctuates, inflation is expected to follow in the same direction. According Sharma (2012), the immediate effect of the oil price shock is the increased cost of production due to increased fuel cost. As a reaction to inflation in the economy, the cost of production would also rise causing the price of the end output to rise and a decrease in supply.

Similarly, Nkomo (2006) posits that the supply side effects are related to the fact that crude oil is a basic input to production and consequently an increase in oil price leads to a rise in production costs that induces firms to lower output. Barsky and Kilian (2001) investigated the pass-through impact of oil price on inflation and domestic prices in the United States. They used a vector error correction model find that in the United States the oil price fluctuations has a negative long-run effect on the producer prices.

McCarthy (2000) examined the effects of oil price and import inflation on domestic producer prices and inflation in selected industrialized economies. The empirical framework of the study consisted of a vector autoregressive (VAR) model incorporating a distribution chain of pricing. The findings of the study shows that imported prices have more effect on domestic prices and inflation and the pass-through impact was found to be stronger in oil-importing countries.

In addition, Barrell and Pain (1996) estimated pass through impact of oil price for Brazil using a VAR model in which the endogenous variables were exchange rate, output, interest rates and inflation rate. The study finds that the pass through impact of oil price is relatively higher in developing economies than in developed countries. Çelik and Akgül (2011) studied

the relationship between consumer price index (CPI) and oil prices in Turkey using the Vector Error Correction Model (VECM). Their findings reveals that a 1% increase in oil prices caused the CPI to rise by 1.26% with an approximate one year lag.

LeBlanc and Chinn (2004) estimated the effects of oil price changes on inflation in the United States, United Kingdom, France, Germany and Japan using an Augmented Phillips curve framework. Their study found that oil price increases of as much as 10 % will lead to direct inflationary increases of about 0.1 to 0.8 % in the US and the EU, which showed a modest response.

Bacon (2005) found that the average impact of a US\$10 a barrel price increase translate to a shock lowering the GDP by 0.8% and increases the inflation by 1.2% in the United States. Hamilton (2008) on the other hand stresses that a key mechanism whereby energy price shocks affect the economy is through a disruption in consumers' and firms' spending on goods and services other than energy.

Cuñado and Pérez de Gracia (2005) analyzed the effect of oil prices on inflation and industrial manufacturing for several European countries for the period of 1960 to 1999. They found that there is an asymmetric effect of oil price on production and inflation. Their results suggest that there are expected differences in countries' responses to changes in global oil prices depending on whether the country is an oil importer or exporter, and the monetary policies adopted by a given country in response to global oil prices and other trends like exchange rate variations.

In addition, Mabro (2004) investigated the pass-through impact of oil prices on inflation and domestic prices. His study finds that the pass-through effects on domestic producer prices in the United States is greater in industries that are less concentrated and face greater import penetration. Barsky and Kilian (2001) also examined the pass-through impact of oil price on inflation and domestics prices. The study used a vector error correction model to estimate the pass-through impact of oil price and find that in the United States oil price fluctuations has a negative long-run effect on the producer prices.

Regarding developing countries, Barrell and Pain (1996) estimated pass through impact of oil price for Brazil using a VAR model, in which the endogenous variables were exchange rate, output, interest rates and inflation rate. Their study found that the pass through impact of oil price is relatively higher in developing economies than in developed countries.

The Effect of International oil prices on Inflation: South Africa's experience

A number of studies have been undertaken to investigate the size and magnitude of the pass-through effects of oil price on domestic prices and inflation. However, few of them focused on the South African economy. Hence it is important for this section to discuss the effects of international oil prices on domestic prices and inflation in South Africa.

Sukati (2013) believes that the linkage between oil prices and inflation is especially important for the South African economy for two reasons. Firstly, in terms of income, South Africa is one of the most unequal countries in the world with a Gini coefficient of over 64% in 2012. This means that inflation disproportionately affect larger sectors of the population that do not have enough income to keep up with rising prices (Sukati, 2013).

According to DME (2008), a major consequences of South Africa's strong economic growth since the dispensation of democracy in 1994 is the rapid increase in the domestic demand for oil. Growth in total oil consumption has averaged over 2% annually. This is mainly due to the expansion in the transportation and mining sectors. Duma (2008) analysed the direct impact of oil price volatility by studying the pass-through to imported prices. The study employed vector error correction model and the findings shows that the pass-through in South Africa is incomplete at about 50% within a year and 30% in six months and that in the long run, the pass-through effect will be around 75%.

The National Agricultural Marketing Council (2007) annual surveys shows that food price inflation (CPI-F) generally increased faster than general inflation, but has done so in particular since the end of 2005. During 2006, food inflation has tended to be higher than the general price level (CPI) of all items. The data shows that price variations in food prices were mainly caused by high oil price.

According to Mboweni (2005), the inflationary pressure from oil prices to food items has increased in the period under review and that the main inflation indices that caused an upward trend in 2000, was driven mainly by the interaction of rising in food prices and

effects of the large depreciation of the exchange rate currency in 2001. In addition, Chris (2010) observed that for a given value of the Rand of R6.70 to the dollar, every US\$10 a barrel increase in oil prices added between 0.5% and 1% to inflation will reduce GDP by 0.8%. He further argued that the successive fluctuations in oil price during 2008 increased import prices, which led to a sharp increase in general prices and inflation in South Africa.

For energy-importing countries like South Africa, oil is the key to the country's energy security. High oil prices are a major threat to the country's overall energy security and lead to high direct costs to consumers (Stringer 2008). However, Stringer, (2008) explained that the indirect effects of oil-product price increases are much more complex and pass through the input cost of products consumed by households. For example, the increase of diesel cost contributes to the increase of transport costs and then to the increase of food costs. The extent to which such effects affect the various groups of households depend on the relative share of oil and oil products, and the oil-input intensive products in household budgets.

The effects of crude oil price fluctuations on the economy ultimately affect the motorists and retailers. The South African petrol price largely depends on international market conditions. The industry faces change and challenges. The future uncertainty of the supply of exhaustible resources like crude oil impacts on the crude price experienced by the global market. The energy demand thus exerts another pressure on price as the world economy grows rapidly. The uncertainty about whether to deregulate the liquid fuel industry adds a new dimension to the industry's future, (Nkomo, 2006).

Flamini (2007) analysed that an upward increase in international crude oil prices in 2004 partly accounted for the escalation in domestic inflation in South Africa, with the impact depending on the strength of the Rand against the US dollar. Mboweni (2005) shows that based on the oil price averages of US\$37 per barrel in 2004, the global economy would slow down by 0.5%, inflation increase by 0.3% and trade balance decline by 0.3%. Mboweni argued that for South Africa, this would translate to a decline in economic growth by 0.6%, an increase in inflation by 1.6% and the worsening of the trade balance by about 1.4% of the gross domestic product.

Chris (2010) in his study shows that prior 2008, there have been some serious fluctuations in economic activities which affected the economic performance of South Africa. This included the ever raising inflation, fluctuations in international oil prices, domestic currency movements and domestic price variations.

From the discussion, it can be concluded that oil prices has a significant impact the South African economy. Since it is used as a major input in the production process in huge industries, thus a rise in oil price lead to a rise in production costs and ultimately lead to a rise in general prices and inflation. The next section outlines the methodology used in the paper.

RESEARCH METHODOLOGY

This section presents the statistical tests and data used in the paper to estimate the pass-through effects of oil prices on inflation in South Africa. The paper employed the theoretical underpinnings of granger-causality test and its interpretation using the annual prices of crude oil, South Africa’s exchanges rates, producer prices and inflation rates. The data covers a period of 25 years, thus from 1990 to 2014.

Granger-causality test

The Granger-causality test is a statistical hypothesis test for determining whether one series is useful in forecasting another. For instance, a time series X_t is said to Granger-cause Y_t . Using t-tests and F-tests, the values of X_t can provide information about the future values of Y_t (Gujarati and Porter, 2009). Given the theoretical background, the paper estimates the pass-through effects of international oil prices on inflation in South Africa. The equation is therefore expressed as follows;

$$Y = \beta_0 + \beta_1(Oil\ price) + \beta_2(Producer\ prices) + \beta_3(Exchange\ rates) + e_t \dots\dots\dots 1$$

Where: Y measure the inflation rate,

β_0 _ is the intercept.

β_1 _ measures the price of crude oil per barrel valued in US dollar

β_2 _ represents the producer prices

β_3 _ measures the exchange rates

e_t – represents the error term.

The estimation procedure proceeds as follows. The first step is to test for stationarity of the dependent variable. The paper applied the Augmented-dickey Fuller test to test for stationarity. The second step tests for the causal relationship between oil prices, producer prices, exchange rates and inflation. Thirdly, the Ramsey-reset test is employed to test for the stability of the parameters in the model.

Ramsey-reset stability test can be utilized to determine whether the inflation respond asymmetrically or symmetrically to oil price fluctuations. An advantage of this test is that it does not require selecting potential structural break points and that it assesses the all the parameters jointly in the entire equation (Gujarati and Porter, 2009). The overall significance of these tests is that they contribute to a greater understanding of oil price and its impact of producer price and inflation, particularly in South Africa.

RESEARCH RESULTS

This section presents the results of all econometric tests employed in the paper. Thus results for stationarity test, granger-causality test, Ordinary Least Squares test and Ramsey-reset test.

Table 1: Results of Unit root test (Testing for stationary)

In order to arrive to the proper specification of the empirical model, as an important step, unit root test need to be carried out. The paper applied Augmented-Dickey fuller test to check for stationarity of the dependent variable. The following with regard to trend and intercept (Tt) were obtained.

Null hypothesis: No unit root

Series	Model	Lag	ADF test	P value	Conclusion
Inflation	Trend & Intercept (tt)	2	-3.138281	0.0297**	Do not reject Ho

Note: ** represents the reject of the null hypothesis at 5% level of significance

Source: Author's own estimates

The results deduced above were tested with trend and intercept only. Since the ADF value of -3.138281 is greater than the p value of 0.0297, this led to the rejection of null hypothesis at 5% level of significance. We can therefore conclude that the inflation has no unit root.

Table 2: Results of Pairwise Granger-causality test

Testing for the granger-causality upholds the standard procedure outlined by Gujarati and Porter (2009). If the F-statistic value is greater than the probability value (P value), we then conclude by rejecting the null hypotheses and accept the alternative hypotheses *vice-versa*. The results of causality test are therefore presented below.

Sample: 1990-2014

Lag: 2

Null Hypothesis	Obs	F stat	P value	Conclusion
H01: Oil Price does not granger-cause inflation	23	0.5801	0.0714*	Reject H0 ₁
H02: Inflation does not granger-cause oil price	23	0.9647	0.0063***	Reject H0 ₂

Note: [*] (***) indicates the rejection of [H₀] at 10% (1%)

Source: Author's own estimates

The results reveal the existence of bi-directional relationship between oil prices and inflation. For H0₁, the F statistic of 0.5801 is greater than the probability value of 0.0714*, we therefore reject the null hypothesis (H0₁) at 10% level of significance. Thus, implies that the causality runs from oil prices to inflation. For H0₂, the F statistic of 0.9647 is also greater than the probability value of 0.0063 which also indicates that the causality runs from inflation to oil price. From the results, it is evident that both oil price and inflation causes each other, thus implies that a rise in inflation can also cause oil price to increase *vice-versa*.

As indicated (*see equation 1*), inflation is estimated as a function of oi prices, producer prices (PP) and exchange rate. Using Ordinary Least Squares regression model, the equation 2 below presents the estimated relationship between the selected variables for the period reviewed, thus from 1990 to 2014.

$$Y = 0.79038 + 0.34190 (Oil P) + 0.00483 (PP) - 0.06274(Exch) + et \dots\dots\dots 2$$

Equation 2 shows a positive relationship between inflation, oil prices and producer prices however, the results further denote that inflation is negatively related to exchange rates. The variables are computed and regressed in their log form. Thus, implies that a 1% increase in oil price lead to 0.00483% increase in producer prices and the rand (exchange rate) depreciates by 0.0627%. The effect is expected to pass-through to inflation rate increasing by 0.7603%. This is results are compatible and consistent with theoretical underpinnings which supports that as oil prices increases inflation is expected to increase and since oil is used as a major input in production processes, producers are likely to increase their prices. Due to inflation, the rand is expected to depreciate.

Adding to the existing body of knowledge, the findings of this paper are consistent to that of Nkomo, (2006); Flamini, (2007) and Sukati, (2013) who also concluded that movements and fluctutions in oil prices can cause changes in producer prices and inflation. Similarly,

Niyimbanira (2013) also found a causal link between oil prices and inflation in South Africa, using Engle Granger causality test. The data used in the study covered a period from 1987 to 2013.

Table 3: Results of stability test: Ramsey-reset test

The key principle of carrying out this test is to determine if the error correction equation is correctly specified. If the equation is incorrectly specified, it may lead to bias and wrong functional forms that would result into a high R^2 and thus, yielding misleading results (Gujarati and Porter, 2009). The results of stability test are presented on the table below.

Test	Null Hypothesis (H0)	T stat	P value	Conclusion
Ramsey-reset	The equation is incorrectly specified	3.8977	0.0684*	Reject H0 since $3.8977 > 0.0684$

Note: Reject H0 if T stat is greater than P value

:* represents the rejection of H0 at 10% level of significance

Source: Author's own estimates

The stability test shows the T stat of 3.8977 is greater than the probability value of 0.0684. This implies the rejection of the null hypothesis at 10% level of significance. Thus, that the equation used is correctly specified. It can therefore be concluded that the results of this paper are reliable.

Though the null hypotheses of this paper are rejected, this however might not reflect the reality. According to Gujarati and Porter (2009), two types of errors might have occurred. Firstly, when the null hypothesis is actually true but is rejected, meaning that the truth is being rejected. Secondly, when the null hypothesis is false but is not rejected, meaning we have not rejected the false statement. All this might lead to a wrong conclusion or misleading results.

It is also important to note that other research methodologies can be used and possibly gives different results. It is therefore imperative for future studies to ascertain the relationship between oil prices and inflation and how it affects other macroeconomic variables such as producer prices and exchange rate. This will assist policy makers to introduce policies to minimize the effects of oil prices on domestic prices and inflation in South Africa. The next section presents the conclusion of the paper.

CONCLUSION

The purpose of this paper was to estimate the pass-through effects of oil prices on inflation in South Africa. The effect is expected to pass-through producer prices and exchange rates. This is because oil is used as a major input in the production processes and as its price increases, the production costs are expected to rise and firms are likely to respond by increasing the price of the end output. Since oil is imported, its trade and price also affect the South Africa's exchange rate (rand).

The findings of this paper, revealed a bi-directional link between oil prices and inflation. This is confirmed by the granger-causality test. The OLS test also shows that oil price is positively related to inflation and producer prices, thus implies that a rise in oil price lead to a rise in both inflation and producer prices. The results however shows that oil price is negatively related to exchange rate, implying that a rise in oil price lead to a rise in inflation and thus ultimately causing the rand to depreciate. Since South Africa depends largely on imported oil, this provides this paper and future studies with a need to investigate the pass-through effects of oil prices to inflation and also to fill the gap left by previous studies, since many of them focused on developed countries.

More importantly, due to the fact that oil prices are exogenously determined, the monetary authority of South Africa has no direct control to exogenous shocks that are caused by rapid rise in oil prices. Therefore, this paper recommends that the South African government should implement a price control policy to stabilize domestic prices that may rise due to fluctuations in oil prices. This would minimize the pass-through effects of oil prices to producer prices, exchange rate and to the overall inflation.

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