The Impact of Changes in Fuel Prices on Inflation and Economic Growth in South Africa

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ABSTRACT: From a cost-push inflation point of view, the fuel energy sector plays a significant role in price stability and production costs. This sector has been volatile over the last decade, impacting on global economic stability. In South Africa, which is a fuel importer, fuel prices have been rising at an alarming rate of 21 percent since the beginning of 2018, causing inflation pressure within a low growth environment. The objective of this study was to analyse the impact of changes in fuel prices on inflation and economic growth in South Africa as a proxy for fuel importing developing countries. This study followed a quantitative research approach with time series data from 2001 to 2018. The impact of changes in the fuel price on inflation and economic growth were analysed by means of the Johansen cointegration and Granger causality econometric models. The results indicated both long and short-run relationships between the variables. The Granger causality tests indicated that causality is from changes in fuel prices to economic output and inflation. The results of the study could be used in monetary and fiscal policy, although not much control regarding the changes of the fuel price exists except for reduction in levies as a direct method of taxation.

KEYWORDS: Economic growth, fuel prices, inflation, South Africa

Introduction

Since World War II, fuel price increases and fluctuations have had major impacts from a supply side on the global economy. Fuel price shocks have significant impacts on most global economies, for both developed and developing countries (Cunado & Perez de Gracia 2005). Fuel as an energy source, still plays an undisputed significant role in the global economy. Fuel price changes affect global energy markets and the economy, including all sectors (Katircioglu, Sertoglu, Candemir & Mercan 2015). Rapid increases in fuel prices have preceded all but one of the global recessions since World War II (Brown & Yucel 2002). In terms of this study, the term "fuel" is used for similar terms such as oil, gasoline, petrol and diesel.

Current global trends regarding fuel prices, in this case Brent crude oil prices, indicates instability. For the period since the financial crises in 2008 to 2018, the prices changed drastically. Brent crude oil sold for $40 per barrel in December 2008, increasing to $126 per barrel in March 2012. In January 2016 however the price reached a record low of only $30.5 per barrel, but since then has recovered to a price of $81 per barrel in September 2018 (Macrotrends 2018). This volatility also affects fuel (petrol) prices in South Africa which is a fuel importing developing country. Figure 1 indicates fuel prices from 2012 to 2018 in South Africa. Fuel prices has increased by 40 percent over the period. Fuel prices also increased significantly from 2017 to 2018 by more than 21 percent (SAPIA 2018). This increase has resulted in rising inflation, although the country is experiencing low growth of below 1 percent over the same period. Due to this phenomenon of rising fuel prices leading to cost-push inflation and low growth, this study provides interesting insight on the effect of fuel price changes in the South African economy, which is a prominent developing country. As far as it could be established, no recent study has been conducted analysing this phenomenon. The main objective of this study is therefore to determine the extent of the impact of changes in the fuel price on macro-economic variables including economic growth and inflation in a fuel importing developing country.
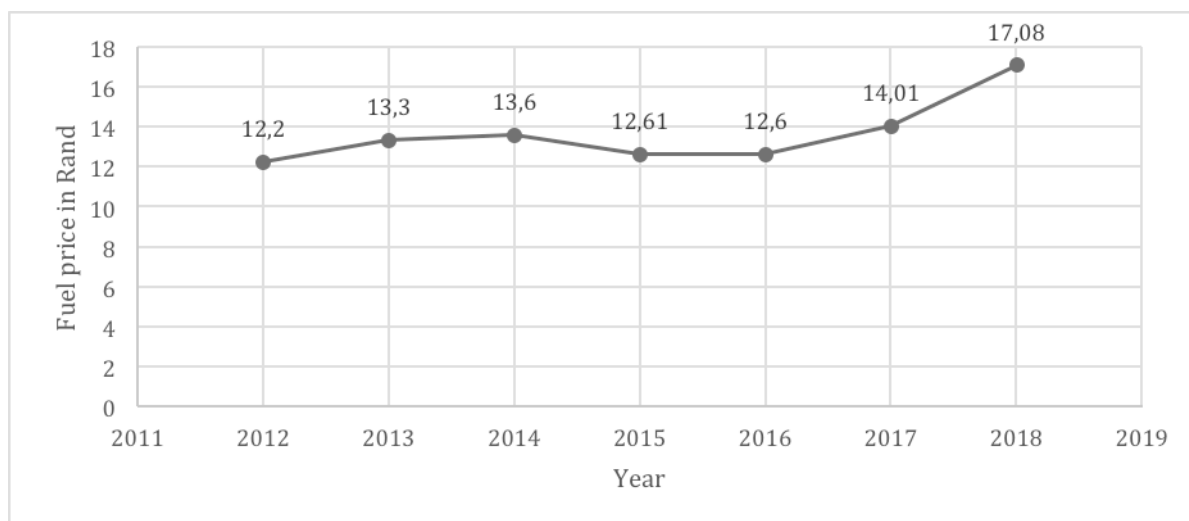
Figure 1. Fuel price trends in South Africa

Source: SAPIA, 2018

Literature review

From a theoretical point of view, changes in the fuel price has an impact on the economy. This relationship between the fuel price and the economy could be classified as a non-linear relationship. According to Cunado and Perez de Gracia (2005) this non-linear relationship is established when a fuel price shock leads to a decrease in aggregate demand in the economy due to general price increases and rising inflation leading to a decrease in real income and demand diminish. From the supply side, production costs rise with fuel price increases leading to reduction in aggregate supply, ultimately leading to less output with will affect labour and capital.

A significant body of academic literature indicates the negative impact of the increase in fuel prices or sudden shocks in the price of fuel on economic growth. The importance of increasing fuel prices are listed by Tang, Wu & Zhang 2010, which state that continuous rising fuel prices are in most cases an indication of an imminent recession; while Brown and Yucel (2002) state that rapid rising fuel prices preceded all but one of the recessions since World War II. An increase in fuel prices in most cases have a negative impact on output, production cost and inflation, although the strength of the impact is different depending on the region and other economic factors (Huang, Hwang, & Peng 2005; Cologni & Manera 2008).

According to Brown and Yücel (2002), and from a theoretical point of view, changes in the fuel price has a number of negative impacts on the economy of fuel importing countries which could include: supply-side impact resulting in cost-push inflation pressure; increased production costs; negative impact on consumer spending; negative impact on the country's trade surplus; changes in money demand and impact on interest rates and monetary policy; market uncertainty and volatile macro- economic environment. A fuel price increase presents possible inflationary shocks in the economy. Research is undecided on the level of the impact on inflation (Lescaroux & Mignon 2008; Hooker 2002; Barsky & Kilian 2004; LeBlanc & Chinn 2004).

Tang, Wu & Zhang (2010), analysed the relationship between the fuel price, output, investment and interest rates in China from 1998 to 2008. The results indicate that increases in the fuel price have both a negative a long and short-run impact on output and investment, but have a positive relationship with inflation and interest rates. Results also show that output is negatively affected by fuel price increases and inflation. The impact on the short-run is quantified as follows: a 1 percentage increase in the fuel price could lead to a decrease in economic output of 0.38 percent. Du and Wei (2010) also analysed the situation in China from 1995 to 2008. Major findings are that economic growth and inflation is significantly affected by fuel price changes and the impact is non-linear. Causality results indicate that fuel prices causes changes in economic growth as well as in

inflation and not vice versa. Cunado and Perez de Gracia (2005) analysed the impact of fuel prices increases on economic activity and inflation in six Asian countries from 1975 to 2002. Results indicate that the fuel price has significant negative impacts on economic growth and inflation, but mostly on the short-run as no long run relationship was detected. Granger causality (short-run analysis) tests found that fuel price shocks affects economic activities and fuel price shocks also affect inflation rates. Also for Asian countries (Japan, Korea, India and Indonesia), Cunado, Jo and Perez de Gracia (2015), analysed fuel price shocks from the period 1997 to 2014, results indicate that fuel supply shocks do not have a significant impact on economic output in the Asian countries. Chang, Jha, Fernandez, and Jam'an (2011) analysed the impact of fuel prices changes on macro-economic variables such as GDP, inflation and unemployment in 17 Asian countries. Fuel price increases had a negative impact on most of the Asian countries on the short-run. Chang and Wong (2003) analysed the impact of fuel price increases on the Singapore economy from 1978 to 2000. Results indicate that fuel price increases has an adverse effect on economic activities, but the impact on variables such as GDP, inflation and employment is limited and marginal.

Katircioglu, Sertoglu, Candemir and Mercan (2015) analysed the impact of fuel price changes on macro-economic performance in 26 OECD countries (mostly developed countries) from 1980 to 2011. The results indicate a long-run relationship between variables and that the fuel price has a statistically negative impact on GDP, inflation and employment. Papapetrou (2011) tested the relationship in Greece and found that fuel prices significantly affects economic output and employment. Lardic and Mignon (2006) analysed the relationship in a number of Europian countries and also found that fuel price increases negatively impacted in GDP on the long and short-run and that the fuel price also affected inflation and employment in the region. Roeger (2005), in a DSGE model analysis of European countries, found short and long-run statistical significant impacts of fuel price shocks on economic output and inflation. The impact on GDP was mostly negative with a coefficient of -0.5 percent on the short-run and even a -1 percent impact over the long-run.

Cavalcanti and Jalles (2013) studied Brazil and US regarding the impact of fuel prices on the macro-economy. It was found for both countries, fuel price increases had a negative impact on GDP and a positive impact on inflation. Cologni and Manera (2008), analysed the relationship between changes in fuel prices, inflation and interest rates in the G-7 countries from 1980 to 2003. Results of the VAR analysis include that fuel price changes have an impact on all the countries involved. Inflation pressure is then translated to increased interest rates through monetary policy impacts. Peersman and Van Robays (2012) analysed in impact of fuel price shocks on industrialized countries from 1986 to 2010. The main results from the study are that results depend on the reasons for the price shock. If oil prices rise due to growth in global economic growth and demand, rising fuel prices resulted in decline in GDP and an increase in inflation. Fuel exporting countries are however not affected by such increases.

Korhonen and Ledyaeva (2010) analysed both fuel exporting and fuel importing countries regarding the impact of fuel price increases on GDP. It was found that for Russia, a fuel exporting country, fuel price increases positively supported GDP growth. On the other hand, for countries such as Japan, US, China, Finland, Germany and the UK, fuel price increase had a negative impact on GDP. Lescaroux and Mignon (2008) analysed the influence of fuel prices on macro-economic variables in 36 countries which included fuel importing and exporting countries. Generally long-run relationships were found between fuel price increases and other economic variables with fuel price increases in all cases having negative impact on GDP, while on the short-run, Granger causality indicated that causality runs from fuel prices to other variables. The fuel price plays a major role in most of the importing countries. In Nigeria which is an oil-exporting country, Iwayemi and Fowowe (2011) studied the same relationships in the economy from 1985 to 2007. They found that fuel price shocks do not have a significant impact on other macro-economic variables in Nigeria.

Carruth, Hooker, and Oswald (2010), investigated the relationship between fuel prices, interest rates and unemployment in Turkey as an emerging economy. The results include a long-run relationship between variables, with fuel price increases having a negative impact on employment.

Nkomo (2009) analysed the impact of rising fuel prices in South Africa and states that the country has high levels of dependence on the import of crude oil for its energy needs. This exposes the country to price shocks, as crude oil prices increase and a possible weakening currency. Higher fuel prices is found to undermine economic growth and the dependence on international fuel prices leaves the country vulnerable to factors beyond the control of economic planners. In summary, rising fuel prices negative impacts on economies of especially fuel importing countries, with different levels and extent of impacts. While the impact on fuel exporting countries is mostly positive. The focus of this study is however on the impact in a fuel importing developing country.

Methodology

The study focuses on South Africa as a fuel importing country, and as a proxy for emerging developing countries, analysing the impact of changes in the fuel price on macro-economic variables. The study follows a quantitative approach based on a dataset of 70 quarterly observations from quarter one of 2001 to quarter two of 2018. 2001 was selected as the starting date due to availability of data. Variables included in the study are the price of fuel in South African currency (Rand); GDP at constant prices and CPI. The data was derived from Quantec (2018) data series for the fuel prices and from the South African Reserve Bank (SARB) for GDP and CPI (inflation) data. The main objective of the study was to determine the impact of fuel price changes on economic activity, measured as GDP and also on the inflation rate in South Africa. Two different equations are used as follows to achieve the objective:

LINF $= f$ (LFUEL, LGDP)   (1)

LGDP $= f$ (LFUEL, LINF)   (2)

Where: LINF is the natural logarithm of the inflation rate, LGDP is the natural logarithm of natural logarithm of the real gross domestic product and LFUEL is the natural logarithm of the fuel price in Rand. All variables were converted to their natural logarithms for the adjustment of any likelihood of scale effect and to estimate growth or elasticities. The Vector Autoregressive model (VAR) is thus used in regressing the multivariate relationships into a finite-order structure as suggested by Sims (1980). Prior to conducting the analysis, the Augmented Dickey-Fuller (ADF) test was used to test the variables for stationarity or unit root. If the observed variables are found to be stationary, then the VAR model in Equations (1) and (2) are estimated. However, if all variables are found to be non-stationary then a cointegration test is estimated to determine whether a linear combination of such non-stationary variables is stationary. This is known as a cointegration test for a long-run relationship (Nielsen 2005). Johansen's multivariate co-integration method was used in testing the long-run relationship amongst the variables. The existence of cointegrating relationships between the variables further implies undertaking the Vector Error Correction Model (VECM) (Kakes 2000). Alternatively, the study may proceed with the VAR model of the 1st differenced in case there are no co-integrating relationships. Preceding the interpretation of the VCM output, diagnostic tests are conducted to ensure that the model meets stochastic properties. Also Granger causality tests are estimated to determine the flow of impacts.

Results and Discussion

This section includes the results from the estimations and discussions of results compared to empirical findings from previous research. Figure 2 indicates the raw data for the three variables which were logged and differenced. The impact of the financial crises are clearly visible on all three sub-graphs for the period 2007 to 2009, with recovery during 2009 towards 2010. GDP has steadily increased from 2001 to 2007, with a slight recovery in 2010 after the financial crises. Since 2011 however, the GDP trend is negative due to low growth and technical recessions. The fuel price is more volatile that changes in GDP, with a number of periods where the price have spiked and decreased for example during 2003 to 2003, 2007 to 2009 and 2013 to 2015. Lastly, the CPI (inflation rate) graph indicates significant economic cycles from 2002 to 2003 where a recession

affected economic activity, with a recovery from 2004 to 2007, the financial crises from 2007 to 2009 and the constant low economic activity and growth period from 2010 to 2018.
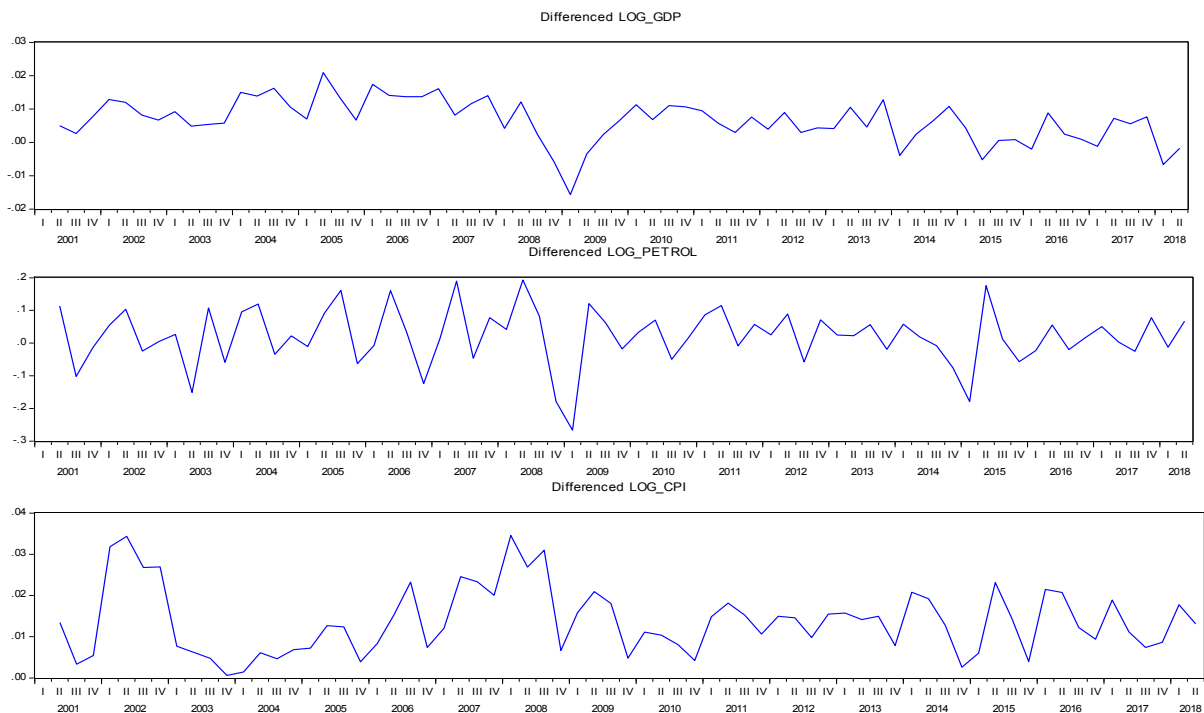

Figure 2. Trends analysis

Table 1 reports unit root test results of the Augmented Dicky-Fuller test. At levels, all variables are non-stationary as the p-values are greater than a 0.05 level of significance. Therefore, the null hypothesis of no stationarity is accepted. This means that the series exhibits a unit root. At first difference, all variables are stationary as the p-values are less than 0.05 level of significance. The null hypothesis is rejected at first difference at 0.01 significance level. Therefore, all variables reached the same order of integration at I(1) or first difference. The proceeding step is a test for cointegrating vectors or long run relationship using the Johansen cointegration approach to test whether the variables are integrated in the long-run.

Table 1. Augmented Dickey-Fuller (ADF) Unity Root Test

Variables	Level: I(0)		First difference: I(1)		Order of integration result
	t-stat	P-value	t-stat	P-value	
LINF	-0.4335	0.9829	-3.7944	0.0048*	I(1)
LGDP	-2.6592	0.0865	-4.4613	0.0006*	I(1)
LFUEL	-1.0905	0.7152	-8.3038	0.0005*	I(1)

*Note: * denotes P-value at 1% level of significance.*

Prior to conducting the Johansen cointegration test, a lag order selection process was used to select and determine the number of lags to be used in this test, including the vector error correction model (VECM). The optimal lag selection was based on five selection criteria, namely; LR, FPE, AIC, SC and HQ, where all criteria reached the same conclusion of two (2) lags. Therefore, 2 lags were used in the Johansen co-integration test and VECM. Table 2 reports results for the Trace test and Max-Eigenvalue statistics in the Johansen cointegration test. Both tests show one co-integrating equation (r≤1) at 0.05 level of significance. Thus the null hypothesis of no co-integrating equation is rejected. This suggests that variables are co-integrated or that a long-run relationship exists within the series. Similar long-run results were also determined by Tang, Wu & Zhang (2010), Chang, Jha, Fernandez, and Jam'an (2011) and Lardic and Mignon (2006).

Table 2. Johansen co-integration test results

Ho: No of CE(s)	Trace Test			Maximum Eigen-value		
	Trace Statistic	T-critical value	P-values*	Max-Eigen Statistic	T-critical value	P-values*
None	39.5673	35.1927	0.0158*	22.9545	22.2996	0.0405*
At most 1	16.6128	20.2618	0.1476	11.2041	15.8921	0.2371
At most 2	5.4086	9.1645	0.2416	5.4086	9.1645	0.2416

*Note: * denotes rejection of the hypothesis at the 0.05 level.*

The existence of a cointegrating relationship between the selected variables explain the long-run equilibrium. The long-run relationships are expressed in Equation (3) and (4) as follows:

$$LINFt\text{-}1 = +2.3960 + 0.1534(LFUELt\text{-}1) + 0.4152(LGDPt\text{-}1) \qquad (3)$$
$$LGDPt\text{-}1 = -5.7670 - 0.3696(LFUELt\text{-}1) + 0.4079(LINFt\text{-}1) \qquad (4)$$

In the long-run (Equation 3), with inflation (LINF) as the dependent variable, fuel (LFUEL) and GDP (LGDP) both have significant and positive relationships with the dependent variable. This means that an increase in the fuel price level will have an increasing impact on inflation. As such, a one percent increase in the fuel price induces a 0.15 percent increase in inflation, while an increase in GDP growth leads to an even higher impact on inflation. In terms of equation (4), with GDP as the dependent variable, the fuel price as a negative impact on GDP while an increase in inflation as a positive impact on GDP on the long run. Table 3 captures the speed of adjustment of the short-run dynamics towards the suggested long-run relationship using the error correction term (ECT) (Magee 2013). All variables being cointegrated, VECM can be estimated to explain short-run disequilibrium adjustments towards the long-run equilibrium (Noumbissie & Mongale 2014). Therefore, it follows that a negative adjustment coefficient (error correction term) and a significant t-value are conditions in explaining short-run adjustments towards the long-run equilibrium (Mukhtar & Rasheed, 2010). The VECM output (Table 3) indicates that CointEq1 constitutes one significant equation which explain short-run adjustment towards the long-run equilibrium and that is LGDP. These results provide a robust set of items of evidence of error correction in the first co-integrating equation. LGDP has a negative coefficient and t-value of -4.2407. The variable is significant at 0.05 significance level. This suggests that the LGDP has a short-run relationship with LINF. Therefore, 1.4 percent of the disequilibrium in LGDP is corrected in each quarter. Further short-run results indicate that both the first and second lag in LFUEL has a positive significant impact on LINF; LGDP (second lag) has a positive impact on LFUEL; both first and second lag of changes in LINF have an impact on LFUEL; the second lag of LINF has a negative impact on LGDP; and change in LFUEL (lag 2) has a negative impact on LGDP.

Table 3. Vector Error Correction Model

Error Correction	D(LINF)	D(LFUEL)	D(LGDP)
CoinEq1	-0.004511 [-0.9940]	-0.01328 [-0.2802]	-0.0144 [-4.2407]*
D(LINF(-1))	[4.7193]*	[4.0126]*	[0.9953]
D(LINF(-2))	[0.6199]	[4.1783]*	[-3.4759]*
D(LFUEL(-1))	[2.3140]*	[-3.2876]*	[0.1980]
D(LFUEL(-2))	[3.7815]*	[-1.5911]	[-2.2298]*
D(LGDP(-1))	[1.4038]	[2.9494]*	[2.6427]*
D(LGDP(-2))	[0.8991]	[-0.9519]	[-1.0560]

*Note: T-value in [ ], * indicates significance at 5% level.*

To confirm these short-run results, Granger causality tests, were conducted and the results are listed in Table 4. Granger causality tests indicate bi-directional causality between inflation and economic growth, and more importantly it is confirmed that changes in the fuel price causes changes in inflation as well as changes in economic growth. Similar results were also confirmed by Cunado and Perez de Gracia (2005), Lardic and Mignon (2006) and Du and Wei (2010).

Table 4: Pairwise Granger Causality results

Null Hypothesis	F-statistic	P-value
LFUEL does not Granger Cause LINF	2.8452	0.0464*
LINF does not Granger Cause LFUEL	4.1375	0.0960
LGDP does not Granger Cause LINF	6.0742	0.0163*
LINF does not Granger Cause LGDP	4.1392	0.0459*
LGDP does not Granger Cause LFUEL	17.5101	0.0952
LFUEL does not Granger Cause LGDP	2.8658	0.0252*

reject null hypothesis of no Granger causality at 5% significance

The model passed diagnostic tests of no heteroscedasticity, no serial correlation, and normality with results shown in Table 5. AR root test estimates can further be estimated (Razali & Wah 2011). Results of the AR root test confirm the stability of the model as all AR roots lie within the unit circle.

Table 5: Diagnostic tests results

Test	H0	Probability	Decision
LM Test	No serial correlation	0.4283	With a P-value above 5%, do not reject the H0. Therefore, there is no serial correlation in the model.
White (CT)	No heteroscedasticity	0.0892	With a P-value above 5%, do not reject the H0. Therefore, there is no heteroscedasticity in the model.
Jarque-Bera	Residuals are normally distributed	0.4266	With a P-value less than 5%, reject H0. Therefore, the results show that the data is not normally distributed.

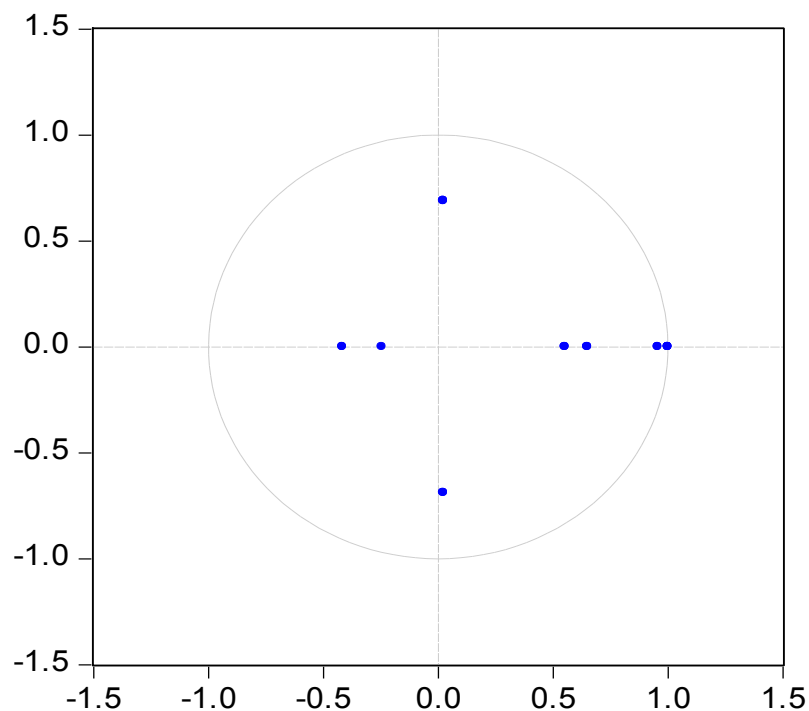## Inverse Roots of AR Characteristic Polynomial

Figure 3: Inverse roots AR test

Conclusion

The main objective of this study was to determine the impact of changes in the fuel price on inflation and economic growth in a fuel importing developing country. The main objective was achieved by means of a comprehensive literature review and also through the use of a quantitative analysis of time series data for South Africa from 2001 to 2018. The most important results are that the relationship between the variables are non-linear and that rising fuel prices have a negative impact on the South African economy on both the long and short-run. This duel negative impact through lower output and rising inflation, has caused the South African economic to be caught in a low growth scenario while cost-push inflation is also having a significant impact on the local economy.

Empirical results from a global point of view also indicate that the fuel energy sector still has a significant impact on global economies, despite the growth of the green-economy. The volatility of fuel prices causes uncertainty in markets and price shocks. It is interesting to note that the causality for most economies runs from changes in the fuel price to economic activities and to inflation, leading to monetary policy changes. In South Africa however, the causality has been confirmed in the study. As with any quantitative study, limitations include the number and type of variables included in the study, as well as time periods and availability of data. Future studies could include the use of different variables such as employment and even the producer price index (PPI) and also the inclusion of more countries in the model such as a comparison of African countries and the BRICS countries. A comparative analysis between fuel importing and exporting countries could also be considered. For example, different impacts on different economies depending on the structure of the economy, sectoral composition and fuel importing or exporting countries could be investigated (Cunado & Perez de Gracia 2005).

The implications of the study are that the fuel industry still has a major impact on the global economy and specifically on developing countries and rising fuel prices can have a significant negative impact on economic activities. These impacts should be taken into account in the formulation of economic policy. The impact of the rising fuel prices also have an impact on both monetary and fiscal policy, and careful consideration should be given to price shocks and the effect on local economies. Fuel importing countries should investigate alternative sources of energy and to diversify their energy sector to reduce the dependence and possible future price shocks.

References

Alvarez, L.J., Hurtado, S., Sanchez, I. & Thomas, C. 2009. The impact of oil price changes on Spanish and Euro area consumer price inflation. *Economic Modelling* 0904:9–36.

Ashley, R. & Tsang, K.P. 2013. The oil price-real output relationship: does persistence matter? *Virginia Technical Working Papers* 2013: 1-31.

Barsky, R.B. & Kilian, L. 2004. Oil and the Macro-economy since the 1970s. *Journal of Economic Perspectives 18*(4): 115-134.

Brown, S.P.A. & Yücel, M.K. 2002. Energy prices and aggregate economic activity: an interpretative survey. *Quarterly Review of Economics and Financ,* 42(2002): 193-208.

Carruth, A., Hooker, M. & Oswald, A. 1998. Unemployment equilibrium and input prices: Theory and evidence from the United States. *Review of Economics and Statistics* 80:621-8.

Cavalcanti, T. & Jalles, J.T. 2013. Macroeconomic effects of oil price shocks in Brazil and in the United States. *Applied Energy* 104: 475-86.

Chang, Y., Jha, K., Fernandez, K.M. & Jam'an, N.F. 2011. Oil price fluctuations and macroeconomic performances in Asian and Oceanic economies. Final Year Project, School of Humanities and Social Sciences; 1-47.

Chang, Y. & Wong, J.F. 2003. Oil price fluctuations and Singapore economy. *Energy Policy 31*(11): 1151-1165.

Cunado, J. & De Gracia, F.P. 2005. Oil prices, economic activity and inflation: evidence for some Asian countries. *The Quarterly Review of Economics and Finance 45*(1): 65-83.

Cunado, J., Jo, S. & De Gracia, F.P. 2015. Macro-economic impacts of oil price shocks in Asian economies. *Energy Policy 45*(1): 65-83.

Cologni, A. & Manera, M. 2008. Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G-7 countries. *Energy Economics* 30(3): 856-888.

Du, L., Yanan, H. & Wei, C. 2010. The relationship between oil price shocks and China's macro-economy: An empirical analysis. *Energy policy 38*(8): 4142-4151.

Farzanegan, M.R. & Markwardt, G. 2009. The effects of oil price shocks on the Iranian economy. *Energy Economics* 31: 134–151.

Gomez-Loscos, A., Montanes, A. & Gadea, M.D. 2011. The impact of oil shocks on the Spanish economy. *Energy Economics* 33: 1070-81.

Hamilton, J. 1996. This is what happened to the oil price–macroeconomy relationship? *Journal of Monetary Economy* 38: 215-220.

Hooker, M. 2002. Are oil shocks inflationary? Asymmetric and nonlinear specifications versus change in regime. *Journal of Money, Credit and Banking* 34: 540-561.

Huang, B.N., Hwang, M.J. & Peng, H.P. 2005. The asymmetry of the impact of oil price shocks on economic activities: an application of the multivariate threshold model. *Energy Economics* 27: 455-476.

Iwayemi, A. & Fowowe, B. 2011. Impact of oil price shocks on selected macroeconomic variables in Nigeria. *Energy Policy 39*(2): 603-612.

Kakes, J. 2000. Monetary transmission in Europe: The role of financial markets and credit. Cheltenham, UK: Edward Elgar Publishing.

Katircioglu, S.T., Sertoglu, K., Candemir, M. & Mercan, M. 2015. Oil price movements and macroeconomic performance: Evidence from twenty-six OECD countries. *Renewable and Sustainable Energy Reviews 44:* 257-270.

Korhonen, I. & Ledyaeva, S. 2010. Trade linkages and macroeconomic effects of the price of oil. *Energy Economics* 32: 848-56.

Lardic, S. & Mignon, V. 2006. The impact of oil prices on GDP in European countries: an empirical investigation based on asymmetric cointegration. *Energy Policy* 34: 3910-3925.

LeBlanc, M., & Chinn, M. 2004. Do High Oil Prices Presage Inflation? The Evidence from G-5 Countries (February 19, 2004). UC Santa Cruz Economics Working Paper No. 561; SCCIE Working Paper No. 04-04. Available at SSRN: https://ssrn.com/abstract=509262.

Lescaroux, F. & Mignon, V. 2008. On the influence of oil prices on economic activity and other macroeconomic and financial variables. *OPEC Energy Review* 32(4): 343-380.

Macrotrends. 2018. Brent crude oil prices. Date of access: 15 October 2018. https://www.macrotrends.net/2480/brent-crude-oil-prices-10-year-daily-chart.

Magee, L. 2013. Unit roots, cointegration, VARs and VECMs. Date of access: 05 November 2017. http://socserv.mcmaster/magee.pdf.

Mukhtar, T. & Rasheed, S. 2010. Testing a long run relationship between exports and imports: Evidence from Pakistan. *Journal of Economic Cooperation and Development* 31(1): 41-58.

Nielsen, B. 2005. *Analysis of co-explosive processes*. UK: Nuffield College.

Nkomo, J.C. 2009. Energy security and liquid fuels in South Africa. *Journal of Energy in Southern Africa* 20(1): 20-24.

Noumbissie, F.F. & Mongale, I.P. 2014. The impact of monetary policy on financial markets in South Africa: A VAR analysis. *Journal of Economics and Behavioral Studies* 6(8): 636-646.

Papapetrou, E. 2001. Oil price shocks, stock market, economic activity and employment in Greece. *Energy Economics* 23: 511-32.

Peersman, G. & Van Robays, I. 2012. Cross-country differences in the effects of oil shocks. *Energy Economics 34*(5): 1532-1547.

Quantec. 2018. Easy Data. Date of access: 12 September 2018. https://www.easydata.co.za/.

Razali, N.M. & Wah, Y.B. 2011. Power comparisons of Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors and Anderson-Darling tests. *Journal of Statistical Modeling and Analytics* 2(1): 21-33.

Roeger, W. 2005. International oil price changes: impact of oil prices on growth and inflation in the EU/OECD. *International Economics and Economic Policy* 2(1): 15-32.

SAPIA. 2018. Fuel price history in South Africa. Date of access: 5 October 2018. http://www.sapia.org.za/overview/old-fuel-prices.

Sims, C.A. 1980. Macroeconomics and reality. *Econometrica: Journal of the Econometric Society* 48(1): 1-48.

South African Reserve Bank (SARB). 2018. Statistics. Date of access: 10 September 2018. https://www.resbank.co.za/Research/Statistics/Pages/Statistics-Home.aspx.

Tang, W., Wu, L. & Zhang, Z. 2010. Oil price shocks and their short-and long-term effects on the Chinese economy. *Energy Economics 32:* S3-S14.