

OIL PRICE PASS-THROUGH INTO INFLATION IN KENYA

BY

MOSES KIPTUI ¹

KENYA SCHOOL OF MONETARY STUDIES RESEARCH CENTRE

MAY 2009

¹The views and conclusions presented in this paper are exclusively those of the author and do not necessarily reflect the position of the Central Bank of Kenya or the Kenya School of Monetary Studies.

ABSTRACT

The sharp increase in world oil prices in 2002-2008 was associated with high inflation in Kenya. This study examines the oil price pass-through to inflation in order to inform monetary policy decisions. The study adopts a Philips curve approach to estimate pass-through. It is found that oil prices have significant effects on inflation with a pass-through of 0.05 in the short-run and 0.1 in the long-run, implying that 10 per cent increase in oil prices results in 0.5 per cent inflation in the short run and 1 per cent in the long run. It is also found that exchange rates have a significant influence on inflation with a pass-through of 0.32 in the short-run and 0.64 in the long-run. Pass-through is therefore incomplete in both cases. The other finding of this study is that inflation is highly influenced by aggregate demand conditions as captured by the output gap measure.

I. INTRODUCTION

The magnitude of the impact of oil prices on inflation remains contentious. Some studies find that oil prices have major effects on inflation while others find the effects not so large. A study by Duma (2008) investigating pass-through effects of external shocks i.e exchange rates, oil price and import price shocks to inflation in Sri Lanka finds low and incomplete pass-through of external shocks to consumer inflation, reflecting a combination of factors including the existence of administered prices, high content of food in the consumption basket and low persistence and volatility of the exchange rate. External shocks are shown to explain 25 per cent of the variation in consumer price inflation, reflecting room for domestic policies in controlling inflation. Hahn (2003) investigates the pass-through of external shocks i.e oil price shocks, exchange rate shocks and non-oil import price shocks to euro area inflation. The study finds that external shocks explain a large fraction of the variance in all price indices and that shocks seem to have contributed largely to inflation in the euro area since the start of the European Monetary Union. Brown, Oppedahl and Yucel (1995) analyze how oil price shocks move through major channels of the U.S. economy to affect inflation. The analysis shows that oil price shocks have permanent effects on the price level. The findings suggest that monetary policy generally accommodated the inflationary pressure of oil price shocks.

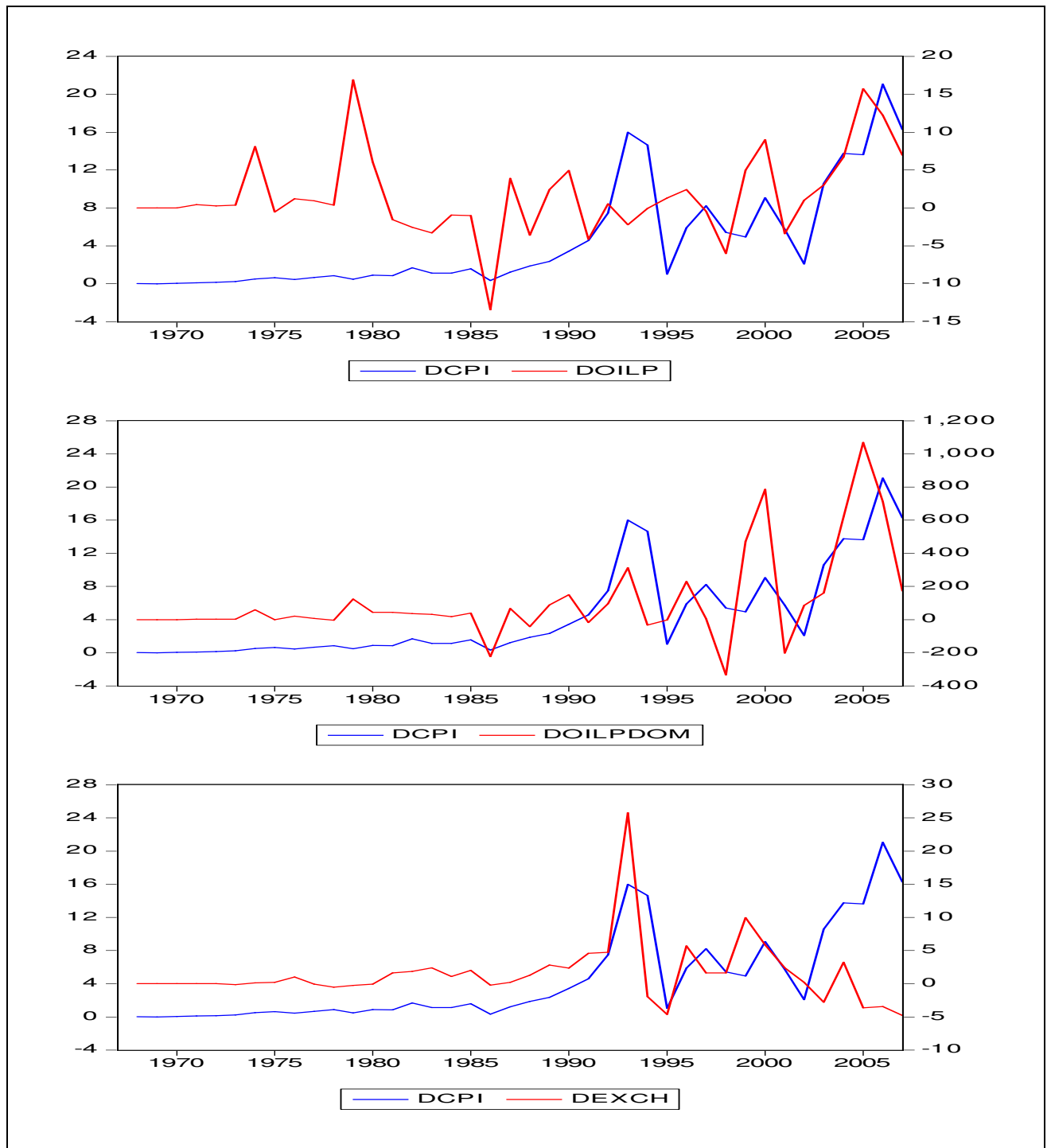
Berument and Tasci (2002) investigated effects of oil prices in Turkey and found that when wages and other three factors of income (profit, interest and rent) are adjusted to the general price level that includes the oil price increases, the inflationary effect of oil prices becomes significant. LeBlanc and Chinn (2004) estimating the effects of oil price changes on inflation for the United States, United Kingdom, France, Germany and Japan using an augmented Phillips curve framework. Statistical estimates suggest current oil price increases are likely to have only a modest effect on inflation in the U.S, Japan and Europe. Oil price increases of as much as 10 percentage points will lead to direct inflationary increases of about 0.1-0.8 percentage points in the U.S and E.U. Inflation in Europe, traditionally thought to be more sensitive to oil prices than in the U.S is unlikely to show any significant difference in sensitivity from that in the United States. Using a dynamic stochastic general equilibrium model, which is tailored to reflect the characteristics of African economies, to quantify the effect of the increase in the price of oil on the main macroeconomic variables, Bouakez (2007) argues that high oil prices would lead to an increase in inflation by a much greater magnitude under managed than under a fixed exchange rate regime.

Recent studies have focused on whether pass-through from oil price shocks to inflation has been declining overtime. Gregorio, Launderrette and Neilson (2007) find a decline in the pass-through from the price of oil to the general price level. They find a fall in the average estimated pass-through for industrial economies and a lesser degree for emerging economies. The effect

of oil shocks on inflation has weakened for most of the twelve countries in the sample. Among the factors that might help to explain this decline is reduction in oil intensity of economies around the world, a reduction in exchange rate pass-through, a more favourable inflation environment and the fact that the current oil price shock is largely the result of strong world demand. These factors help to explain why oil shocks have had limited inflationary effects. Chen (2009) uses data for 19 industrial countries and a state space approach to estimate time-varying oil price pas-through coefficients and find evidence of declining pass-through for almost all the countries considered. The study investigated some potential explanantions for declining pass-through and concludes that an appreciation of the domestic currency, a more active monetary policy in response to inflation and a higher degree of trade openness are major causes of the recent decline in oil price pass-through. The study argues that energy intensity may have played a minor role in the evolution of pass-through overtime.

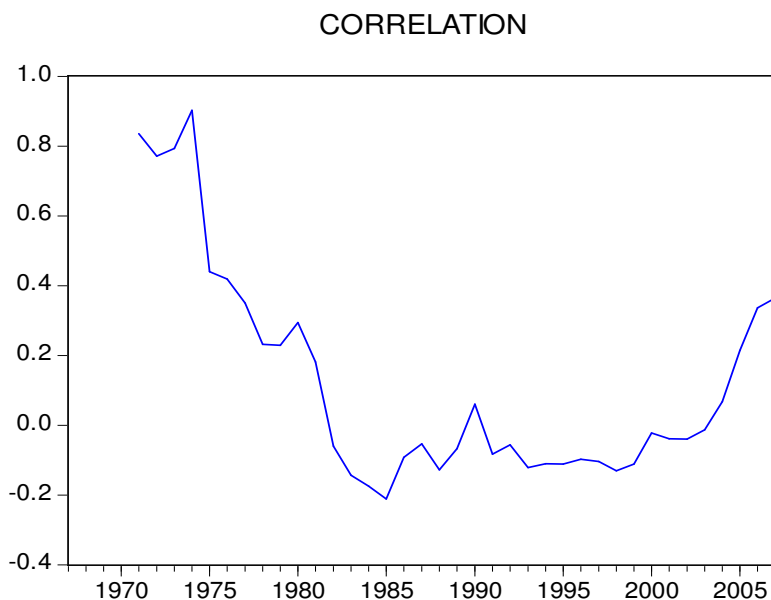
Looking at the Kenyan situation, oil prices seem to be highly correlated with inflation, quite visible in the period following liberalization. The relationship between changes in CPI (or inflation) (DCPI), changes in oil prices in dollar values (DOILP), changes in oil prices in domestic currency (DOILPdom) and changes in the nominal exchange rate (DEXCH) is shown in chart 1 below. From Chart 1, the relationship between the two variables even seems quite strong in the period after liberalization which is contrary to empirical findings that pass-through from oil prices to inflation has been declining in the recent past.

Figure 1: Relationship between changes in CPI, Oil Prices and Exchange Rates



A closer examination of the relationship between oil prices and inflation shows that over the 1967-2007 period, the correlation between inflation and oil prices in domestic currency (i.e. dollar prices per barrel multiplied by the nominal exchange rate) is 0.61; the correlation between inflation and oil prices in dollar values is 0.36 while that between inflation and the exchange rate is 0.17. Therefore oil prices are correlated with inflation. Computation of rolling correlation coefficients shows that correlation between changes in oil prices and inflation was on a downward trend till the early 90's, but started to rise just after liberalization (figure 2), contrary to findings in some studies that pass-through has recently been declining.

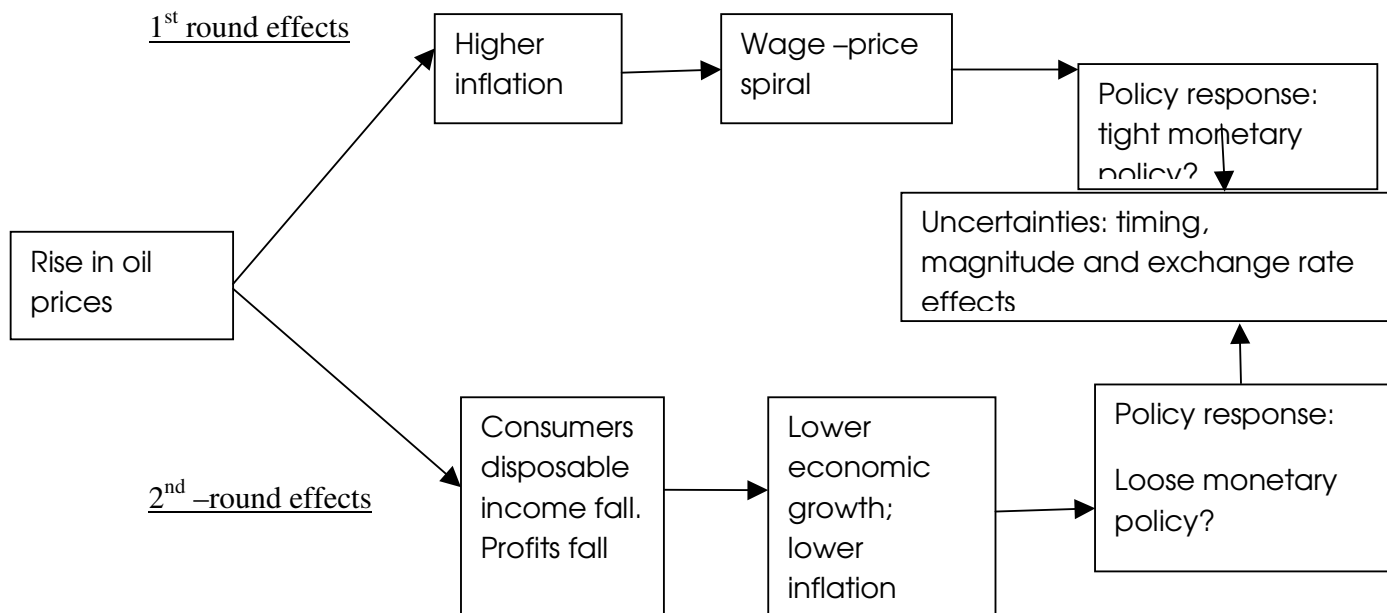
Figure 2: Rolling Correlation Coefficients between Changes in Oil Prices and Changes in CPI



This study therefore examines oil prices-inflation nexus in Kenya and seeks to determine whether pass-through is comparable with that reported in recent studies on other economies. Understanding the pass-through of oil prices to inflation will help monetary authorities anticipate effects of oil price shocks on inflation.

II. METHODOLOGY AND DATA

As shown in chart 2 below, the first round effects of an oil price shock are transmitted through the pricing structure of the economy via wages and producer prices. The second round effects result in subdued economic activity with a possible downward impact on the inflationary pressures in the longer term.



Source: Adopted from the Royal Bank of Scotland Group Economics

Almost all studies that attempt an estimation of pass-through for oil in the end boil down to an estimation of a Phillips Curve. In this regard we estimate the effect of oil prices using a traditional Phillips Curve with one lag of inflation, the output gap, and the percentage change in oil prices.

Pass-Through Equation

We estimate a generalized Phillips Curve as follows:

$$\Delta CPI_t = \alpha + \sum_{i=1}^{i=m} \beta_i \Delta CPI_{t-i} + \sum_{i=0}^{i=m} \gamma (y_{t-i} - \overline{y_{t-i}}) + \sum_{i=0}^{i=m} \theta_i \Delta oil p_{t-i} + \sum_{i=0}^{i=m} \lambda \Delta EXCH_{t-i}$$

Where ΔCPI is the change in the logarithm of the annual CPI index, y is real GDP, \bar{y} is the Hodrick-Precott filtered trend of real output, ΔOILP is the annual change in the logarithm of the price in US dollars of a barrel of Dubai Petroleum since most of the country's imports come from the Persian Gulf. ΔEXCH is the change in the logarithm of the annual average nominal exchange rate. We would have multiplied the oil price in dollars and the nominal average exchange rate to get the local currency price of oil but instead estimated the coefficients of oil prices and exchange rates to separate the exchange rate and oil price pass-through coefficients. Data is obtained from the Central Bank of Kenya and the IMF's IFS.

The model is a standard pass-through equation in the form of an autoregressive distributed lag model. In this set up, the inflation rate of a certain item is regressed on past values of itself and other variables.

Short-run pass-through is given by the estimated coefficient θ while long-run or full pass-through from an oil price shock to inflation is obtained as follows:

$$\text{Pass-through } (\Omega) = \frac{\sum_{i=0}^{i=m} \theta_i}{1 - \sum_{i=1}^{i=m} \beta_i}$$

III. ESTIMATION AND RESULTS

A. Estimation

The estimation involved first carrying out unit root tests to determine the order of integration of the variables used in estimation i.e CPI, oil prices in dollar values, and exchange rates given in shillings per US dollar. These three variables are found to have unit roots; in other words integrated of order 1. They were therefore differenced once to make them stationary. The output gap variable was however found to be stationary and therefore did not need to be differenced prior to estimation.

Table 1: Unit Root Tests

Variable	Augmented Dickey Fuller Test (ADF)	Phillips Perron Test (PP)
Log(CPI)	-0.39(0.90)	0.26(0.97)
$\Delta\text{log(CPI)}$	-3.27(0.02)	-3.27(0.02)

Log(OILP)	-1.52(0.51)	-0.52(0.51)
$\Delta\log(\text{OILP})$	-6.21(0.00)	-6.21(0.00)
log(EXCH)	-0.26(0.92)	-0.35(0.91)
$\Delta\log(\text{EXCH})$	-4.59(0.00)	-4.59(0.00)
YGAP	-5.39(0.00)	-5.38(0.00)

The regression of inflation against oil prices and the other variables initially examined the effects of the nominal oil price in US dollar terms on inflation. Later this was substituted by real US dollar price of oil derived by deflating oil prices in US dollar terms by the US CPI index. The lag length was determined by various lag order selection criteria by running a VAR model. One lag was found optimal as indicated by the LR test statistic, Final Prediction Error and Akaike Information Criteria. On the other hand, Schwarz Information Criterion and Hannan-Quinn Information Criterion found zero lags optimal. The selected lags are consistent with annual data series used in the study. We therefore estimated with one lag of each variable and sequentially removed insignificant lags while observing the Akaike Information and Schwarz Information criteria for model improvement.

The empirical estimation using nominal oil prices in US dollars yielded significant results. Oil prices are found to have significant effects on inflation being significant at 5 per cent level. The exchange rate is also highly significant at 1 per cent level. The output gap variable is significant at 5 per cent. The signs on the coefficients of the variables are positive as expected suggesting that inflation increases following a rise in oil prices, increased aggregate demand and a depreciation of the currency.

Table 2: Regression Results

Dependent Variable: $\Delta\log(\text{CPI})$

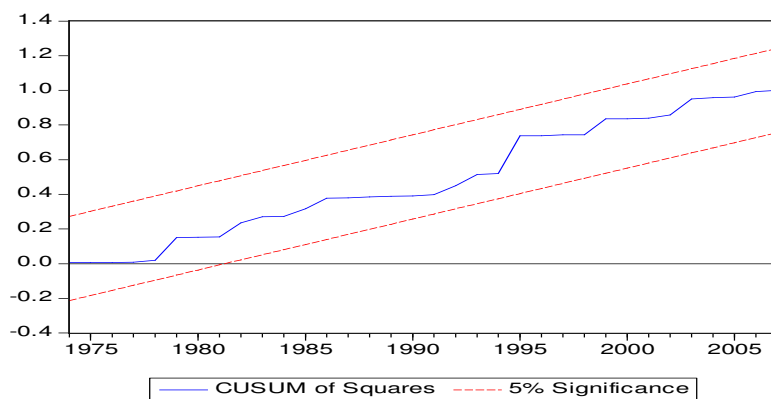
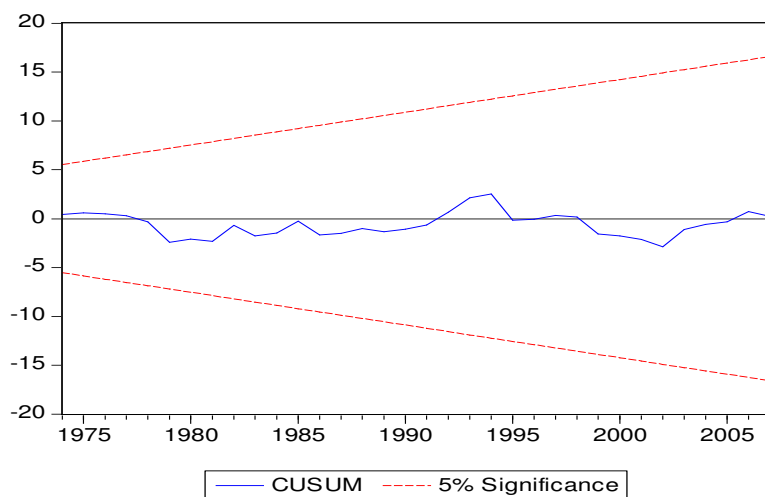
Variable	Coefficient	Std. error	t-statistic
C	0.0347	0.0135	2.575
$\Delta\log(\text{CPI}(-1))$	0.5016	0.1006	4.9845
$\Delta\log(\text{OILP})$	0.0483	0.0232	2.0777

$\Delta\log(\text{EXCH})$	0.3178	0.0633	5.0228
YGAP(-1)	0.00005	0.00002	2.0643

Adjusted R² 0.624 SE 0.0445 Durbin Watson 2.3568

Diagnostic Tests

	(p-values)
Jarque-Bera Normality	0.4818
Breusch-Godfrey Serial Correlation LM(2lags)	0.3383
Breusch-Pagan-Godfrey Heteroskedasticity	0.1064
Ramsey Reset	0.0824



A similar picture is obtained when nominal oil prices is substituted with real oil prices in US dollars. Oil prices remain significant at 5 per cent level of significance, exchange rates at 1 per cent level and the output gap at 5 per cent level of significance. The output gap in both cases is lagged one period.

The two estimations pass all the residual tests, namely, normality, serial correlation, and heteroskedasticity tests. The estimations also pass the stability tests as indicated by Ramsey Reset, CUSUM and CUSUM Squares tests.

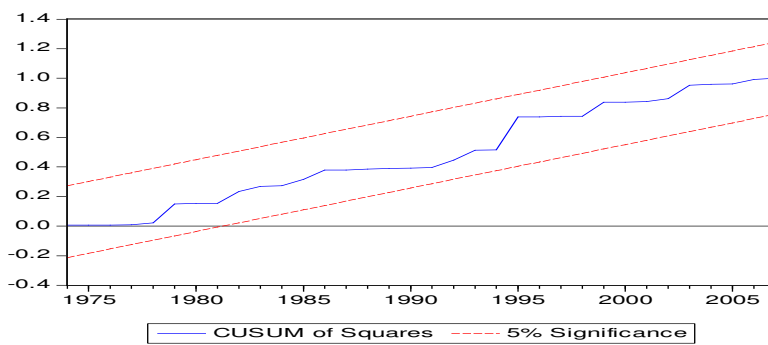
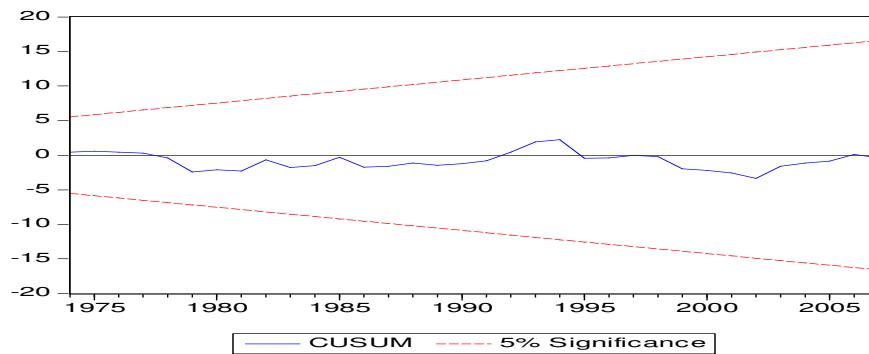
Dependent Variable: $\Delta \log(CPI)$

Variable	Coefficient	Std. error	t-statistic
C	0.0369	0.0133	2.7808
$\Delta \log(CPI(-1))$	0.5020	0.1010	4.9694
$\Delta \log(OILP/CPI_US)$	0.0488	0.0635	2.0169
$\Delta \log(EXCH)$	0.3171	0.0635	4.9966
YGAP(-1)	0.00005	0.00002	2.0825

Adjusted R² 0.622 SE 0.0447 Durbin Watson 2.3516

Diagnostic Tests

	(p-values)
Jarque-Bera Normality	0.48
Breusch-Godfrey Serial Correlation LM(2lags)	0.3541
Breusch-Pagan-Godfrey Heteroskedasticity	0.1165
Ramsey Reset	0.0855



B. Pass-Through Coefficients

Pass-through of oil price increases to inflation is 0.05 in the short-run. Long-run pass-through is therefore 0.10. The results suggest that a 10 per cent increase in oil prices leads to 0.5 per cent increase in inflation in the short run and 1 per cent in the long-run. These results are comparable to the findings in Duma (2008) and LeBlanc and Chinn (2004) who find low and incomplete pass-through due to combination of factors such as high content of food in the CPI basket.

The additional result is that the exchange rate pass-through to inflation is 0.32 in the short-run and 0.64 in the long-run. This also represents another case of incomplete pass-through but much higher compared to the oil price pass-through to inflation.

V. CONCLUDING REMARKS

This paper estimates a traditional Phillips curve to derive estimates of oil price pass-through to inflation in Kenya. It is shown that oil prices have been correlated with inflation. This correlation seems to have declined towards the early 90's but started to increase after trade liberalization.

The estimation results indicate that changes in oil prices have had significant effects on inflation. Other findings are that inflation has been significantly influenced by exchange rate changes and changes in aggregate demand conditions as captured by the output gap.

The measure of oil price pass-through to inflation is found to be 0.05 in the short-run and 0.10 in the long-run much lower compared to exchange rate pass-through of 0.32 in the short-run and 0.64 in the long-run. It implies that a 10 per cent increase in oil prices leads to only 0.5 per cent increase in inflation in the short-run and 1 per cent in the long-run. Oil price pass-through is therefore low and incomplete, consistent with findings in other studies.

REFERENCES

- Baffes, J., 2007. Oil Spills on other Commodities. *Resources Policy* 32, 126-134.
- Bermingham, C., 2008. Quantifying the Impact of Oil Prices on Inflation. Central Bank and Financial Services Authority of Ireland Research Technical Paper.
- Berument, H., Tasci, H., 2002. Inflationary Effect of Crude Oil Prices in Turkey. *Physica A*. 316, 568-580.
- Bouakez, H., Rebei, N., Vencatachellum, D., 2008. Optimal Pass-Through of Oil Prices. Institute of Applied Economics and African Development Bank.
- Brown, S.P.A., Oppedal, D.B., Yucel, M.K., 1995. Oil Prices and Inflation. Federal Reserve Bank of Dallas Working Paper 95-10.
- Cogni A., Manera, M., 2005. Oil Prices, Inflation and Interest Rates in a structural Cointegrated VAR model for the G-7 Countries. University of Milan-Bicocca and Fondazione Eni Enrico Mattei
- DeGracia, P., Cunado, J., 2005. Oil Prices, Economic Activity and Inflation: Evidence for some Asian Countries. *The Quarterly Review of Economics and Finance* 45, 65-83.

- DeGregoria, J., Landerretche, O., Neilson, C., 2007. Another Pass-Through Bites the Dust? Oil Prices and Inflation. Central Bank of Chile Working Paper No. 417.
- Duma, N., 2008. Pass-Through of External Shocks to Inflation in Sri Lanka. IMF Working Paper
- Ferderer, J.P., 1996. Oil Price Volatility and the Macroeconomy. *Journal of Macroeconomics*, Vol. 18, No. 1, pp. 1-26.
- Hahn, E., 2003. Pass-Through of External Shocks to Euro Area Inflation. European Central Bank Working Paper Series, No. 243.
- Hamilton, J.D., 2003. What is an Oil Price Shock? *Journal of Econometrics* 113, 363-398.
- Hooker, M.A., 1996. What Happened to the Oil Price-Macroeconomy Relationship?. *Journal of Monetary Economics*, 38, 195-213.
- Hunpage, F.O., Pelz, E., 2003. Do Energy Price Spikes Cause Inflation? Federal Reserve Bank of Cleveland.
- LeBlanc, M., Chinn, M.D., 2004. Do High Oil Prices Presage Inflation? The Evidence from G-5 Countries. US Department of Agriculture
- Leduc, S., Sill, K., 2004. A Quantitative Analysis of Oil-Price Shocks, Systematic Monetary Policy and Economic downturns. *Journal of Monetary Economics*, 51, 781-808.
- Royal Bank of Scotland Group, 2004. The Economic impact of High Oil Prices.