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# Disaggregated Consumer Prices and Oil Prices Pass-Through: Evidence from Malaysia

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**ABSTRACT**

The present paper analyzes the oil price pass-through into consumer price inflation for a developing country, Malaysia, using an augmented Phillips curve framework. The focus is on whether aggregate consumer prices and different consumer price components or sub-price indexes are related in different ways to oil price in the long run and in the short run. We find evidence for a long run relation or cointegration of the oil price with only the aggregate consumer price and food price indexes. Moreover, in the short run, the oil price changes have significant bearings on the consumer price inflation, the food price inflation, the rent, fuel and power price inflation and the transportation and communication price inflation. In addition, the short-run asymmetry in the oil price-food price inflation is also evident. Finally, we observe the neutrality of the medical care and health price index to the oil price changes. Our result that the inflationary consequence of oil price hikes is likely to work mainly through the food prices has important implications on the effects of oil price changes on the poor and policy directions to contain inflation.

Keywords: Oil Price Pass-though, Disaggregated Consumer Prices, Augmented Phillips Curve, Malaysia

## INTRODUCTION

The extent of oil price pass-through into inflation has captured much interest ever since the first OPEC oil embargo in 1973. Recently, this interest has been further intensified by episodes of drastic hikes and sharp swings in global oil prices that have occurred since 1999. During the 1990s, the West Texas Intermediate (WTI) spot oil price was relatively stable with the monthly average of USD19.70 per barrel and a standard deviation of USD3.90. Since 1999, the WTI oil price posted an upward trend and reached its peak at USD133.93 per barrel in June 2008. From 2000 to 2010, the average WTI oil price was USD53.68 per barrel, a rise of almost three times from the preceding decade. The extent of its volatility is even more alarming having the standard deviation of USD25.92, an almost seven-time increase. This wide fluctuation in the oil price has raised concern over their bearings on macroeconomic performance and has drawn attention of researchers to assess their impacts on such macroeconomic variable as inflation.

Arguably, there are several channels through which oil price changes affect inflation. It is often cited that hikes in the prices of oil push a nation's aggregate supply function backward through production cost increase and productivity decline, which leads to the increase in the aggregate price level (Brown and Yucel, 2002). Subsequently, it may generate a wage-price spiral leading to further increase in the consumer prices. At the same time, it may also depress the nation's aggregate demand through real balance effect (Mork, 1994) and consumption and investment effects (Lardic and Mignon, 2008). Hanson et al. (1993) further note the transmission channel of oil prices to inflation through exchange rate changes. The directional influence of this channel, however, tends to depend on whether the nation is an oil-importing or oil-exporting country and its dependence on international trade. For the oil-importing and trade-dependent economy, the increases in oil price worsen its terms of trade, depreciate its currency and consequently raise costs of its imported goods and inflation. By contrast, for the oil-exporting country, foreign exchange gains from oil price hikes are likely to appreciate the domestic currency. As a result, the imported goods become relatively cheaper to the country and its products are less competitive in the global market. Thus, income gains of the oil-exporting country may be countered by subsequent drop in the costs of imported goods and the demand for its product. Based on these various channels of influences, it seems that the inflationary effect of oil price increases for a specific country is an empirical issue.

In this paper, we empirically investigate the extent of oil price pass-through into inflation for a small open economy, Malaysia. Malaysia's macroeconomic performance since its independence in 1957 has been impressive recording an average GDP growth rate of more than 6% and an average inflation of 3.7% per year over 1971-2009. Still, Malaysia also experienced spikes in its inflation rate in 1974 and 1981 peaking respectively at more than 16% and 9%. These two episodes of high inflation are normally associated with the oil price shocks of 1973 and 1979. Thus, it is not surprising that, with the recent sharp swings in global oil prices, the inflationary experience of the 1970s and early 1980s are not far from the minds of Malaysian public and monetary authorities. At the same time, the Malaysian macroeconomic structure has changed as well. While Malaysia has been a highly open economy, it has transformed itself from a commodity-based economy to a manufacturing-based economy. In addition, Malaysia is also considered as a significant oil-exporting country. While its oil production exceeds its consumption, the domestic oil consumption has increased by a greater proportion than the oil production in recent years due to its industrialization process and the domestic retail oil price being below the global market price. Based on Malaysia's inflationary experiences and macroeconomic structure, Malaysia seems to serve an interesting country case study for the issue at hand.

Acknowledging that the changes in oil prices may not have equal effects on different goods prices, we evaluate the implications of oil price on disaggregated price levels by focusing on those prices that form major components in Malaysia's consumer prices. More specifically, in addition to the aggregate consumer price index, we also examine the behavior of sub-price indexes, namely, food price index, rent, fuel and power price index, transportation and communication price index, and medical care and health price index. While the first three sub-indexes form the major components of the aggregate price level, we add the medical care and health price index in the analysis due to recent popular discussion on health care costs in Malaysia. In this light, we contribute to existing literature that has a predominant focus on the inflationary effect of oil prices at the aggregate level and that contains limited number of studies that perform comparative analyses at the disaggregated levels especially for a developing economy.

The rest of the paper is structured as follows. In the next section, we review related literature. Then, we outline our empirical framework. Data and results are presented next. Finally, we summarize the main findings and some concluding remarks.

## RELATED LITERATURE

The implications of oil price shocks on such macroeconomic variables as real output and inflation have attracted empirical attention ever since the first OPEC oil embargo in 1973. With the recent escalating food prices amidst oil price sharp swings, the interest in the inflationary effects of oil prices have been further ignited. While some studies have evaluated the oil price pass-through into aggregate price inflation, others have a focus on the impacts of oil price on individual commodity prices at the global as well as at the national levels. The pre-dominant focus is on the developed economies. Despite the far-reaching implications of oil price fluctuations on developing countries, studies on these countries are still scarce.

The inflationary effects of oil price shocks at the aggregate price level for the developed economies have been the focus of numerous studies. Notable among them are Burbridge and Harrison (1984), Hooker (2002), Barsky and Kilian (2004), LeBranc and Chinn (2004), Gregario et al. (2007), Cologni and Manera (2008), and most recently Chen (2009). They yield rather conflicting results as to whether oil price shocks contribute significantly to inflation in these countries. Burbridge and Harrison (1984) employs a 7-variable vector autoregressive (VAR) framework to assess dynamic influences of oil prices on the industrial production and aggregate price level for five developed economies – Canada, Germany, Japan, the UK and the US. They note significant oil price effects on the US and Canadian price levels and smaller effects in other countries. Barsky and Kilian (2004) provide further support to the oil price – price level link by attributing the US excessive inflationary experience since the 1970s to oil price increase. In the same vein, using a Phillips curve framework augmented to include oil prices, Leblanc and Chinn (2004) further suggest modest effects of oil price changes on inflation for France, Germany, Japan, the UK, and the US. Cologni and Manera (2008) further reaffirm these results for the G-7 countries using a structural cointegrated VAR model, although they note the effects to be temporary.

Other researchers have questioned the inflationary consequences of oil price increases by pointing to the declining or even disappearing of oil price pass-through into inflation. Hooker (2002), in particular, documents a breakdown in the oil price pass-through into core US inflation since 1980 using the augmented Phillips curve model. Using a similar Philips curve specification, the recent study by Gregorio et al. (2007) for 34 developed and developing countries also note the declining inflationary effects of oil prices in many of their sample countries. Most recently, Chen (2009) documents similar findings for 19 industrialized countries and attributes the declining pass-through to various factors including active monetary policy in combating inflation, currency appreciation and trade openness.

The interest in the subject has also motivated researchers to evaluate the oil price implications on inflation in other groups of countries and on price inflation at the commodity levels. Canudo and de Gracia (2005) examine the real and inflationary effects of various oil price shock measures for six Asian countries – Japan, Singapore, South Korea, Malaysia, Thailand, and the Philippines). Evaluating the influences of lagged measures of oil price shocks in the US dollar or in domestic currency values on real output growth and inflation, they document some evidence that shocks in oil prices anticipate future variations in output growth and inflation. Indeed, they note more evidence of the inflationary effects of oil prices when the oil price shocks are measured in domestic currencies. Alghalith (2010) quantifies the interaction between food prices and oil prices for a small oil-producing country, Trinidad and Tobago, using a non-linear framework. He concludes that the food price index will increase by about 5.6 points following a dollar increase in the oil prices.

Baffes (2007), Harri et al. (2009) and Chen et al. (2010) demonstrate significant relations between oil prices and various internationally traded commodities. Baffes (2007) employs a linear regression model that links the price of a commodity to the price of oil and price deflator to estimate the oil price pass-through into 35 commodity prices. They find large variations in the pass-through across the commodities. For the food prices, they note that a 10% increase in oil prices is associated with the increase in the expected food prices by 1.8%. Using monthly observations from January 2000 to September 2008, Harri et al. (2009) establish the presence of cointegrating relations between crude oil and four agricultural commodities, i.e. corn, soybeans, soybean oil, and cotton. Chen et al. (2010) use weekly data from 1983 to 2010 to model the relations between crude oil price and the world prices of corn, soybeans and wheat. Employing the autoregressive distributed lags (ARDL) framework, they show that the three agricultural prices are significantly influenced by the crude oil price.

While these studies have noted significant influences of oil prices on commodity prices, Zhang et al. (2010) document the lack of long-run relations between energy prices (ethanol, gasoline and oil) and a set of global commodity prices (corn, rice, soybeans, sugar and wheat) using monthly data from March 1989 to July 2008. In addition, they also document the absence of short-run causality between the energy prices and agricultural prices. Similar evidence is also documented for the commodity prices at the national levels by Zhang and Reed (2008) and Nazlioglu and Soytas (2011). Employing cointgration analysis and dynamic interactions of world crude oil prices and China's corn, soy meal, and pork prices for the period January 2000 – October 2007, Zhang and Reed (2008) sideline the oil prices as a major contributing factor to agricultural price uptrend in China. Nazlioglu and Soytas (2010) examine the Turkey case by looking at the relations between oil prices, lira-dollar exchange rate, and individual agricultural prices (wheat, maize, cotton, soybeans, and sunflower). The results indicate neutrality of these agricultural prices to oil price fluctuations.

As argued by Baffes (2007), the focus on disaggregated prices are more informative and better point to policy-related conclusions. In light of this, we further argue that meaningful recommendation to contain inflationary pressures of recent oil price shocks for a country requires investigating which goods sectors are mostly affected by oil price changes. Hence, we add to the literature in this direction by focusing on Malaysia's experience.

## EMPIRICAL FRAMEWORK

In line with Chen (2009) and others, we adopt an augmented Phillips curve to examine the degree of oil price pass-through into inflation. To begin, we frame the short-run dynamics of the inflation rate in an error-correction form as:

$$\Delta p_t = \gamma + \sum_{i=1}^{k} \delta_i \Delta p_{t-i} + \sum_{i=0}^{k} \omega_i (y_{t-i} - \bar{y}_{t-i-1}) + \sum_{i=0}^{k} \theta_i \Delta o_{t-i} + \varphi \varepsilon_{t-1} + v_t \qquad (1)$$

where $\Delta$ is the first difference operator, $p$ is the natural log of the price index under consideration, $y$ is the natural log of real output, $\bar{y}$ is potential output, $o$ is the natural log of oil price, and $k$ is the optimal lag order. Note that the augmented terms of the Phillips curve in (1) are the contemporaneous and lagged oil price changes and the deviation of the price level from its long run value, i.e.

$\varepsilon_t = p_t - \alpha - \beta_1 y_t - \beta_2 o_t$, the so-called error correction term. Specification (1) conveniently combines the short-run dynamics and long-run information in the data series by allowing the responses of inflation not only to changes in real output and oil prices but also to the deviation of the price level from its long run level with the parameter $\varphi$ measuring the speed of adjustment. As in Chen (2009), the inclusion of the error correction term is to allow for potential long-run co-movements or cointegration among the three variables – consumer prices, real output and oil prices. Thus, in the case that no cointegration is documented, we drop the error-correction term from equation (1).

In addition to (1), we also consider asymmetric effects of oil price increase and decrease on the inflation rate. Empirically and theoretically, the asymmetry in the oil price – consumer price relations is a possibility that deserves attention. Empirically, various studies have noted differential impacts of oil price increases and oil price decreases on macroeconomic activities (Mork, 1989; Mory, 1993; and Hamilton, 1996). Moreover, it is well noted that economic activities behave asymmetrically across the business cycles. As suggested by Sichel (1993), contractions tend to be steeper than expansion (i.e. sharpness) and troughs tend to be more pronounced than peaks (i.e. deepness). Accordingly, inflation can also exhibit asymmetric behavior as well. Theoretically, the presence of their asymmetric relations can be motivated by the downward rigidities in the price level and nominal wages. In the face of oil price increase, firms may cut down production or pass-through the increase in production costs to consumers. By contrast, the reduction in the global oil price is not necessarily translated to cost reduction. More likely, as a result of downward rigidity in nominal wages, the production costs would remain high. Even if the costs of production decline, the firms may not pass through the decline to goods prices if the decline is merely a temporary correction of initial oil price increases and that the price uptrend will continue. Based on this, it can be posited that positive oil price changes may have significantly larger pass-through than negative oil price changes.

To ascertain the presence of asymmetry in the relations between oil price changes and inflation, we follow the approach taken by Mehrara (2008) and Cong et al. (2008) who, respectively, examine the asymmetric relation between oil revenue and economic activities and between stock markets and oil prices. The approach is based on decomposing the oil price changes to positive and negative changes given by $\Delta o_t^+ = \max(0, \Delta o_t)$ and $\Delta o_t^- = \min(0, \Delta o_t)$. Thus, we have:

$$\Delta p_t = \gamma + \sum_{i=1}^{k} \delta_i \Delta p_{t-i} + \sum_{i=0}^{k} \omega_i (y_{t-i} - \bar{y}_{t-i-1}) + \sum_{i=0}^{k} \theta_i^+ \Delta o_{t-i}^+ + \sum_{i=0}^{k} \theta_i^- \Delta o_{t-i}^- + \varphi \varepsilon_{t-1} + v_t \qquad (2).$$

We also examine possible asymmetric price adjustment towards the long run equilibrium by means of an asymmetric cointegration test as suggested by Enders and Siklos (2001). As we document the absence of asymmetric adjustment speeds of the price inflation, we only incorporate possible asymmetry only in the relations between oil price changes and inflation and not in the latter's adjustment towards the long run.

Both (1) and (2), referred respectively as Model I and Model II, are estimated. However, we allow the data to decide whether the error correction term should be included in both models. This consideration necessitates us to proceed in steps. First, we subject each series to the widely-used augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests to establish their stationarity properties and integration orders. Then, given that the variables under study are non-stationary integrated of the same order, we examine whether they share a long run relation or are cointegrated by means of the VAR-based cointegration test as proposed by Johansen (1988) and Johansen and Juselius (1990). These preliminary analyses of the data series are now imperative as to avoid spurious regressions. Moreover, they serve as guidelines for modeling short-run dynamics of a variable of interest. Third, if there is a cointegrating or long-run relationship among the variables, we provide the estimates of the long-run parameters. And finally, we estimate the dynamics of consumer prices as specified in (1) and (2) for the cointegrated cases. For the non-cointegrated cases, the error correction term is dropped from the two equations.

## DATA AND RESULTS

### Data preliminaries

The data are annual covering the period 1971 to 2009. We employ the consumer price index (CPI) to represent the aggregate price level. In addition, four sub-components of the CPI are considered. These are the food price index (FPI), rent, fuel and power price index (RFPI), transportation and communication price index (TCPI), and medical care and health price index (MHPI). The first three sub-indexes are the major components of the CPI with the combined weightage of more than 70%. The weight of the MHPI, however, is only 1.8% but is considered in the analysis due to heated discussion on healthcare costs in recent times. Real output is represented by real gross domestic product. The Hodrick-Prescott filter is adopted to extract the trend output and is taken as measuring potential output. For the oil price, we use the West Texas Intermediate (WTI) crude oil price multiplied by the ringgit-USD exchange rate. Data on the price indexes, real GDP and ringgit-USD rate are from *Monthly Statistical Bulletin* published by Malaysia's Central Bank. Meanwhile, the WTI crude oil price data are from FRED II of the Federal Reserve Bank of St. Louis. These data are expressed in natural logarithm.

Figure 1 plots these variables in level while Table 1 provides descriptive statistics of these variables in first difference, i.e. their growth rates. All variables exhibit an uptrend pattern over the sample period. Notably, the increase in the WTI crude oil price accelerated during the 1970s and during recent years and recorded an annual growth of 7.9% over 1971-2009. It also recorded the highest volatility as indicated by the standard deviation. The growth rate of Malaysia's real GDP is respectable by the international standard with an annual average growth of 6.2%. Malaysia suffered the biggest drop in its real GDP in 1998 due to the Asian financial crisis, i.e. a contraction of 7.7%. Among the consumer prices, the food price index demonstrated the highest rate of growth (i.e. 4.4% per year) and the highest variations (i.e. 4.5% standard deviation). All variables are positively skewed except the transportation and communication price inflation and show excess kurtosis except the rent, fuel and power price inflation. The Jarque-Bera test statistics soundly rejects the null hypothesis of normality in the growth rates of all series except the rent, fuel and power price inflation.

We first conduct the preliminary analyses of unit root and cointegration tests. Table 2 reports the ADF and PP unit root test results while Table 3 provides the cointegration test results. In implementing the unit root tests, we include both the constant and trend terms in the test equations and adopt the Schwartz information criterion (SIC) for selecting the optimal lag order in the ADF test equation. The two tests agree in classifying the WTI oil price, real GDP, consumer price index, transportation and communication price index, and medical care and health price index to be non-stationary integrated of order 1. Likewise, the two tests indicate the possibility of the rent, fuel and power price index being I(2). Finally, the results for the food price index are conflicting with the ADF test suggesting its stationarity and the PP test its non-stationarity. We plot the correlogram of the food price index and note its gradually declining pattern. This suggests non-stationarity of the variable in level. Based on this, we take the food price index to be integrated of order 1.

Due to the disparate property of the rent, fuel and power price index, we omit the series from the cointegration analysis. From Table 3, we are able to document the long run relation among the variables when the CPI and FPI are used. The finding suggests the presence of a unique cointegrating vector for both systems. In the case of the TCPI and MHPI, the null hypothesis of no cointegration cannot be rejected at conventional levels of significance. It seems that, in the long run, both real output and oil prices drive the aggregate price level and the source of this long run relation is the evolution of the food price index in response to long term movements in real output and oil prices. Thus, for the CPI and FPI, their interactions with the oil prices can be in the short run and the long run. However, for the TCPI and MHPI, the only relations that may exist between them and the oil prices are short run in nature. We investigate these dynamic interactions next.

**Estimation results**

As noted, we find a unique cointegrating relation in the systems with the CPI and FPI. Hence, the long-run relations between these price indexes and other variables are of particular interest. The Johansen-Juselius estimates of the long run parameters are given below (* indicates significance at 1% level):

$$\text{CPI:} \quad p_t = -1.4364 + 0.4546^* y_t + 0.0268 o_t$$

$$\text{FPI:} \quad p_t = -1.4364 + 0.5179^* y_t + 0.0563^* o_t$$

The long-run relation between the two price indexes and both real output and oil prices are positive as should be expected. While the long run coefficient of the real output is significant in both equations, interestingly, we observe the significant long run relation between the consumer prices and oil prices only in the FPI equation. As a confirmatory exercise, we also estimate the long run relations using the dynamic ordinary least squares (DOLS) as suggested by Stock and Watson (1993). The long-run oil price pass-through into the food price index remains significant albeit with a slightly lower coefficient estimate (i.e. 0.044). These results, thus, suggest that the food prices are not neutral to variations in the oil prices. Based on the Johansen-Juselius estimate, a 10% increase in the price of oil is associated with the increase in the expected FPI by roughly 0.56%.

Table 4 presents estimation results of Model I and Model II for both the consumer and food price inflation. In estimating the model, we apply the general-to-specific procedure to trim insignificant lags from the maximum lag order of 3. The models perform reasonably well with the adjusted $R^2$ to be higher than 0.65 and significant F-statistics. To further validate the models, we perform various diagnostic tests. With one exception, we find the error terms to be normally distributed by the Jargue-Bera (JB) statistics, non-autocorrelated by the LM autocorrelation statistics, and absent from the ARCH effects by the ARCH statistics at 5% significance levels. The exception is Model II for the FPI inflation, which fails the ARCH test. Accordingly, for this case, the Newey-West variance-covariance matrix is employed. In addition to these tests, we also examine whether there are structural breaks in the models using the Chow's breakpoint test. We choose the break points at 1985 and 1997, the years that Malaysia experienced major recessions and at 1990, the mid-sample point. The results indicate no structural breaks in these years.

As we have noted above, the long-run oil price pass-through into the FPI seems larger than the pass-through into the aggregate price level (CPI). This stronger effect on the FPI than on the CPI is also carried over to their dynamic behavior. We find the error-correction terms to be significant at 1% level in all estimations, reaffirming the presence of cointegration among the variables. More importantly, we note faster adjustment of the FPI to the long run line as compared to the CPI. The estimated error-correction coefficients indicate that more than 50% of the FPI deviations from its long run value is corrected the next year. The corresponding adjustment speed for the CPI is just slightly over 30%. Looking at the immediate or short run impacts of oil price changes on both CPI and FPI inflation, we may also note stronger and more significant influences of contemporaneous oil price changes on the latter. By allowing asymmetry in their short-run interactions, we uncover evidence that the significant influences of oil price changes in the models stem mainly from the oil price increases. Namely, the positive changes in oil prices are contemporaneously and significantly related to both CPI and FPI inflation. By contrast, the negative changes in oil price are insignificant. Again, in the case of positive oil price changes, their immediate impacts on prices are larger for the FPI case. However, when we test for symmetric effects of positive and negative oil price changes, i.e. $H_0$: $\theta_0^+ = \theta_0^-$, using the standard F test, the asymmetric effect is evident only for the food price inflation. Finally, as a side result, we also observe the autoregressive term to be significant in the FPI inflation equation and not in the CPI inflation equation. Thus, the FPI inflation seems more persistent.

We also estimate short-run dynamic behavior of other price indexes. Since they do not share a long run relation with oil price and real output, the error-correction term is not included. The lag order in the models is fixed at 1, which is based on the SIC and is sufficient to render the error terms serially uncorrelated. The results are presented in Table 5. Among the three sub-indexes, the RFPI inflation seems to respond significantly to both output gap and changes in oil prices. For the case of MHPI inflation, we observe no significant impacts of either the output gap or oil price changes at 5% significance level. Finally, oil price changes do exert significant influences on the TCPI inflation at 5% level when the model imposing symmetric effects of oil prices is used. Interestingly, when we allow for asymmetry, the positive oil price changes are significant while the negative oil price changes are not in the RFPI inflation. Meanwhile, countering our expectation, the negative changes in oil price turn significant while its positive changes are not for the TCPI inflation. However, the null hypothesis of symmetry cannot be rejected in both cases.

## Discussion

In general, our results suggest adverse repercussions of oil price increases on the CPI inflation. They further indicate that the inflationary effects of oil price changes in the long run are likely to work through the food prices. Meanwhile, except the medical care and health price index, other sub-price indexes tend to be related to oil price hikes in the short run. Based on these findings, there are at least three important inquiries that need to be addressed. First, why are the linkages between oil and consumer prices different across the sub-indexes? Second, should the significant effect of oil price on food prices be a major concern? And finally, what are the main policy implications of the findings?

The low inflation environment experienced by the country since its independence in 1957 is supported by prudential price regulation of essential items and by responsive monetary policy. However, with the nation's transformation from a commodity-based economy to an industrial-based economy, Malaysia has been a net food importer. As a result, Malaysia becomes susceptible to global food price fluctuations. Hence, we posit that the rising domestic food prices in responses to crude oil price hikes are likely to be the consequences of the interplays between recent parallel developments in the global oil markets and food markets. In other words, the noted long run relation and short run causal influences of oil prices on food prices stems from the adjustments in international food markets working through international trade. It should be noted that, due to price regulation of certain food items, the oil price pass through into CPI or FPI inflation in Malaysia is much lower than the estimate for the global food price, which is noted to be 0.18 by Baffes (2007) and 0.25 by Gilbert (1989).

The lack of cointegration between the remaining price indexes with the global oil price seems puzzling especially for the rent, fuel and power price index and transportation and communication price index, which are considered to be highly energy intensive. We believe that the driving forces behind these indexes may be different from those that affect the food prices. These price indexes may be arbitrarily and persistently deviate away from the global oil price due to the fixed domestic retail energy prices below the global level. Moreover, these prices are more easily controlled as compared to the food prices. Accordingly, there are no forces at work to move these prices in accordance with the global oil price trend. In the case of the transportation and communication sector, the sector may have benefited the ASEAN Free Trade Agreement (AFTA) and technological progress of the communication sector.

We do note significant short run influences of both output gap and oil price changes on the rent, fuel and power prices. This means that the rent, fuel and power prices are subject to cyclical fluctuations in output as well as changes in oil prices. In a similar vein, the transportation and communication prices are also influenced by the changes in oil prices in the short run. Finally, we believe that the recent heated debate on health costs is not related to oil price increase but point towards rare occurrences of malpractice in the industry.

While we note a low pass-through of oil price into food price inflation, the concern of rising oil prices is justifiable since it will have a disproportionate effect on various income groups of consumers. Spending on food items takes up substantial proportion of income of low-income households. Accordingly, the rising oil price will erode their purchasing power and consequently may lead to undernourishment. Moreover, due to the noted asymmetry, the positive oil price changes will immediately raise food prices without immediate offsetting effect when the oil prices decline. In short, the food prices tend to be exhibit downward rigidity in the short run. Finally, rising global food prices amidst episodes of oil price upswings can have adverse repercussions on Malaysia's food import bills, which then may affect its balance of payment. From 2001 to 2010, the imports of primary and processed food and beverages have increased by more than 8.5% in nominal terms. In 2008, the year of escalating food and commodity prices, their imports have risen by more than 19%. Accordingly, Malaysia has to bear substantial costs of food bills in recent years due to sharp oil price increases.

With the central role of food prices in causing inflationary pressure as experienced by Malaysia, it is recommended that policy attention be directed to the agricultural sector to ameliorate the effects of oil price increases on the overall inflation. The conventional wisdom seems to call for the increase in domestic food supply or the reduction in production and transportation costs. To this end, various approaches have been noted in policy circles. Among them include enhancing agricultural productivity, better land management, improving distribution and marketing chains, stockpiling, and subsidies. Among these, stockpiling and subsidies may not be appropriate as it will add further to the government's fiscal burden. However, by increasing domestic production of essential food items through productivity and better land management as well as by reducing costs through efficient distribution and marketing chains of domestic food products, we believe that the adverse implications of global oil prices on domestic food prices as well as Malaysia's balance of payments can be curtailed.

## CONCLUSION

The recent oil price shocks and their bearings on the consumer prices have received much discussion in both popular and academic discussion. While some have noted the declining inflationary effects of oil prices, others have warned that the oil price shocks may have pushed many households in developing countries into poverty and malnutrition. In this paper, we make an empirical assessment of the link between oil price and consumer prices using the augmented Phillips curve model for a small developing country, Malaysia. In the analysis, we examine which goods prices are more likely to be affected by oil price fluctuations by looking at various sub-indexes of the aggregate consumer price index, namely, the food price index, the rent, fuel and power price index, the transportation and communication price index, and the medical care and health price index in addition to the aggregate consumer price index. We believe that the disaggregated analysis will be more meaningful for a national policy to contain inflationary pressure from oil price increases since it pinpoints which sectors are responsible for the general increase in the price level.

The results we obtain can be summarized as follows:

- The oil price and real output are cointegrated only with the aggregate consumer price index and the food price index. Thus, oil price fluctuations are related to both prices in the long run.
- At the same time, the evidence also suggests the short run effects of oil price changes on the consumer price index, food price index, rent, fuel and power price index, and transportation and communication price index.
- The presence of short-run asymmetric inflationary impacts of positive and negative oil price changes is evident only for the food price inflation.
- The long run oil price pass-through and the short-run inflationary effects of oil prices changes seem larger for the food price index than for the aggregate consumer price index.

From these results, we conclude that the oil price effects on the aggregate price level seem to be from its effects on mainly the food prices. This finding is a cause of concern and, at the same time, points toward policy focus to contain inflationary pressure amidst sharp increases in oil prices. It is a concern since the oil price shocks through their impacts on domestic food prices disproportionately affect poor households and raise Malaysia's import bills of food items. To alleviate this concern, the policy attention should be directed toward the food sector by increasing domestic food supply and cutting costs of bringing food products to the market. To these ends, measures need to be taken to increase agricultural productivity, better manage idle land, and improve distribution and marketing chains of food items. Stockpiling and subsidies, which are common policy measures in many countries, should be sidelined as they will add further to the government's fiscal burden.

## REFERENCES

Alghalith, M. (2010), "The interaction between food prices and oil prices", *Energy Economics*, Vol. 32, No. 6, pp. 1520-1522.

Baffes, J. (2007), "Oil spills on other commodities", *Resource Policy*, Vol. 32, No. 3, pp. 126-134.

Barsky, R. B. and Kilian, L. (2004). "Oil and the macroeconomy since the 1970s", *Journal of Economic Perspectives*, Vol. 18, No. 4, pp. 115-134.

Brown, S. P. A. and Yücel, M. K. (2002). "Energy prices and aggregate economic activity: an interpretive survey", *Quarterly Review of Economics and Finance,* Vol. 42, No. 2, pp. 193-208.

Burbridge, J. and Harrison, A. (1984), "Testing for the effects of oil price rises using vector autoregressions", *International Economic Review,* Vol. 25, No. 2, pp. 459-484.

Chen, S.-S. (2009), "Oil price pass-through into inflation", *Energy Economics*, Vol. 31, No. 1, pp. 126-133.

Chen, S.-T., Kua, H.I. and Chen, C.-C. (2010), "Modeling the relationship between the oil price and global food prices", *Applied Energy*, Vol. 87, No. 8, pp. 2517-2525.

Cologni, A. and Manera, M. (2008), "Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G-7 countries, *Energy Economics*, Vol. 30, No. 3, pp. 856-888.

Cong, R.-G., Wei, Y.-M., Jiao, J.-L. and Fan, Y. (2008), "Relationship between oil price shocks and stock market: an empirical analysis from China," *Energy Policy,* Vol. 36, No. 9, pp. 3544-3553.

Cunado, J. and de Gracia, F. P. (2005). "Oil prices, economic activity and inflation: evidence from some Asian countries", *Quarterly Review of Economics and Finance,* Vol. 45, No. 1, pp. 65-83.

Enders, W. and Siklos, P. L. (2001), "Cointegration and threshold adjustment", *Journal of Business & Economic Statistics*, Vol. 19, No. 2, pp. 166-176.

Gilbert, C.L. (1989), "The impact of exchange rates and developing country debt on commodity prices," *Economic Journal*, Vol. 99, No. , pp. 773-783.

Gregario, J. D., Landerretche, O. and Neilson, C. (2007), "Another pass-through bites the dust? Oil prices and inflation", Working Paper, Central Bank of Chile.

Hamilton, J. D. (1996), "This is what happened to the oil price – macroeconomy relationship", *Journal of Monetary Economics*, Vol. 38, No. 2, pp. 215-220.

Hanson, K., Robinson, S. and Schluter, G. (1993), "Sectoral effect of world oil price shock: economywide linkages to the agricultural sector", *Jouranl of Agricultural and Resource Economics*, Vol. 18, No. 1, pp. 96-116.

Harri, A., Nally, L. and Hudson, D. (2009), "The relationship between oil, exchange rates, and commodity prices", *Journal of Agricultural and Applied Economics*, Vol. 41, No. 2, pp. 501-510.

Hooker, M. A. (2002), "Are oil shocks inflationary? Asymmetric and non-linear specifications versus changes in regime", *Journal of Money, Credit and Banking*, Vol. 34, No. 2, pp. 540-561.

Johansen, S. (1988), "Statistical analysis of cointegration vectors", *Journal of Economic Dynamics and Control*, Vol. 12, No. 2-3, pp. 231-254.

Johensen, S. and Juselius, K. (1990), "Maximum likelihood estimation and inferences on cointegration with application to the demand for money", *Oxford Bulletin of Economics and Statistics*, Vol. 52, No. 2, pp. 169-210.

Lardic, S. and Mignon, V. (2008), "Oil prices and economic activity: An asymmetric cointegration approach", *Energy Economics*, Vol. 30, No. 3, pp. 847-855.

LeBlanc, M. and Chinn, M. D. (2004), "Do high oil prices presage inflation? The evidence from G5 countries", *Business Economics*, Vol. 34, pp. 38-48.

Mehrara, M. (2008), "The asymmetric relationship between oil revenues and economic activities: the case of oil-exporting countries", *Energy Policy*, Vol. 36, No. 3, pp. 1164-1168.

Mork, K. A. (1989), "Oil and the macroeconomy when prices go up and down: an extension of the Hamilton's results", *Journal of Political Economy*, Vol. 97, No. 3, pp. 740-744.

Mork, K. A. (1994), "Business cycles and the oil market", *The Energy Journal*, Vol. 15, Special Issue , pp. 15-38.

Mory, J. F. (1993), "Oil prices and economic activity: Is the relationship symmetric?" *The Energy Journal*, Vol. 14, No. 4, pp. 151-161.

Nazlioglu, S. and Soytas, U. (2011), "World oil prices and agricultural commodity prices: evidence from an emerging market", *Energy Economics*, Vol. 33, No. 3, pp. 488-496.

Sichel, D. E. (1993), "Business cycle asymmetry: A deeper look", *Economic Inquiry,* Vol. 31, No. 2, pp. 224–236.

Stock, J. H. and Watson, M. W. (1993), "A simple estimator of cointegrating vectors In higher order integrated systems", *Econometrica*, Vol. 61, No. 4, pp. 783-820.

Zhang, Q. and Reed, M. (2008), "Examining the impact of the world crude oil price on China's agricultural commodity prices: the case of corn, soybean, and pork", The Southern Agricultural Economics association Annual Meetings, Dallas, TX. February 2-5.

Zhang, Z., Lohr, L., Escalante, C. and Wetzstein, M. (2010), "Food versus fuel: what do prices tell us", *Energy Policy*, Vol. 38, No. 1, pp. 445-451.

TABLE 1: Descriptive Statistics

| | ΔO | ΔY | ΔCPI | ΔFPI | ΔRFPI | ΔTCPI | ΔMHPI |
|---|---|---|---|---|---|---|---|
| Mean | 0.0791 | 0.0617 | 0.0376 | 0.0444 | 0.0309 | 0.0356 | 0.0372 |
| Median | 0.0315 | 0.0684 | 0.0341 | 0.0364 | 0.0272 | 0.0362 | 0.0302 |
| Maximum | 0.9689 | 0.1108 | 0.1597 | 0.2345 | 0.0953 | 0.0906 | 0.1282 |
| Minimum | -0.5816 | -0.0766 | 0.0031 | -0.0251 | -0.0198 | -0.0790 | -0.0031 |
| Std. Dev. | 0.2615 | 0.0387 | 0.0293 | 0.0448 | 0.0278 | 0.0299 | 0.0273 |
| Skewness | 0.6461 | -1.6508 | 2.2353 | 2.2870 | 0.4651 | -1.2612 | 1.4192 |
| Kurtosis | 5.7102 | 5.9365 | 9.5571 | 10.2132 | 2.6096 | 6.7779 | 5.0069 |
| Jarque-Bera | 14.273 | 30.913 | 99.721 | 115.505 | 1.6112 | 32.671 | 19.133 |
| Probability | 0.0008 | 0.0000 | 0.0000 | 0.0000 | 0.4468 | 0.0000 | 0.0001 |

TABLE 2: ADF and PP unit root tests

| Variables | Level | | First Difference | |
|---|---|---|---|---|
| | ADF | PP | ADF | PP |
| O | -2.0802 | -2.1029 | -5.7499* | -5.7450* |
| Y | -1.3155 | -1.4899 | -4.9146* | -4.9246* |
| CPI | -3.3062 | -2.9230 | -4.3466* | -4.4541* |
| FPI | -4.6448* | -3.3474 | -- | -4.3678* |
| RFPI | -2.9768 | -1.0467 | -2.8345 | -2.9487 |
| TCPI | -0.9562 | -0.7233 | -4.6215* | -4.2076* |
| MHPI | -2.5041 | -0.9494 | -3.4549 | -5.5411* |

Note: O = oil price; Y = real gross domestic product; CP = consumer price; FP = food price; RFP = gross rent, fuel and power price; MHP = medical care and health price; TCP = transport and communication price.The test equations include both constant and trend terms. The SIC is used to determine the optimal lag length in the ADF test equation. * and ** denote significance at 1% and 5% respectively.

TABLE 3: Johansen-Juselius cointegration tests

| Systems | Test Statistics | Number of Cointegrating Equations | | |
|---|---|---|---|---|
| | | None | At most 1 | At most 2 |
| CPI, O, Y | Trace | 34.224 | 7.139 | 3.140 |
| | Max | 27.085 | 3.999 | 3.140 |
| FPI, O, Y | Trace | 44.869 | 6.899 | 2.031 |
| | Max | 37.969 | 4.8689 | 2.031 |
| MHPI, O, Y | Trace | 24.415 | 7.141 | 2.020 |
| | Max | 17.274 | 5.121 | 2.020 |
| TCPI, O, Y | Trace | 24.962 | 10.498 | 4.550 |
| | Max | 14.463 | 5.948 | 4.550 |
| Critical Value | Trace | 29.797 | 15.495 | 3.841 |
| (5%) | Max | 21.132 | 14.265 | 3.841 |

Note: O = oil price; Y = real gross domestic product; CPI = consumer price; FPI = food price; RFPI = gross rent, fuel and power price; MHPI = medical care and health price; TCPI = transport and communication price.

TABLE 4: Error-correction models of CPI and FPI inflation

| Coefficients | Model I | | Model II | |
|---|---|---|---|---|
| | CPI | FPI | CPI | FPI |
| $\gamma$ | 0.0358 (0.000) | 0.0313 (0.000) | 0.0334 (0.000) | 0.0247 (0.001) |
| $\delta_1$ | -- | 0.2251 (0.024) | -- | 0.2229 (0.022) |
| $\theta_0$ | 0.0233 (0.055) | 0.0411 (0.018) | -- | -- |
| $\theta_0^+$ | -- | -- | 0.0328 (0.048) | 0.0678 (0.004) |
| $\theta_0^-$ | -- | -- | 0.0029 (0.912) | -0.0165 (0.649) |
| $\varphi$ | -0.3095 (0.000) | -0.5478 (0.000) | -0.3085 (0.000) | -0.5459 (0.000) |
| Adj-$R^2$ | 0.6525 | 0.6908 | 0.6502 | 0.7099 |
| F | 34.800 (0.000) | 27.807 (0.000) | 23.303 (0.000) | 23.025 (0.000) |
| JB | 2.3992 (0.301) | 0.7178 (0.698) | 2.0075 (0.3665) | 0.8392 (0.657) |
| LM(1) | 2.3194 (0.128) | 1.0506 (0.305) | 3.5482 (0.060) | 0.0049 (0.944) |
| LM(2) | 2.3874 (0.303) | 1.1229 (0.570) | 3.5845 (0.167) | 0.8375 (0.658) |
| ARCH(1) | 0.7358 (0.391) | 3.6745 (0.055) | 0.7455 (0.3879) | 5.0846 (0.0241) |
| CHOW(1985) | 1.1643 (0.339) | 0.8726 (0.492) | 1.8956 (0.138) | 0.5483 (0.738) |
| CHOW(1990) | 0.3447 (0.793) | 1.2157 (0.326) | 0.6838 (0.609) | 0.6985 (0.629) |
| CHOW(1997) | 0.8299 (0.488) | 1.3100 (0.289) | 0.9060 (0.473) | 0.8193 (0.547) |

Notes: Through general-to-specific procedures applied to equation (1) and (3), we arrive at the following final models: Model I: $\Delta p_t = \gamma + \delta_1 \Delta p_{t-1} + \theta_0 \Delta o_t + \varphi \varepsilon_{t-1} + v_t$ and Model II: $\Delta p_t = \gamma + \delta_1 \Delta p_{t-1} + \theta_0^{+} \Delta o_t^{+} + \theta_0^{-} \Delta o_t^{-} + \varphi \varepsilon_{t-1} + v_t$. Number in parentheses are p-value.

TABLE 5: Causality tests of non-cointegrated systems

| Price Variables | Model | Coefficient sums of first-differenced terms (p-value) | | | | |
|---|---|---|---|---|---|---|
| | | $\Delta p$ | $\Delta(y-\bar{y})$ | $\Delta o$ | $\Delta o^{+}$ | $\Delta o^{-}$ |
| RFP | I | 0.7203 | 0.1830 | 0.0396 | -- | -- |
| | | (0.000) | (0.049) | (0.012) | | |
| | II | 0.7352 | 0.2080 | -- | 0.0521 | 0.0078 |
| | | (0.000) | (0.050) | | (0.011) | (0.749) |
| MHP | I | 0.2166 | 0.2026 | 0.0236 | -- | -- |
| | | (0.215) | (0.346) | (0.632) | | |
| | II | 0.2421 | 0.2017 | -- | 0.0251 | 0.0228 |
| | | (0.187) | (0.494) | | (0.626) | (0.802) |
| TCP | I | 0.2003 | -0.1102 | 0.0580 | | |
| | | (0.356) | (0.280) | (0.049) | | |
| | II | 0.1491 | -0.1172 | -- | 0.0490 | 0.0937 |
| | | (0.495) | (0.293) | | (0.400) | (0.093) |

FIGURE 1: Graphical plots of time series