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# INFLATION IN MALAYSIA

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## Abstract

*This study examines the determination of inflation in Malaysia. The results of the generalised forecast error variance decomposition show that real import price change is the most important factor in the determination of inflation. The impact of real oil price change on inflation is marginal. An increase in real oil price has a more significant impact on inflation than a decrease in real oil price. The results of the generalised impulse response function show the impact of variables examined on inflation is relatively short. There is evidence that real oil price change Granger causes inflation.*

***Keywords*****:** *Inflation; Malaysia; cointegration; generalised forecast error variance decomposition; generalised impulse response function.*

## Abstrak

*Kajian ini menguji penentuan inflasi di Malaysia. Keputusan dekomposisi varian ralat ramalan umum menunjukkan bahawa perubahan harga import benar adalah faktor terpenting dalam penentuan inflasi di Malaysia. Impak perubahan harga minyak benar ke atas inflasi adalah marginal. Kenaikan dalam harga minyak benar mempunyai impak yang lebih signifikan ke atas inflasi berbanding dengan kejatuhan dalam harga minyak benar. Keputusan fungsi tindak balas impuls umum menunjukkan impak pemboleh ubah yang diuji ke atas inflasi secara relatifnya adalah pendek. Terdapat bukti bahawa perubahan harga minyak benar menjadi penyebab Granger inflasi.*

***Kata Kunci*****:** *Inflasi; Malaysia; kointegrasi; dekomposisi varian ralat ramalan umum; fungsi tindak balas impuls umum.*

## Introduction

Malaysia achieved a relatively high and rapid economic growth over the past decades. In the 1970–1979 period, the average economic growth rate was 7.67% per annum. The average economic growth rate per annum was about the same, that is, 5.46%, 6.53%, and 4.91% over the 1980–1989, 1990–1999, and 2000–2005 periods, respectively. During the same periods, the average inflation was relatively low. In the 1970–1979 period, the average inflation per annum was 5.04%. In the 1980–1989, 1990–1999, and 2000–2005 periods, the average inflation per annum was 3.45%, 3.53%, and 1.67%, respectively (Table 1). Generally, the growth rate of Gross Domestic Product (GDP) and inflation increased over the period from 1970 to 2005 (Figure 1). The coefficient of correlation between Consumer Price Index (CPI, 2000 = 100) and GDP volume (2000 = 100) over the period from 1970 to 2005 was 0.9702 (*International Financial Statistics*, International Monetary Fund (IFS, IMF)). In the 1973–1974 period, world oil price increased sharply. Inflation was high in Malaysia whilst economic growth rate was low. High inflation and low economic growth rate also happened in Malaysia during world oil price increase in the 1980–1981 period. In the 1997–1998 period, Malaysia suffered from the Asian financial crisis, where inflation was relatively high whilst economic growth rate was relatively low. Inflation was relatively high partly because Malaysia had depreciated its currency. In the 2000s, oil price increased in the world market (Table 1). However, inflation in Malaysia was relatively under control. On the whole, it is a motivation to examine factors that influence inflation in Malaysia as inflation was relatively low whilst economic growth rate was relatively high. The experience of Malaysia achieved relatively low inflation and high economic growth could be an example for other developing countries.

Table 1

*The Average Growth Rate per Annum of Consumer Price Index (CPI) and Gross Domestic Product (GDP) Volume in Malaysia and Oil Price in the World (OIL, the US Dollar per Barrel)*

| Year | CPI | GDP | OIL |
|---|---|---|---|
| 1970–1979 | 5.04 | 7.67 | 9.93 |
| 1980–1989 | 3.45 | 5.46 | 25.17 |
| 1990–1999 | 3.53 | 6.53 | 18.20 |
| 2000–2005 | 1.67 | 4.91 | 32.92 |

*Source*. IFS, IMF

There are many factors that could cause inflation in an economy. Cunado and De Gracia (2005) examined the impact of real oil price change on inflation in six Asian countries using the Johansen (1988) cointegration method and Granger causality test. The main results were real oil price change has a significant short-run impact on inflation and more significant when real oil price change is defined in domestic currency than in the United States dollar ($US). The impact of real oil price change on inflation is different across economies in Asia. The study examined only the impact of various measures of real oil price change on inflation, but does not examined other factors that cause inflation. Cheng and Tan (2002) examined inflation in Malaysia using the Johansen (1988) cointegration method, impulse response function, variance decomposition of the Sims (1980) approach. The results showed that external factors such as exchange rate and the rest of inflation in Association of Southeast Asian Nations (ASEAN) are relatively more important than domestic factors in explaining inflation in Malaysia. However, the study did not examine the impact of real oil price, real import price, and financial development on inflation. In 1986, oil price decrease failed to stimulate economic growth. This leads to the hypothesis that there is existence of an asymmetric relationship between oil price change and economic growth (Cunado & De Gracia, 2005, pp. 77–78; Cologni & Manera, 2008, p. 5). The relationship between oil price change and inflation could also be asymmetric.

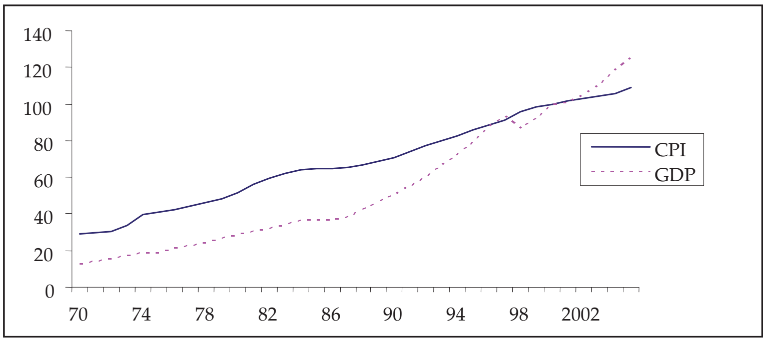



*Figure 1*. Plots of the Natural Logarithm of Consumer Price Index (CPI, 2000 = 100) and the Natural Logarithm of Gross Domestic Product (GDP, 2000 = 100) Volume, 1970–2005.

*Source*. IFS, IMF

Uncontrolled inflation could have a significant negative impact on other economic variables in an economy and thus it is important to identify the determination of inflation. In world oil price shocks of 1974–1975 and 1978–1979, Malaysia experienced double digit inflation and achieved low economic growth rate. An increase in oil price in the world market recently could result in low economic growth in Malaysia. An increase in oil price will lead to a decrease in aggregate supply because higher energy prices mean that firms purchase less energy. Thus the productivity of any given amount of capital and labour declines and potential output falls. The decline in factor productivity implies real wages will be lower (Cunado & De Gracia, 2005, p. 66). This study examined the determination of inflation in Malaysia using time-series data. Malaysia is a net oil exporter. The impact of oil price on a net oil exporter could be different from a net oil importer. Moreover, an oil price shock could have a different impact on different countries due to different economy and tax structures (Cunado & De Gracia, 2005, p. 66). More specifically, this study estimated a vector of nine variables, namely inflation, real GDP, real budget deficit, real money supply, real exchange rate, real interest rate, real import price, financial development, and real oil price. Thus this study adds to the literature of inflation in Malaysia by examining the impact of real import price, financial development, and oil price on inflation. The vector is estimated over the full sample, that is, from 1975QI to 2001QIV and a sub-sample, that is, from 1975QI to 1996QIV to exclude the Asian financial crisis, 1997–1998, in the estimation. The asymmetric impact of real oil price change on inflation was also examined. The asymmetric relationship between oil price and macroeconomics variables has been investigated in many papers (Cunado & De Gracia, 2005; Cologni & Manera, 2008). The impact of oil price increase will retard the economy by more than oil price decrease. Thus it is also important to examine the asymmetry impact of oil price on inflation.

## Oil Price and Inflation in Malaysia

Oil price plays an important role in the economy. It is a vital source of energy and an important raw material in many manufacturing processes (Chang & Wong, 2003, p. 1151). Moreover, oil is an important source of fuel for transportation. Thus demand for oil is inelastic, especially in the short run. In 1970, world oil price was $US1.79 per barrel. In the 1973–1974 period, the world experienced oil price shocks. World oil price increased from $US2.44 per barrel in 1972 to $US3.27 per barrel in 1973. In 1974, world oil price was $US11.50 per barrel.

In other words, world oil price increased 33.90% in 1973 and 251.60% in 1974. As a result, inflation in Malaysia increased 10.56% in 1973 and 17.33% in 1974. In 1979, the world experienced another oil price shock. World oil price increased from $US12.78 per barrel in 1978 to $US29.83 per barrel in 1979 or, increased 133.45%. Nonetheless, inflation in Malaysia was relatively low at 3.65%. However, inflation was high two years later, that is, 6.67% in 1980 and 9.70% in 1981. In the 1980–1981 period, the inflation rates in Malaysia were relatively low when comparing to inflation rates in the 1973–1974 period (IFS, IMF). The first world oil price shocks had a more significant impact on inflation in Malaysia than the second world oil price shock.

In the 1981–1986 period, the world experienced negative growth rates in oil price. Besides, in the 1985–1987 period, Malaysia experienced economic recession and inflation rates were low, less than 1% in the period. In 1998, world oil price decreased 32.14%. However, inflation was relatively high at 5.27 in Malaysia. The relatively high inflation was the result of effect of the Asian financial crisis. In order to check high imported inflation, Malaysia fixed its currency against $US at Malaysian ringgit 3.80 per $US on 2 September 1998. This move had promoted economic stability and restored public confidence toward the financial market in Malaysia Ministry of Finance, (MOF, 1999, p. 17). This move also helped to curve imported inflation. In 1999 and 2000, world oil price increased to 37.53% and 57.02%, respectively. Nevertheless, inflation rates were under control in Malaysia at 2.74% and 1.53% respectively. In the 2003–2006 period, world oil price increased to two digit levels. Conversely, inflation rates in Malaysia were 1.06% in 2003, 1.45% in 2004, 2.96% in 2005, and 3.61% in 2006. In 2006, world oil price was $US64.27 per barrel. In 2008, the oil price was more than $US100 per barrel (IFS, IMF; Figure 2). On 21 July 2005, Malaysia floated its currency against $US and let the value of the currency be determined by market forces. The stronger Malaysian ringgit was supported by strong trade performance, sustained capital flows, and positive economic prospects. A strong currency helped to reduce inflation through cheaper imports of goods and services (MOF, 2006, p. 2). Table 2 provides summary statistics of world oil price growth ($US) and inflation in Malaysia. In the 1970-2006 period, world oil price increased from the lowest at $US1.79 per barrel in 1970 to the highest at $US64.27 per barrel in 2006. Generally, oil price increased over time. Inflation ranged from the lowest rate at 0.29% to the highest rate at 17.33%. The coefficient of correlation between world oil price growth and inflation in Malaysia was 0.57 over the period from 1970 to 2006. Thus there is strong relationship between these two variables.

Table 2

*Summary Statistics of World Oil Price Growth and Inflation in Malaysia, 1970–2006*

| | World Oil Price (%) | Inflation (%) |
|---|---|---|
| Maximum | 251.60 | 17.33 |
| Minimum | –48.22 | 0.29 |
| Mean | 16.61 | 3.84 |
| Standard Deviation | 49.47 | 3.17 |
| Skewness | 3.27 | 2.47 |
| Kurtosis – 3 | 12.58 | 7.53 |
| Coefficient of Variation | 2.98 | 0.83 |
| Coefficient of Correlation between World Oil Price (%) and Inflation (%) 0.57 | | |

*Source*. IFS, IMF

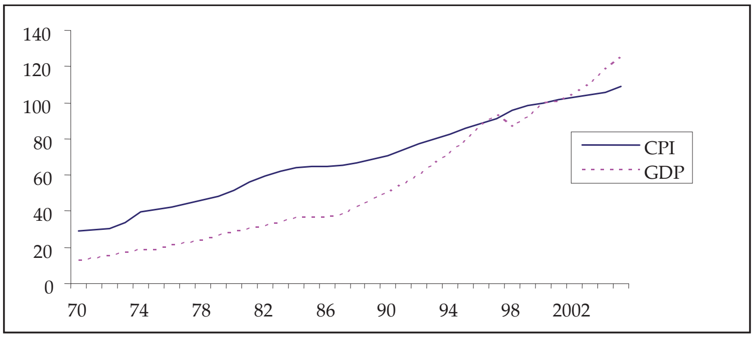



*Figure 2*. Plots of consumer price index (CPI, 2000 = 100) in Malaysia and world oil price (Oil price, 2000 = 100), 1970–2006.

Source. IFS, IMF

## Literature Review

Cologni and Manera (2008) examined the impact of oil price on inflation and interest rate in the G-7 countries, namely Canada, France, Germany, Italy, Japan, the United Kingdom (UK), and the United States

(US) using quarterly data over the period from 1980QI to 2003QIV. The study used a structural cointegrated vector autoregressive (VAR) model to examine the relationship. The variables in the VAR are short-run interest rate (Treasury Bill or lending rate), money supply (M1), CPI, real GDP, oil price (UK Brent price) in $US, and exchange rate. The main results, amongst others, were that a stationary money demand can be identified in most countries, an increase in oil price has a significant impact on inflation in most countries, except Japan and the UK, the existence of an instantaneous temporary effect of oil price innovations on prices in most countries, and impulse response function indicates different monetary policy reactions to inflationary.

Cunado and De Gracia (2005) examined the impact of various measures of real oil price change on inflation in six Asian countries, namely Japan, Singapore, Korea, Philippines, Thailand, and Malaysia using quarterly data over the period from 1975QI to 2002QII. The study also examined the asymmetry impact of real oil price change on inflation. The study used the Johansen (1988) cointegration method and Granger causality test. The main results were that real oil price change has a significant short-run impact on inflation and becomes more significant when real oil price change is defined in domestic currency rather than in $US. Furthermore, the impact of real oil price change on inflation is different across economies in Asia. The real oil price change and inflation relationship appears to be more significant and more general than the real oil price change and output relationship for Asian countries. For Malaysia, the relationship between real oil price change and inflation is less significant. Moreover, there is no evidence of Granger causality from real oil price change in $US to inflation. However, some evidence was found when real oil price change is measured in domestic currency. Also, some evidence was found for the asymmetric impact of real oil price change in $US and in domestic currency on inflation.

Cheng and Tan (2002) examined inflation in Malaysia using quarterly data over the period from 1973QI to 1997QII. The study used the Johansen (1988) cointegration method, impulse response function, and variance decomposition of the Sims (1980) approach. They included 11 variables in their analysis, namely CPI, money supply, interest rate, income, private expenditure, government expenditure, exchange rate, trade balance, capital inflows, the rest of inflation in ASEAN, and the rest of inflation in the world. The results showed that external factors such as exchange rate and the rest of inflation in ASEAN are relatively more important than domestic factors in explaining inflation in Malaysia.

Mansor (2003) examined the impact of the US macroeconomic variables on the Malaysian economy using monthly data over the period from 1977 to 1988. The study also used the Johansen (1988) cointegration method, impulse response function, and variance decomposition of the Sims (1980) approach. The variables in the VAR are real industrial production, CPI, three month Treasury Bill rates, and money supply (M2) of Malaysia, and real industrial production, federal fund rates, CPI, and exchange rate of the US. The results showed that the foreign price level and real industrial production do influence exchange rate, which in turn influences domestic variables including real industrial production, price level, and money supply. More specifically, an increase in the US real industrial production or monetary policy has an impact on the Malaysian real industrial production. An increase in money supply in Malaysia or the US lagged inflation will lead to an increase in inflation in Malaysia. The study emphasised the importance of exchange rate stability for the Malaysian economy.

## Methodology and Data

The Dickey and Fuller (1979) (DF), and Phillips and Perron (1988) (PP) unit root test statistics are used mainly to examine the stationarity of the data. The Johansen (1988) cointegration method is used to examine the long-run relationship among variables in a system. This study estimated a vector of nine variables, namely inflation ($P_{d,t}$), real GDP ($Y_t$), real budget deficit ($BD_t$), real money supply ($MS_t$), real exchange rate ($ER_t$), real interest rate ($R_t$), real import price ($P_{m,t}$), financial development ($FD_t$), and real oil price ($P_{o,t}$). An increase in real GDP, real budget deficit, or real money supply will lead to an increase in aggregate demand. These variables are examined mainly because they are argued to be important factors in the determination of inflation (Cheng & Tan, 2002; Mansor, 2003; Cunado & De Gracia, 2005; Cologni & Manera, 2008). An increase in aggregate demand will lead to an increase in inflation (Romer, 2001). The coefficients of real GDP, real budget deficit, and real money supply are expected to be positive.

An increase in financial development will lead to an increase in aggregate demand and thus an increase in economic growth. Also, an increase in financial development will lead to an increase in aggregate supply and thus an increase in economic growth. Aggregate demand and aggregate supply can move at the same time. However, this does not imply that they will change at the same proportion. As a result, price level may not be the same. Cointegration means that two or more series are themselves non-stationary but a linear combination of them is stationary. More specifically, a ($n \times 1$) vector time series $y_t$ is said to be cointegrated if each of the series is nonstationary with a unit root and some linear combination of the series $a'y$ is stationary for some nonzero ($n \times 1$) vector $a$ (Engle & Granger, 1987). In other words, the series are cointegrated partly because the vector $a$ is nonzero. A sound financial system is important for economic growth as financial system facilitates the allocation of resources over time and space (King & Levine, 1993; Levine, 1997; Ang, 2008). An increase in economic growth will lead to an increased aggregate demand, which in turn increases inflation. The coefficient of financial development is expected to be positive.

An increase in real import price or real oil price will lead to an increase in costs of production or prices of goods. Thus inflation will increase (Cunado & De Gracia, 2005; Cologni & Manera, 2008). The coefficients of real import price and real oil price are expected to be positive. An increase in real interest rate will lead to a decrease in investment and thus aggregate demand will decrease. This will lead to a decrease in economic growth and inflation. Moreover, an increase in real interest rate will lead to an increase in inflation, that is an increase in real interest rate could lead to an increase in cost of production and thus inflation will increase. Linnemann (2005, p. 308) used a new Keynesian sticky price business cycle model to show that an increase in interest rate will lead to an increase in inflation. More specifically, a higher interest rate with a balanced government budget implements a higher tax rate which implies higher interest rate payments on debt would discourage current labour supply for intertemporal substitution reasons. Thus there will be upward pressure on wages and inflation. An increase in real interest rate will lead to an increase or a decrease in inflation could be an empirical matter. The coefficient of real interest rate is expected to be positive.

Conversely, an increase in real exchange rate, which implies a real appreciation in ringgit, will decrease trade balance if the elasticity of import demand is larger than the elasticity of export supply. On the other hand, an increase in real exchange rate will increase trade balance if the elasticity of import demand is smaller than the elasticity of export supply. In other words, the sum of the elasticity of import demand and the elasticity of export supply exceed unity, namely the Marshall-Lerner condition holds (Daniels & VanHoose, 2005, pp. 276–277), an increase in real exchange rate will lead to a decrease in trade balance and economic growth. Thus inflation will decrease. The coefficient of real exchange rate is expected to be negative.

The generalised forecast error variance decomposition and generalised impulse response function (Koop, Pesaran & Potter, 1996; Pesaran & Shin, 1998) are used to examine the relationship of variables in a system. The generalised forecast error variance decomposition identifies the proportion of forecast error variance in one variable caused by the innovations in other variables in a system. Therefore, the relative importance of a set of variables that affect a variance of another variable can be identified. The generalised impulse response function traces the dynamic responses of a variable to innovations in other variables in a system. The generalised forecast error variance decomposition and generalised impulse response function (Koop, et al., 1996; Pesaran & Shin, 1998) may solve the orthogonalised problem of the forecast error variance decomposition and impulse response function of Sims (1980). The problem is that the latter approaches are sensitive to the order of the variables in a VAR system.

In the Granger (1969) sense of a variable *X* causes another variable *Y* if the current value of *Y* can better be predicted by using the past values of *X*. When a series is not cointegrated, the testing of Granger causality of real oil price change on inflation shall be as follows;

$$\Delta \log P_{d,t} = \beta_{10} + \sum_{i=1}^{a} \beta_{11i} \Delta \log P_{d,t-i} + \sum_{i=1}^{a} \beta_{12i} \Delta \log P_{o,t-i} + u_{1,t} \quad (1)$$

where $\Delta$ denotes the first difference operator, log is the natural logarithm, and $u_{1,t}$ is a disturbance term. The joint test of lagged variables, that is, $\Delta \log P_{o,t}$ in equation (1) by mean of the F-statistic (Wald statistic) is significantly different from zero, which implies the presence of Granger causality.

In this study, the test for asymmetries was carried out to include real oil price increase and real oil price decrease as separate variables in the inflation equation, as in the following;

$$\Delta \log P_{d,t} = \beta_{20} + \sum_{i=1}^{a} \beta_{21i} \Delta \log P_{d,t-i} + \sum_{i=1}^{a} \beta_{22i} \Delta \log P^{+}_{o,t-i} + \quad (2)$$

$$\sum_{i=1}^{a} \beta_{23i} \Delta \log P^{-}_{o,t-i} + u_{2,t}$$

where $\Delta \log P^{+}_{o,t-i}$ is real oil price increase, $\Delta \log P^{-}_{o,t-i}$ is real oil price decrease, and $u_{2,t}$ is a disturbance term. If the joined test of lagged variables of $\Delta \log P^{+}_{o,t-i}$ ($\Delta \log P^{-}_{o,t-i}$) in equation (2) is significantly different from zero, it implies that real oil price increase (real oil price decrease) Granger causes inflation (Mork, 1989; Cunado & De Gracia, 2005, p. 79).

Inflation is expressed by CPI (2000 = 100). Real GDP is expressed by GDP volume (2000 = 100). Real budget deficit is expressed by federal government revenue minus its expenditure divided by CPI. Real money supply is expressed by M2 divided by CPI. Money supply, that is, M2 was used since it is argued to be an important monetary aggregate policy variable in Malaysia (Bahmani-Oskooee & Rehman, 2005). This study also has tried to use money supply, that is, M1 and M3. However, the results are qualitatively the same. Real exchange rate is expressed by real effective exchange rate (2000 = 100). Real interest rate is expressed by based lending rate divided by CPI. Real import price is expressed by Import Price Index (2000 = 100) divided by CPI. The based year for Import Price Index was originally in the year 1995. However, it has been converted into the year 2000.

Financial development is expressed by credit to private sector divided by nominal GDP. Baltagi, Demetiades, and Law (2009, p. 289), and Ang (2008, p. 51), amongst others, use credit to private sector divided by GDP as a measure of financial development. The measure is said to be the standard practice in the literature of financial development and economic growth. Moreover, the measure is said to be the most important banking development indicator because it proxies the extent to which new firms have opportunities to obtain bank finance. According to Rajan and Zingales (2003, p. 9), the measure provides the ease with which any entrepreneur or company with a sound project can obtain finance. On the other hand, non-interest financial instruments in the form of trading and development-financing instruments could be better choices for financial development when inflationary pressure is on. Inflation in Malaysia was rather low and stable over the past decades at an average of about 4% per annum (Table 1 and Table 2). The quarterly data for non-interest financial instruments in the 1970s may not be easily obtained. However, they shall be tried as measurements of financial development in a future study.

Real oil price is expressed by the world oil price (2000 = 100) divided by CPI. In the literature of the impact of oil price, the choice of oil price is usually in the $US of world oil price as an indicator of the world market disturbances or this world oil price is converted into respective currency by means of the market exchange rate. The difference between the two variables is that only the second one takes into account the differences in the oil price that a country faces due to its exchange rate fluctuations or its inflation levels (Cologni & Manera, 2008). This index is used as its movements with other oil price indexes, namely the United Arab Emirates oil price (Dubai), the British oil price (Brent), and West Texas intermediate oil price (Texas), were about the same. Generally, the coefficient of correlation of this index with other index was 0.99 over the period from 1960 to 2006. Thus this index is expected to give a good indicate of the movements of oil price in the world.

CPI, GDP volume, real effective exchange rate, money supply (M2), nominal GDP (RM millions), credit to private sector (RM millions), and the world oil price (2000 = 100) were obtained from IFS, IMF. Based lending rate, federal government revenue (RM millions), and federal government expenditure (RM millions) were obtained from *Economic Report*, Ministry of Finance of Malaysia. Import Price Index (2000 = 100) was obtained from *the World Bank Table*, the World Bank. For real GDP, real budget deficit, and import price, the data were originally annually. The data have been converted into quarterly using the average of three quarters of an annual rate subsequently. For example, the data for 1975QIII is an average of the data for 1975QII, 1975QIII, and 1975QIV.

A change in real oil price is said to have asymmetric impact on inflation (Cunado & De Gracia, 2005, pp. 77–78; Cologni & Manera, 2008, p. 5). The asymmetric impact of real oil price change is measured as: (i) real oil price increase is measured as $\Delta \log P^{+}_{o,t}$ = max (0, $\Delta \log P_{o,t}$) and (ii) real oil price decrease is measured as $\Delta \log P^{-}_{o,t}$ = min (0, $\Delta \log P_{o,t}$) (Cunado & De Gracia, 2005, pp. 69, 79). The samples are over the full sample, that is, from 1975QI to 2001QIV and a sub-sample, that is, from 1975QI to 1996QIV to exclude the Asian financial crisis, 1997–1998 in the estimation, which could affect the estimation result. For estimation in full sample, a dummy variable is included as an additional explanatory variable to capture the Asian financial crisis, that is, 1 for the period from 1997QI to 1998QIV and the rest are 0. The data are seasonality unadjusted and were transformed into the natural logarithm before estimation.

**Empirical Results and Discussions**

The DF and PP unit root test statistics are reported in Table 3a. The lag length used to estimate the DF unit root test statistics is based on

Schwarz Bayesian criterion (SBC). The lag length used to compute the PP unit root test statistics is based on Newey-West Bandwidth, with the maximum lag length set to 12. The results of the DF and PP unit root test statistics showed that all the variables, namely inflation, real budget deficit, real money supply, real exchange rate, real import price, financial development, and real oil price, are non-stationary in level but becoming stationary after taking the first differences, except real GDP, real interest rate, and real import price. For real GDP and real import price, the result of the DF unit root test statistic (no-trend or trend) showed no evidence of a unit root whilst the PP unit root test statistic (no-trend or trend) showed evidence of a unit root. For real interest rate, the result of the DF unit root test statistic (trend) showed no evidence of a unit root. Conversely, the DF unit root test statistic (no-trend) and PP unit root test statistic (no-trend or trend) showed evidence of a unit root. Nonetheless, it could be considered as a borderline case and thus it was treated as an I(1) series in this study. The results of the Elliott, Rothenberg, and Stock (1996), Kwiatkowski, Phillips, Schmidt, and Shin (1992), and Ng and Perron (2001) unit root test statistics are reported in Table 3b. Generally, all the variables examined could be treated as I(1) series.

The results of the Johansen (1988) cointegration method are reported in Table 4. The results of the $\lambda_{Max}$ and $\lambda_{Trace}$ test statistics were computed with unrestricted intercepts and no trends. The lag length used in the estimations of the $\lambda_{Max}$ and $\lambda_{Trace}$ test statistics were based on SBC. For sub-sample, the results of the $\lambda_{Max}$ and $\lambda_{Trace}$ test statistics showed that there is one cointegrating vector. For the full sample, the result of the $\lambda_{Max}$ test statistic showed that there are two cointegrating vectors whilst the $\lambda_{Trace}$ test statistic showed that there are three cointegrating vectors. Thus the results of the $\lambda_{Max}$ and $\lambda_{Trace}$ test statistics showed that there is at least one cointegration vector. The likelihood ratio (LR) test statistic was used to test that each variable in the cointegrating vector is zero. The results of the LR test statistic are reported in Table 5. Generally, most of the variables were found important to be included in the estimation. The results of the normalised cointegrating vectors are reported in Table 6. On the whole, explanatory variables in the long-run equations were found to have the expected signs. An increase in real GDP, real budget deficit, real money supply, real interest rate, real import price, financial development, or real oil price will lead to an increase in inflation. On the other hand, an increase in real exchange rate will lead to a decrease in inflation. Moreover, the estimated coefficients of variables in the sub-sample and full sample are not much different.

Table 3a

*The Dickey and Fuller (1979) (DF) and Phillips and Perron (1988) (PP) Unit Root Test Statistics, 1975: QI – 2001:QIV*

| | $t_g$ (No Trend) | $Z(t_g)$ (No Trend) | $t_g$ (Trend) | $Z(t_g)$ (Trend) |
|---|---|---|---|---|
| $\log P_{d,t}$ | –1.4209(5) | –1.5185(7) | –1.3317(5) | –1.4544(7) |
| $\Delta \log P_{d,t}$ | –4.3278***(4) | –9.3834***(8) | –4.4926***(4) | –9.5098***(8) |
| $\log Y_t$ | –1.0428(10) | –0.9221(7) | –3.0454(10) | –1.5473(7) |
| $\Delta \log Y_t$ | –1.9360(9) | –7.8749***(8) | –2.0311(9) | –7.8707***(8) |
| $\log BD_t$ | –1.8975(4) | –1.3068(6) | –2.4386(4) | –1.5189(6) |
| $\Delta \log BD_t$ | –3.1067**(3) | –4.8675***(2) | –3.1073**(3) | –4.8570***(2) |
| $\log MS_t$ | –1.9592(0) | –1.7772(5) | –1.6814(0) | –1.8957(5) |
| $\Delta \log MS_t$ | –8.9144***(0) | –8.9858***(5) | –9.1140***(0) | –9.1413***(5) |
| $\log ER_t$ | –1.1686(1) | –1.2431(3) | –3.1144(1) | –2.1065(3) |
| $\Delta \log ER_t$ | –6.6602***(0) | –7.0605***(1) | –6.6803***(0) | –7.0291***(1) |
| $\log R_t$ | –0.8003(4) | –0.8124(3) | –3.5191***(4) | –2.5932(4) |
| $\Delta \log R_t$ | –3.8790***(3) | –4.4080***(11) | –3.8653***(3) | –4.3614***(11) |
| $\log P_{m,t}$ | –3.2879***(4) | –2.0512(7) | –3.9600***(4) | –2.4730(7) |
| $\Delta \log P_{m,t}$ | –3.6935**(4) | –7.1328***(7) | –3.6810***(4) | –7.1145***(7) |
| $\log FD_t$ | –1.5684(0) | –1.5805(3) | –1.9892(0) | –2.0187(4) |
| $\Delta \log FD_t$ | –10.7847***(0) | –10.7916***(10) | –10.8297***(0) | –10.8411***(3) |
| $\log P_{o,t}$ | –2.0735(1) | –1.8133(2) | –3.0275(0) | –2.6439(2) |
| $\Delta \log P_{o,t}$ | –8.0450***(0) | –8.0450***(0) | –8.0261***(0) | –8.0261***(0) |

*Notes*. $t_g$ is the DF t-statistic. $Z(t_g)$ is the PP t-statistic. No Trend denotes the DF and PP t-statistics are estimated based on the models including an intercept. Trend denotes the DF and PP t-statistics are estimated based on the models including an intercept and a time trend. Values in parentheses are the lag length used in the estimation of the DF or PP unit root test statistic. Critical values can be obtained from MacKinnon (1996). *** (**) denotes significance at the 1% (5%) level.

Table 3b

*The Elliott, Rothenberg, and Stock (1996) (DF-GLS), Kwiatkowski, Phillips, Schmidt, and Shin (1992) (KPSS), and Ng and Perron (2001) (NP) unit root test statistics, 1975:I - 2001:IV*

| | **DF-GLS** | | **KPSS** | | **NP ($MZ\alpha$)** | |
|---|---|---|---|---|---|---|
| | No Trend | Trend | No Trend | Trend | No Trend | Trend |
| $\log P_{d,t}$ | 1.6454(5) | –0.8193(5) | 1.1542***(9) | 0.1509**(9) | –0.0196(5) | –15.7510(5) |
| $\Delta \log P_{d,t}$ | –0.2717(4) | –1.5443(4) | 0.2138(8) | 0.0813(7) | –3.9241(4) | –6.8369(4) |
| $\log Y_t$ | –0.0359(10) | –3.0365*(10) | 1.1782***(9) | 0.1102(8) | –1.2698(10) | –20.6506***(10) |
| $\Delta \log Y_t$ | –1.0355(12) | –1.4636(9) | 0.1316(7) | 0.1026(7) | –1.5455(9) | –2.5441(9) |
| $\log BD_t$ | –1.8060(4) | –2.2908(4) | 0.7205**(9) | 0.1451(8) | –7.3795(4) | –19.3678*(4) |
| $\Delta \log BD_t$ | –3.0998***(3) | –3.1466**(3) | 0.1392(6) | 0.1321(6) | –10.0184*(3) | –13.6767(3) |
| $\log MS_t$ | 0.6897(4) | –1.0260(0) | 1.1740***(9) | 0.1102(8) | 1.2015(4) | –2.6616(0) |
| $\Delta \log MS_t$ | –8.9292***(0) | –9.1683***(0) | 0.2656(5) | 0.1207(5) | –52.1211***(0) | –53.4485***(0) |
| $\log ER_t$ | –0.6877(1) | –2.5504(1) | 0.8688***(9) | 0.1311(8) | –1.7407(1) | –12.9719(1) |
| $\Delta \log ER_t$ | –6.2017***(0) | –6.7078***(0) | 0.0584(3) | 0.0568(3) | –47.5369***(0) | –47.6056***(0) |

(continued)

| | DF-GLS | | KPSS | | NP (MZ$\alpha$) | |
|---|---|---|---|---|---|---|
| | No Trend | Trend | No Trend | Trend | No Trend | Trend |
| log $R_t$ | 0.5394(4) | –3.4758**(4) | 1.0904***(9) | 0.0774(8) | 0.4104(4) | –57.7942***(4) |
| $\Delta$ log $R_t$ | –4.0796***(3) | –4.1252***(3) | 0.0465(3) | 0.0413(3) | –8.2746**(3) | –18.2494**(3) |
| log $P_{m,t}$ | –2.8510***(4) | –3.1031**(4) | 0.4862**(8) | 0.0990(8) | –28.1974***(4) | –37.6544***(4) |
| $\Delta$ log $P_{m,t}$ | –2.9920***(4) | –3.5258**(4) | 0.0715(7) | 0.0717(7) | –8.6548**(4) | –14.1317(4) |
| log $FD_t$ | 0.5585(0) | –1.8833(0) | 1.0660***(9) | 0.1487**(8) | 0.6218(0) | –7.5888(0) |
| $\Delta$ log $FD_t$ | –10.8307***(0) | –10.6410***(0) | 0.1518(3) | 0.0501(2) | –54.7445***(0) | –54.2053***(0) |
| log $P_{o,t}$ | –2.0930**(1) | –2.5924(1) | 0.6982**(8) | 0.1112(8) | –9.4884**(1) | –12.6205(1) |
| $\Delta$ log $P_{o,t}$ | –7.6202***(0) | –7.8281***(0) | 0.0888(0) | 0.0610(0) | –49.3562***(0) | –50.3238***(0) |

*Notes*. No Trend denotes the unit root test statistic is estimated based on the model including an intercept. Trend denotes the unit root test statistic is estimated based on the model including an intercept and a time trend. Values in parentheses are the lag length used in the estimation of the unit root test statistics. The lag length used to estimate the DF-GLS and NP unit root test statistics are based on SBC. The lag length used to compute the KPSS unit root test statistic is based on Newey-West Bartlett kernel. *** (**) denotes significance at the 1% (5%) level.

Table 4

*The Johansen (1988) Likelihood Ratio Test Statistics*

| | | $\lambda_{Max}$ Test Statistic | | |
|---|---|---|---|---|
| $H_0$: | $H_a$: | Sub-Sample | Full Sample | c.v. |
| r = 0 | r=1 | 98.66** | 93.82** | 57.20 |
| r ≤ 1 | r=2 | 48.35 | 59.01** | 51.15 |
| r ≤ 2 | r=3 | 35.32 | 44.31 | 45.63 |
| r ≤ 3 | r=4 | 24.54 | 32.57 | 39.83 |
| r ≤ 4 | r=5 | 17.90 | 26.08 | 33.64 |
| r ≤ 5 | r=6 | 15.58 | 17.10 | 27.42 |
| r ≤ 6 | r=7 | 8.80 | 11.48 | 21.12 |
| r ≤ 7 | r=8 | 5.89 | 4.25 | 14.88 |
| r ≤ 8 | r=9 | 0.40 | 0.30 | 8.07 |
| r = 0 | $r^3$1 | 255.44** | 288.92** | 194.42 |
| r ≤ 1 | $r^3$2 | 156.79 | 195.10** | 157.80 |
| r ≤ 2 | $r^3$3 | 108.44 | 136.09** | 124.62 |
| r ≤ 3 | $r^3$4 | 73.11 | 91.78 | 95.87 |
| r ≤ 4 | $r^3$5 | 48.57 | 59.21 | 70.49 |
| r ≤ 5 | $r^3$6 | 30.67 | 33.13 | 48.88 |
| r ≤ 6 | $r^3$7 | 15.09 | 16.03 | 31.54 |
| r ≤ 7 | $r^3$8 | 6.29 | 4.55 | 17.86 |
| r ≤ 8 | $r^3$9 | 0.40 | 0.30 | 8.07 |

*Notes*. The VAR = 1 is used in the estimations of sub-sample and full sample, respectively. c.v. denotes the 95% critical value. ** denotes significance at the 95% critical value.

Table 5

*The Likelihood Ratio (LR) Test Statistic*

| | LR |
|---|---|
| **Sub-Sample** | |
| log $Y_t$ | 8.2264*** |
| log $BD_t$ | 0.0076 |
| log $MS_t$ | 0.0275 |
| log $ER_t$ | 0.1854 |
| log $R_t$ | 1.3120 |
| log $P_{m,t}$ | 5.0386** |
| log $P_{o,t}$ | 4.0815** |
| log $FD_t$ | 9.1128*** |
| **Full Sample** | |
| log $Y_t$ | 1.1665 |
| log $BD_t$ | 9.8013*** |
| log $MS_t$ | 0.6192 |
| log $ER_t$ | 1.8750 |
| log $R_t$ | 5.0437** |
| log $P_{o,t}$ | 6.9182*** |
| log $P_{m,t}$ | 3.3484* |
| log $FD_t$ | 4.9855** |

*Notes*. The LR test statistic tests that each variable in the cointegrating vector is zero. *** (**, *) denotes significance at the 1% (5%, 10%) level.

Table 6

*The Normalised Cointegrating Vectors*

| | |
|---|---|
| Sub-Sample | $\log P_{d,t} = 0.4315 \log Y_t + 0.0018 \log BD_t + 0.0166 \log MS_t - 0.0355 \log ER_t + 0.0396 \log R_t + 0.0567 \log P_{o,t} + 0.3208 \log P_{m,t} + 0.1272 \log FD_t$ |
| Full Sample | $\log P_{d,t} = 0.2399 \log Y_t + 0.2187 \log BD_t + 0.1162 \log MS_t - 0.1501 \log ER_t + 0.1190 \log R_t + 0.1007 \log P_{o,t} + 0.3900 \log P_{m,t} + 0.1428 \log FD_t$ |

The results of the generalised forecast error variance decomposition are reported in Table 7 and Table 8. The lag length used to compute the generalised forecast error variance decomposition was based on SBC. The results of the generalised forecast error variance decomposition which are reported were based on the 1–20 horizon periods or equivalent to five year periods. For the sub-sample, the results showed that the contribution of inflation is mainly explained by its own innovations, that is, about 90%. Real import price change and real money supply change contribute about 34% and 13% of innovations in inflation, respectively. Real oil price change contributes about 5% of innovations in inflation. The rest of variables (real budget deficit, real GDP, real exchange rate, financial development, and real interest rate) contribute a small percentage of innovations in inflation. For the full sample, the results showed that the contribution of inflation is mainly explained by its own innovations, that is, about 95%. Real import price change and real money supply change contribute about 30% and 11% of innovations in inflation, respectively. Real oil price change contributes about 4% of innovations in inflation. The rest of variables (real exchange rate, real GDP, real budget deficit, financial development, and real interest rate) contribute a small percentage of innovations in inflation. Generally, the relative impact of variables on inflation is different. Real import price change was found to be a very important factor in innovations in inflation. On the other hand, real oil price change was found to have marginal impact on inflation in Malaysia. For sub-sample, real oil price increase contribute about 6% of innovations in inflation whilst real oil price decrease contribute about 1% of innovations in inflation. For full sample, real oil price increase contribute about 5% of innovations in inflation whilst real oil price decrease contribute about 1% of innovations in inflation. On the whole, an increase in real oil price has a more significant impact on inflation than a decrease in real oil price on inflation.

Table 7

*The Generalised Forecast Error Variance Decomposition – The Results of Sub-Sample Real Oil Price Change*

| Horizon | $\Delta$ log $P_{d,t}$ | $\Delta$ log $Y_t$ | $\Delta$ log $BD_t$ | $\Delta$ log $MS_t$ | $\Delta$ log $ER_t$ | $\Delta$ log $R_t$ | $\Delta$ log $P_{m,t}$ | $\Delta$ log $FD_t$ | $\Delta$ log $P_{o,t}$ |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0000 | 0.0018 | 0.0231 | 0.1391 | 0.0012 | 0.0003 | 0.3696 | 0.0068 | 0.0573 |
| 1 | 0.9159 | 0.0157 | 0.0409 | 0.1299 | 0.0146 | 0.0036 | 0.3440 | 0.0189 | 0.0555 |

(continued)

| Horizon | Δ log $P_{d,t}$ | Δ log $Y_t$ | Δ log $BD_t$ | Δ log $MS_t$ | Δ log $ER_t$ | Δ log $R_t$ | Δ log $P_{m,t}$ | Δ log $FD_t$ | Δ log $P_{o,t}$ |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 0.9065 | 0.0159 | 0.0409 | 0.1292 | 0.0151 | 0.0044 | 0.3441 | 0.0200 | 0.0550 |
| 3 | 0.9034 | 0.0161 | 0.0407 | 0.1290 | 0.0152 | 0.0049 | 0.3439 | 0.0201 | 0.0548 |
| 4 | 0.9027 | 0.0161 | 0.0407 | 0.1289 | 0.0152 | 0.0052 | 0.3439 | 0.0201 | 0.0547 |
| 5 | 0.9024 | 0.0161 | 0.0407 | 0.1289 | 0.0152 | 0.0053 | 0.3440 | 0.0201 | 0.0547 |
| 6 | 0.9023 | 0.0161 | 0.0407 | 0.1289 | 0.0152 | 0.0053 | 0.3440 | 0.0201 | 0.0547 |
| 7 | 0.9023 | 0.0161 | 0.0407 | 0.1288 | 0.0152 | 0.0053 | 0.3440 | 0.0201 | 0.0547 |
| 8 | 0.9022 | 0.0161 | 0.0407 | 0.1288 | 0.0152 | 0.0053 | 0.3440 | 0.0201 | 0.0547 |
| 9 | 0.9022 | 0.0161 | 0.0407 | 0.1288 | 0.0152 | 0.0053 | 0.3440 | 0.0201 | 0.0547 |
| 10 | 0.9022 | 0.0161 | 0.0407 | 0.1288 | 0.0152 | 0.0053 | 0.3440 | 0.0201 | 0.0547 |
| 15 | 0.9022 | 0.0161 | 0.0407 | 0.1288 | 0.0152 | 0.0053 | 0.3440 | 0.0201 | 0.0547 |
| 20 | 0.9022 | 0.0161 | 0.0407 | 0.1288 | 0.0152 | 0.0053 | 0.3440 | 0.0201 | 0.0547 |

Table 7 (continued)

*Real Oil Price Increase and Real Oil Price Decrease*

| Horizon | Δ log $P_{d,t}$ | Δ log $Y_t$ | Δ log $BD_t$ | Δ log $MS_t$ | Δ log $ER_t$ | Δ log $R_t$ | Δ log $P_{m,t}$ | Δ log $FD_t$ | Δ log $P^{+}_{o,t}$ | Δ log $P^{-}_{o,t}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0000 | 0.0016 | 0.0230 | 0.1411 | 0.0015 | 0.0003 | 0.3724 | 0.0069 | 0.0635 | 0.0184 |
| 1 | 0.9162 | 0.0152 | 0.0409 | 0.1322 | 0.0144 | 0.0035 | 0.3467 | 0.0190 | 0.0633 | 0.0174 |
| 2 | 0.9069 | 0.0153 | 0.0408 | 0.1316 | 0.0148 | 0.0043 | 0.3462 | 0.0200 | 0.0626 | 0.0172 |
| 3 | 0.9039 | 0.0154 | 0.0407 | 0.1313 | 0.0150 | 0.0050 | 0.3456 | 0.0201 | 0.0624 | 0.0171 |
| 4 | 0.9031 | 0.0154 | 0.0407 | 0.1312 | 0.0150 | 0.0052 | 0.3457 | 0.0201 | 0.0624 | 0.0171 |
| 5 | 0.9028 | 0.0154 | 0.0407 | 0.1311 | 0.0150 | 0.0054 | 0.3457 | 0.0201 | 0.0624 | 0.0171 |
| 6 | 0.9027 | 0.0154 | 0.0407 | 0.1311 | 0.0150 | 0.0054 | 0.3457 | 0.0201 | 0.0623 | 0.0171 |
| 7 | 0.9026 | 0.0154 | 0.0407 | 0.1311 | 0.0150 | 0.0054 | 0.3457 | 0.0201 | 0.0623 | 0.0171 |
| 8 | 0.9026 | 0.0154 | 0.0406 | 0.1311 | 0.0150 | 0.0054 | 0.3457 | 0.0201 | 0.0623 | 0.0171 |
| 9 | 0.9026 | 0.0154 | 0.0406 | 0.1311 | 0.0150 | 0.0054 | 0.3457 | 0.0201 | 0.0623 | 0.0171 |
| 10 | 0.9026 | 0.0154 | 0.0406 | 0.1311 | 0.0150 | 0.0054 | 0.3457 | 0.0201 | 0.0623 | 0.0171 |
| 15 | 0.9026 | 0.0154 | 0.0406 | 0.1311 | 0.0150 | 0.0054 | 0.3457 | 0.0201 | 0.0623 | 0.0171 |
| 20 | 0.9026 | 0.0154 | 0.0406 | 0.1311 | 0.0150 | 0.0054 | 0.3457 | 0.0201 | 0.0623 | 0.0171 |

*Note*. The VAR = 1 is used in the estimations.

Table 8

*The Generalised Forecast Error Variance Decomposition – The Results of Full Sample Real Oil Price Change*

| Horizon | Δ log $P_{d,t}$ | Δ log $Y_t$ | Δ log $BD_t$ | Δ log $MS_t$ | Δ log $ER_t$ | Δ log $R_t$ | Δ log $P_{m,t}$ | Δ log $FD_t$ | Δ log $P_{o,t}$ |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0000 | 0.0003 | 0.0100 | 0.0949 | 0.0139 | 0.0006 | 0.3103 | 0.0108 | 0.0450 |
| 1 | 0.9567 | 0.0086 | 0.0096 | 0.1106 | 0.0336 | 0.0008 | 0.2978 | 0.0113 | 0.0430 |
| 2 | 0.9533 | 0.0089 | 0.0096 | 0.1106 | 0.0339 | 0.0008 | 0.2976 | 0.0117 | 0.0430 |
| 3 | 0.9519 | 0.0089 | 0.0096 | 0.1105 | 0.0342 | 0.0008 | 0.2975 | 0.0117 | 0.0430 |
| 4 | 0.9516 | 0.0089 | 0.0096 | 0.1106 | 0.0343 | 0.0008 | 0.2975 | 0.0117 | 0.0430 |
| 5 | 0.9516 | 0.0089 | 0.0096 | 0.1106 | 0.0343 | 0.0008 | 0.2975 | 0.0117 | 0.0430 |
| 6 | 0.9515 | 0.0089 | 0.0096 | 0.1106 | 0.0343 | 0.0008 | 0.2975 | 0.0117 | 0.0430 |
| 7 | 0.9515 | 0.0089 | 0.0096 | 0.1106 | 0.0343 | 0.0008 | 0.2975 | 0.0117 | 0.0430 |
| 8 | 0.9515 | 0.0089 | 0.0096 | 0.1106 | 0.0343 | 0.0008 | 0.2975 | 0.0117 | 0.0430 |
| 9 | 0.9515 | 0.0089 | 0.0096 | 0.1106 | 0.0343 | 0.0008 | 0.2975 | 0.0117 | 0.0430 |
| 10 | 0.9515 | 0.0089 | 0.0096 | 0.1106 | 0.0343 | 0.0008 | 0.2975 | 0.0117 | 0.0430 |
| 15 | 0.9515 | 0.0089 | 0.0096 | 0.1106 | 0.0343 | 0.0008 | 0.2975 | 0.0117 | 0.0430 |
| 20 | 0.9515 | 0.0089 | 0.0096 | 0.1106 | 0.0343 | 0.0008 | 0.2975 | 0.0117 | 0.0430 |

Table 8 (continued)

*Real Oil Price Increase and Real Oil Price Decrease*

| Horizon | Δ log $P_{d,t}$ | Δ log $Y_t$ | Δ log $BD_t$ | Δ log $MS_t$ | Δ log $ER_t$ | Δ log $R_t$ | Δ log $P_{m,t}$ | Δ log $FD_t$ | Δ log $P^{+}_{o,t}$ | Δ log $P^{-}_{o,t}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.0000 | 0.0002 | 0.0098 | 0.0984 | 0.0136 | 0.0005 | 0.3100 | 0.0107 | 0.0503 | 0.0121 |
| 1 | 0.9558 | 0.0088 | 0.0095 | 0.1140 | 0.0336 | 0.0007 | 0.2972 | 0.0112 | 0.0484 | 0.0128 |
| 2 | 0.9523 | 0.0091 | 0.0094 | 0.1138 | 0.0338 | 0.0007 | 0.2973 | 0.0116 | 0.0486 | 0.0128 |
| 3 | 0.9509 | 0.0091 | 0.0094 | 0.1138 | 0.0341 | 0.0007 | 0.2973 | 0.0116 | 0.0487 | 0.0128 |
| 4 | 0.9507 | 0.0091 | 0.0094 | 0.1138 | 0.0342 | 0.0008 | 0.2973 | 0.0116 | 0.0487 | 0.0128 |
| 5 | 0.9506 | 0.0092 | 0.0094 | 0.1138 | 0.0342 | 0.0008 | 0.2973 | 0.0116 | 0.0487 | 0.0128 |
| 6 | 0.9506 | 0.0092 | 0.0094 | 0.1138 | 0.0342 | 0.0008 | 0.2973 | 0.0116 | 0.0487 | 0.0128 |
| 7 | 0.9506 | 0.0092 | 0.0094 | 0.1138 | 0.0342 | 0.0008 | 0.2973 | 0.0116 | 0.0487 | 0.0128 |

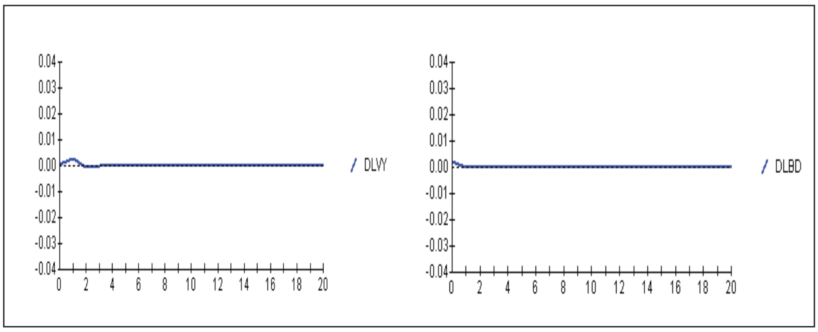
(continued)

| Horizon | $\Delta$ log $P_{d,t}$ | $\Delta$ log $Y_t$ | $\Delta$ log $BD_t$ | $\Delta$ log $MS_t$ | $\Delta$ log $ER_t$ | $\Delta$ log $R_t$ | $\Delta$ log $P_{m,t}$ | $\Delta$ log $FD_t$ | $\Delta$ log $P^{+}_{o,t}$ | $\Delta$ log $P^{-}_{o,t}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 0.9506 | 0.0092 | 0.0094 | 0.1138 | 0.0342 | 0.0008 | 0.2973 | 0.0116 | 0.0487 | 0.0128 |
| 9 | 0.9506 | 0.0092 | 0.0094 | 0.1138 | 0.0342 | 0.0008 | 0.2973 | 0.0116 | 0.0487 | 0.0128 |
| 10 | 0.9506 | 0.0092 | 0.0094 | 0.1138 | 0.0342 | 0.0008 | 0.2973 | 0.0116 | 0.0487 | 0.0128 |
| 15 | 0.9506 | 0.0092 | 0.0094 | 0.1138 | 0.0342 | 0.0008 | 0.2973 | 0.0116 | 0.0487 | 0.0128 |
| 20 | 0.9506 | 0.0092 | 0.0094 | 0.1138 | 0.0342 | 0.0008 | 0.2973 | 0.0116 | 0.0487 | 0.0128 |

*Note*: The VAR = 1 is used in the estimations.

The generalised impulse response function is shown in Figure 3 and Figure 4. The lag length used to compute the generalised forecast error variance decomposition is based on SBC. The results of the generalised impulse response function were plotted over the 20 horizon periods. For sub-sample and full sample, the responses of inflation to one standard error shock in its own are fluctuating over the period before it dies out at about period 4. Generally for the rest of other variables, the responses of inflation to one standard error shock in each of them, inflation fluctuates slightly over the horizon periods before it dies out at the 2-4 period. Generally, the impact of variables on price level lasts 1 year. For sub-sample and full sample, when real oil price increase and real oil price decrease enter separately in the estimation, the responses of inflation to one standard error shock in real oil price decrease is higher than to one standard error shock in real oil price increase. Inflation responses to one standard error shock in real oil price decrease or real oil price increase before it dies out at about period 4.

*Real Oil Price Change*




(continued)

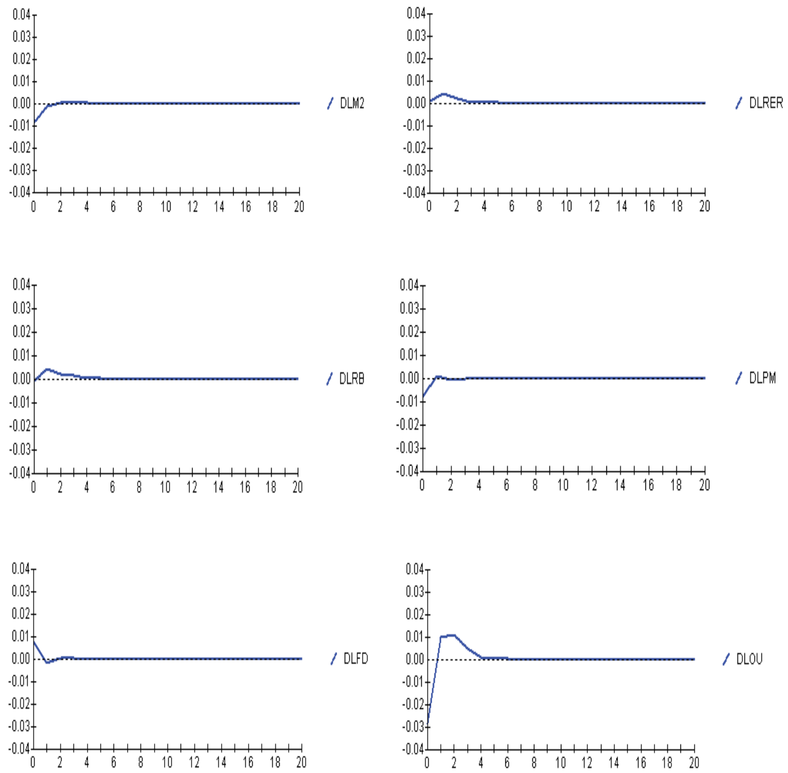
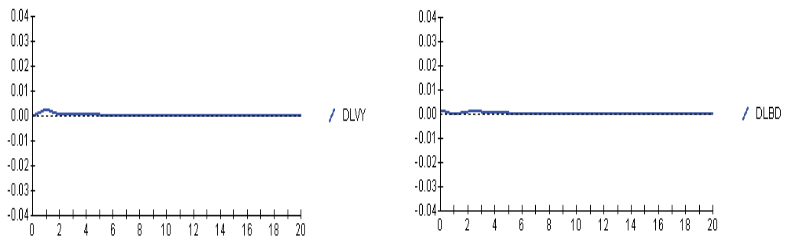
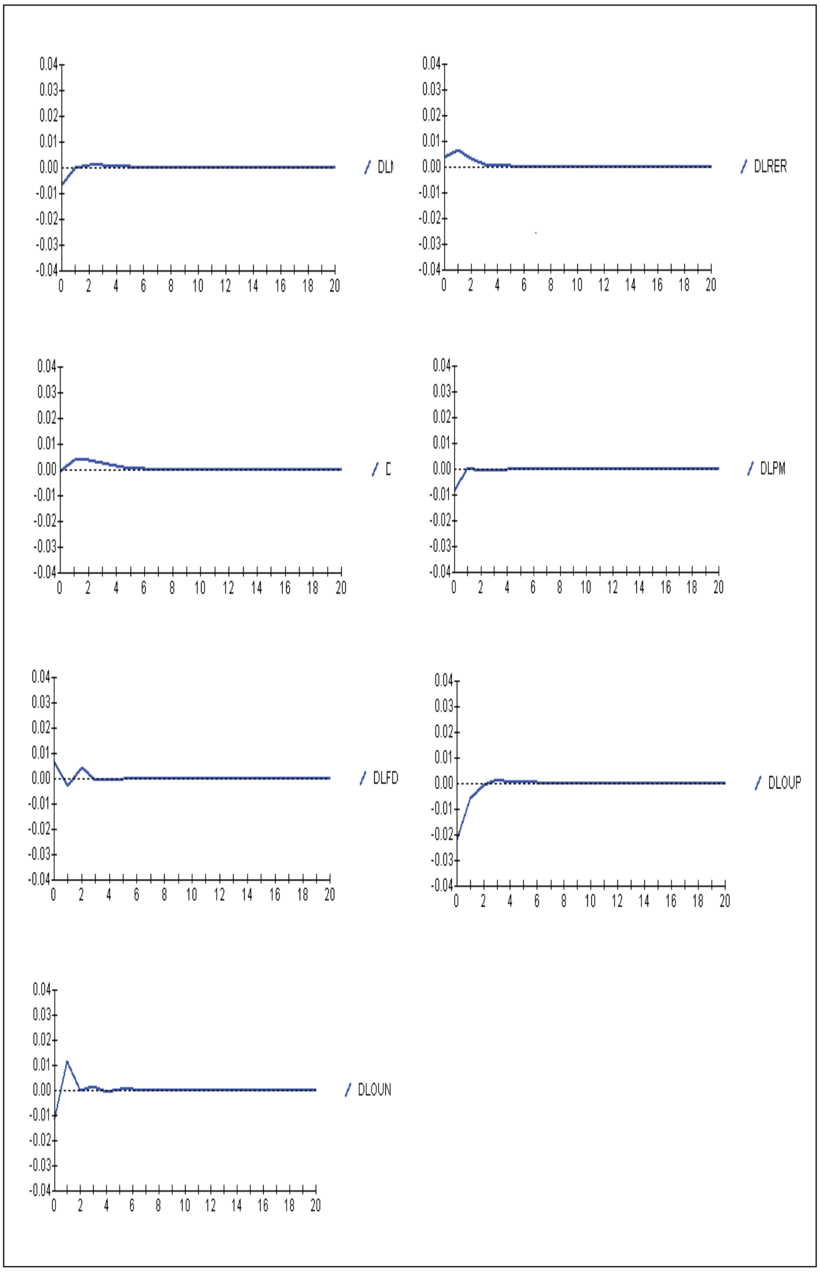



*Figure 3*. Plots of the generalised impulse response function to one standard error shock in the equation for inflation – The results of sub-sample.

*Real Oil Price Increase and Real Oil Price Decrease*




(continued)




*Notes*. DLVY denotes Δ log $Y_t$. DLBD denotes Δ log $BD_t$. DLM2 denotes Δ log $MS_t$. DLRER denotes Δ log $RER_t$. DLRB denotes Δ log $R_t$. DLPM denotes Δ log $P_{m,t}$. DLFD denotes Δ log $FD_t$. DLOU denotes Δ log $P_{o,t}$. DLOUP denotes $\Delta \log P^{+}_{o,t}$. DLOUN denotes $\Delta \log P^{-}_{o,t}$. The VAR = 1 is used in the estimations.

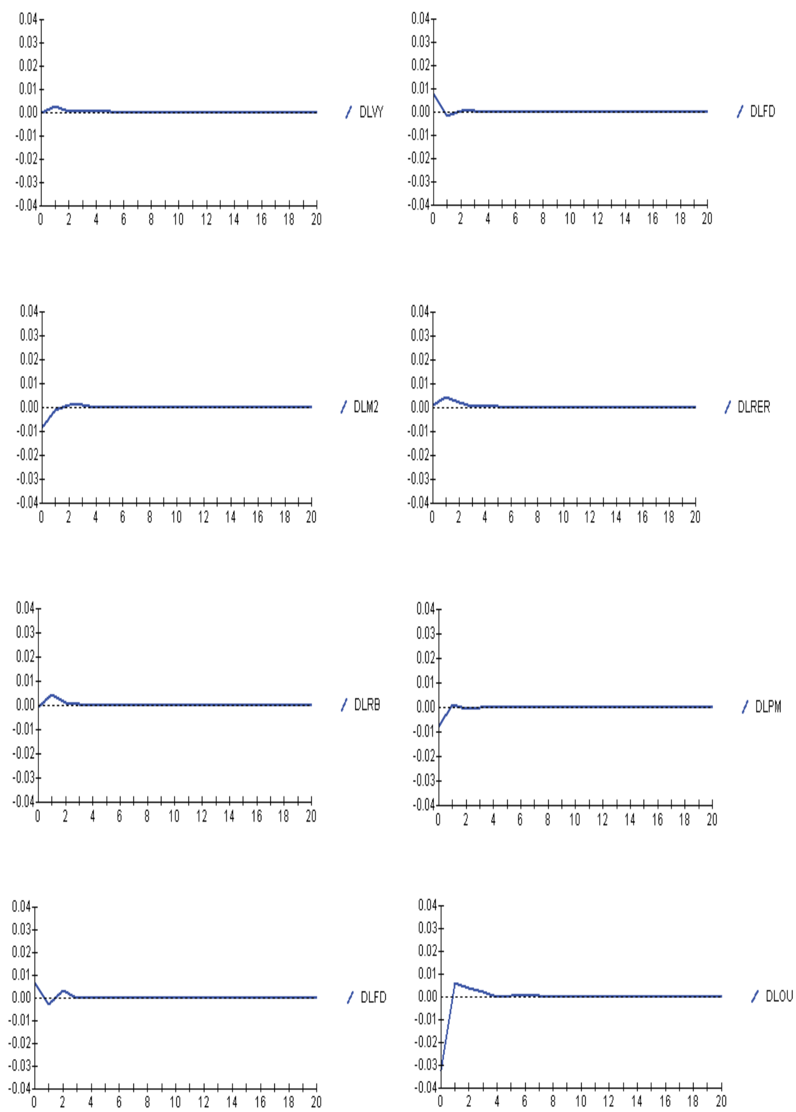
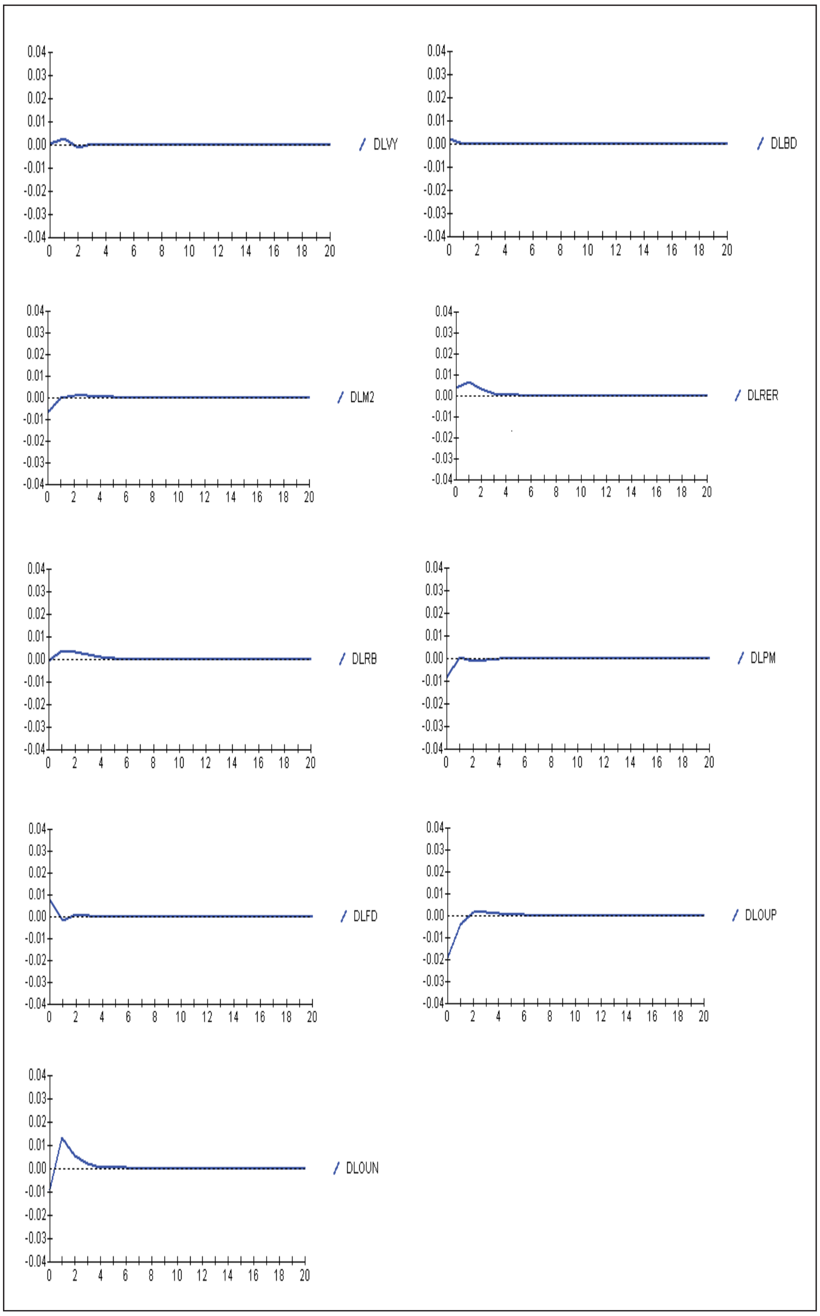



*Figure 4*. Plots of the generalised impulse response function to one standard error shock in the equation for inflation – The results of full sample.




*Notes*. The VAR = 1 is used in the estimations. See also Figure 3 for explanation.

The results of Granger causality test of real oil price change (both real oil price increase and real oil price decrease) on inflation are reported in Table 9. The lag length used in the estimation of Granger causality test is based on SBC. For sub-sample, there is evidence that real oil price change or real oil price increase Granger causes inflation. For full sample, real oil price change is only found to Granger cause inflation. Generally, past real oil price change has predictive power on inflation. However, there is some evidence that past real oil price increase has predictive power on inflation.

Table 9

*The Results of Granger Causality Test*

| | $\Delta \log P_{o,t}$ | $\Delta \log P^{+}_{o,t}$ | $\Delta \log P^{-}_{o,t}$ |
|---|---|---|---|
| Sub-Sample | | | |
| $\Delta \log P_{d,t}$ | 5.5857** | - | - |
| $\Delta \log P_{d,t}$ | - | 3.7852* | 0.9756 |
| Full Sample | | | |
| $\Delta \log P_{d,t}$ | 3.3019* | - | - |
| $\Delta \log P_{d,t}$ | - | 1.5318 | 1.2218 |

*Notes*. ** (*) denotes significance at the 5% (10%) level.

The normalised cointegrating vectors show that an increase in real GDP, real budget deficit, real money supply, real interest rate, real import price, financial development, or real oil price will lead to an increase in inflation whilst an increase in real exchange rate will lead to a decrease in inflation. An increase in real GDP, real budget deficit, or real money supply leading to an increase in inflation is consistent with the typical projections in a standard macroeconomics framework, that is, an increase in real GDP, real budget deficit, or real money supply will lead to an increase in aggregate demand and therefore, inflation will increase (Romer, 2001). An increase in financial development will lead to an increase in economic growth (King & Levine, 1993; Levine, 1997; Ang, 2008). An increase in economic growth will lead to an increase in aggregate demand and thus inflation will increase. Ang (2008) found that financial development has a significant positive impact on economic growth in Malaysia via both quantitative and qualitative channels. Malaysia is an open economy. Openness measured by trade (exports plus imports) over GDP was about 100 in the 1970s and this increased to more than 200 in the 2000s (IFS, IMF).

A more open economy increases economy inter-dependence through international trade and finance. Thus an increase in real import price or real oil price will have a more significant impact on inflation in Malaysia as it becomes more open to the world. Cologni and Manera (2008) also reported that an increase in oil price has a significant impact on inflation in most G-7 countries. O'Neill, Penm, and Terrell (2008) found that an increase in oil price will lead an increase in expectation of higher inflation in major Organisation for Economic Co-operation and Development (OECD) countries.

In this study, an increase in real oil price was found to have a more significant impact on inflation than a decrease in real oil price. Cunado and De Gracia (2005) also found that the relationship between real oil price change and inflation is asymmetric in Malaysia. Moreover, the study reported that there is some evidence of Granger causality from real oil price change, which is measured in domestic currency to inflation. This study also found that past real oil price change has predictive power on inflation. Moreover, there is some evidence that past real oil price increase has predictive power on inflation. An increase in real exchange rate is found to decrease inflation. Mansor (2003) also reported the importance of exchange rate in stability for the Malaysian economy. Appreciation in real exchange rate will help to reduce inflation pressure through cheaper imports of goods and services (MOF, 2006, p. 2).

The main determinants of inflation in Malaysia are real GDP, real import price, and real money supply. Real oil price and other variables examined are relatively less important in the determination of inflation. One reason of less importance of real oil price on inflation is that oil price in Malaysia is subsidised and controlled, and thus its impact on inflation is less significant. Nonetheless, real oil price change has predictive power on inflation. An increase in oil price in the world will likely increase inflation in Malaysia. Malaysia is a small open economy. External shock such as changes in import price has a stronger impact on inflation in Malaysia. Thus an increase in inflation in the world will lead to an increase in inflation in Malaysia.

The policy implications of the study are a set of variables should be checked in order to control inflation. Fiscal and monetary policies can be used for this purpose. During the Asian financial crisis, 1997–1998, the government implemented a budget deficit and strengthened its financial system to promote economic growth. A package of government expenditure and expansionary monetary policy such as low interest rate, were used to stimulate economic growth during the economic downturn in the early of 2000s. A high economic growth will enhance aggregate demand in the economy and thus inflation will increase. A sound financial system is important to promote economic growth. A higher economic growth will lead to a higher inflation. Thus it is important for the government to develop its financial system according to the state of the economy.

Malaysia is a small open economy. The impact of inflation from abroad can be easily transmitted to the economy. A strong exchange rate could help reduce the impact of imported inflation. A fixed exchange rate ringgit against the American dollar was implemented during the Asian financial crisis. For the period from 2 September 1998 to 31 December 2003, the exchange rate was fixed at RM3.80 to one US dollar (Bank Negara Malaysia, 1999, p. 584). It has been argued that generally the fixed exchange rate has provided a strong foundation to improve international reserve and trade balance. An increase in the world oil price will definitely affect inflation in Malaysia. To reduce the impact of high oil price in the world in the 2000s, the government has implemented a package of economic relief such as road tax reduction, fuel subsidy, and price control. In a longer period, alternate use of fuel may introduced and also the society would be educated to use energy efficiently.

## Concluding Remarks

This study has investigated the determination of inflation in Malaysia. For the sub-sample, the results of cointegration tests showed that there is one cointegrating vector. Conversely for the full sample, the results of cointegration tests showed that there is at least one cointegrating vector. The results of the likelihood ratio test statistics showed that there are many factors that are important in influencing inflation in Malaysia. The results of the normalised cointegrating vectors showed that an increase in real GDP, real budget deficit, real money supply, real interest rate, real import price, financial development, or real oil price will lead to an increase in inflation whilst an increase in real exchange rate will lead to a decrease in inflation.

The results of the generalised forecast error variance decomposition showed that the relative impact of variables on inflation is different. Real import price change was found to be one of the most important factors in innovations in inflation. On the other hand, real oil price change was found to have marginal impact on inflation in Malaysia. Moreover, an increase in real oil price was found to have a more significant impact on inflation than a decrease in real oil price. Thus there is asymmetric relationship between real oil price change and inflation in Malaysia. The results of the generalised impulse response function showed that the impact of variables examined on inflation lasts about one year. There is evidence that real oil price change Granger causes inflation.

The main determinants of inflation in Malaysia are real GDP, real import price, and real money supply. Real oil price and other variables examined are relatively less important in the determination of inflation. An increase in real oil price has a more significant impact on inflation than a decrease in real oil price on inflation. Moreover, real oil price change has predictive power on inflation. Malaysia is a small open economy and thus it is vulnerable to external shock such as changes in import price. An increase in inflation in the world will lead to an increase in inflation in Malaysia. On the whole, there are a few important factors that cause inflation in Malaysia, thus managing inflation requires special attention for these factors.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## References


Ang, J. B. (2008). What are the mechanism linking financial development and economic growth in Malaysia? *Economic Modelling*, *25*(1), 38–53.

Bahmani-Oskooee, M., & Rehman, H. (2005). Stability of the money demand function in Asian developing countries. *Applied Economics*, *37*, 773–792.

Baltagi, B. H., Demetriades, P.O., & Law, S. H. (2009). Financial development and openness: Evidence from panel data. *Journal of Development Economics*, *89*(2), 285–296.

Bank Negara Malaysia (1999). *The central bank and the financial system in Malaysia: A decade of change 1989–1999*. Kuala Lumpur: Bank Negara Malaysia.

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

Cheng, M. Y., & Tan, H. B. (2002). Inflation in Malaysia. *International Journal of Social Economics*, *29*(5), 411–425.

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.

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*, 65–83.

Daniels, J. P., & VanHoose, D. D. (2005). *International monetary and financial economics* (3rd ed.). Mason, Ohio: Thomson: South-Western.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, *74*(366), 427–431.

Elliott, G., Rothenberg, T. J., & Stock, J. H. (1996). Efficient tests for an autoregressive unit root. *Econometrica*, *64*, 813–836.

Engle, R. F., & Granger, C. W. J. (1987). Co-integration and error correction: Representation, estimation, and testing. *Econometrica*, *55*(2), 251–276.

Granger, C. W. J. (1969). Investigating causal relations by econometric models and cross spectral models. *Econometrica*, *37*, 424–438.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, *12*(2–3), 231–254.

King, R., & Levine, R. (1993). Finance and growth: Schumpeter might be right. *The Quarterly Journal of Economics*, *108*(3), 717–737.

Koop, G., Pesaran, M. H., & Potter, S. M. (1996). Impulse response analysis in nonlinear multivariate models. *Journal of Econometrics*, *74*, 119–147.

Kwiatkowski, D., Phillips, P. C. B., Schmidt, P., & Shin, Y. (1992). Testing the null hypothesis of stationary against the alternative of a unit root. *Journal of Econometrics, 54*, 159–178.

Levine, R. (1997). Financial development and economic growth: Views and agenda. *Journal of Economic Literature*, *35*(2), 688–726.

Linnemann, L. (2005). Can raising interest rates increase inflation? *Economics letters*, *87*, 307–311.

MacKinnon, J. G. (1996). Numerical distribution functions for unit root and cointegration tests. *Journal of Applied Econometrics*, *11*(6), 601–618.

Mansor, H. I. (2003). International disturbances and domestic macroeconomic fluctuations in Malaysia. *ASEAN Economic Bulletin*, *20*(1), 11–30.

Ministry of Finance Malaysia (MOF) (1999). *Economic report 1999/2000*. Kuala Lumpur: Print Nasional Malaysia Berhad.

Ministry of Finance Malaysia (MOF) (2006). *Economic report 2006/2007*. Kuala Lumpur: Print Nasional Malaysia Berhad.

Mork, K. (1989). Oil and the macroeconomy when prices go up and down: An extension of Hamilton's results. *Journal of Political Economy, 97*, 740–744.

Ng, S., & Perron, P. (2001). Lag length selection and the construction of unit root tests with good size and power. *Econometrica*, *69*(6), 1519–1554.

O'Neill, T. J., Penm, J., & Terrell, R. D. (2008). The role of higher oil prices: A case of major developed countries. *Research in Finance*, *24*, 287–299.

Pesaran, H., & Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economics Letters*, *58*, 17–29.

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335–346.

Rajan, R. G., & Zingales, L. (2003). The great reversals: The politics of financial development in the $20^{th}$ century. *Journal of Financial Economics*, *69*, 5–50.

Romer, D. (2001). *Advanced macroeconomics* (2nd ed.). Singapore: McGraw-Hill.

Sims, C. (1980). Macroeconomics and reality. *Econometrica*, *48*, 1–48.