Jurnal Ekonomi Malaysia 50(1) 2016 41 - 52
http://dx.doi.org/10.17576/JEM-2016-5001-04

Dynamic Linkages between Price Indices and Inflation in Malaysia

(Hubungan Dinamik antara Indeks Harga dan Inflasi di Malaysia)

Rafiqa Murdipi
International Islamic University Malaysia

Siong Hook Law
Universiti Putra Malaysia

ABSTRACT

This study examines the dynamic linkages among consumer price, producer price, industrial production and import price indices in Malaysia by using monthly data from 2005 to 2013. The empirical results based on Johansen multivariate cointegration test reveal that there is a long-run relationship among these indices. The long-run estimations indicate that industrial production and import prices are statistically significant determinants of consumer price index, which indicates that Malaysian inflation is due to demand-pull and international transmission, or imported inflation in the long-run. However, the higher producer price is associated with higher inflation or cost-push inflation in the short-run.

Keywords: Inflation; demand-pull inflation; cost-push inflation; imported inflation; international transmission of inflation

ABSTRAK

Kajian ini mengkaji hubungan dinamik antara indeks harga pengguna, harga pengeluar, pengeluaran perindustrian dan indeks harga import barangan luar di Malaysia, dengan menggunakan data bulanan dari tahun 2005 hingga 2013. Hasil kajian berdasarkan multivariat kointegrasi Johansen menunjukkan bahawa terdapat hubungan jangka panjang antara indeks-indeks ini. Hasil ujian hubungan jangka panjang membuktikan bahawa indeks pengeluaran perindustrian dan indeks harga import barangan luar adalah signifikan penentu terhadap indeks harga pengguna. Ini menunjukkan bahawa inflasi Malaysia dalam jangka masa panjang adalah disebabkan oleh kenaikan permintaan, dan pengaliran antarabangsa atau inflasi yang diimport. Walau bagaimanapun, dalam jangka pendek, indeks harga pengeluar yang lebih tinggi dikaitkan dengan inflasi yang lebih tinggi atau disebut inflasi kenaikan biaya produksi.

Kata kunci: Inflasi; inflasi permintaan; inflasi biaya produksi; inflasi yang diimport; pengaliran inflasi antarabangsa

INTRODUCTION

Recently, the issue of inflation in Malaysia has received considerable attention from the media, economists, and general public, but not because of its implications for development policy. Millions of low and middle-class Malaysians are grappling with increasing prices of goods, threatening the consumer spending and reducing the purchasing power, subsequently increasing cost-of living. Although inflation rate is reported to be relatively low compared to other countries, it is associated with the welfare of the society and economic development.[1] In view that higher inflation rate causes a negative effect on the nation, it is crucial for policy makers to design appropriate policies to curb inflation. The consumer price index, which is employed to measure inflation, is interrelated with other prices such as producer price, industrial production and import price indices. Thus, recent developments in the inflation issues have led to a renewed interest in the dynamic linkages among the price indices, which also intend to identify the type of inflation in Malaysia.

Malaysia has experienced high episodes in 1973-1974 and 1980-1981, and low in 1985-1987 (see Figure 1). During the high economic growth from 1988-1996, Malaysia was able to maintain a low and stable inflation rate. In the 1970s and 1980s, the world experienced a significant increase in global energy and food prices; and experienced its worst years in 1973-1974. In 1974 and 1981, due to high global oil price and food price, inflation in Malaysia reached its peak to 17.3% and 9.7%, respectively (Annual Report Bank Negara Malaysia, Ministry of Finance, various years). The 1997-1998 Asian financial crisis gave another greater impact on inflation rate, rising above 5.5%. However, during the 1990s, Malaysia had maintained low and stable inflation rates, averaging approximately 3% in annual inflation (except the 1997-1998 Asian financial crisis period).

Furthermore, in the early 2000s, the dominant global fuel and food prices caused increased inflation in Malaysia. Inflation in Malaysia began rising in 2005, reaching a peak in July 2008 at 8.5%. During 2001-2007, global oil consumption increased more rapidly, resulting from global economic growth. Changes in global demand and supply conditions have been important drivers of commodity prices, especially during years 2004-2008 (Annual Report Bank Negara Malaysia, various years). In short, inflation rates in Malaysia of previous years were caused by international transmission or imported inflation.

In the literature, there are three main types of inflation, namely (i) demand-pull inflation, (ii) cost-push inflation and (iii) international transmission inflation or imported inflation.[2] Analyzing type of inflation and dynamic linkages between them is a vital element toward understanding the process of inflation itself. This is an important preliminary strategy in dealing with problem of higher inflation rate. It should identify and understand the mechanisms that cause the problems before deciding any strategy to curb inflation rate. Moreover, by analyzing these three types of inflation which are categorized from various determinants of inflation, dynamic linkages and the main type can easily be identified, instead of pooling a large number of determinants which could be more complicated to examine.

The study investigates the dynamic linkages among consumer price index, producer price index, import price index and output (income) using time series datasets from 2005 to 2012.[3] This study contributes to the literature in three important aspects. First, the public perception toward inflation in Malaysia is due to a cost-push factor, where higher prices of goods and services are caused by higher production cost, resulting from higher fuel price and tax, where it leads the producer to increase the price of goods. However, this argument has been descriptive in nature without any empirical evidence. Therefore, it is crucial to carry out an empirical study on this issue to identify the type of inflation in Malaysia. In addition, the previous study by Cheng and Tan (2002) highlighted that the Malaysian inflation is mainly caused by external factors. Second, the econometric method employed is able to evaluate the dynamic linkages among the price indices, namely the vector auto-regressive (VAR) model. This method allows three types of inflation to be identified in the system rather than only one type of inflation as shown in the previous studies.[4] Third, this study utilizes recent monthly datasets covering from 2005 to 2012 and two import price indices are used in the analysis, namely oil price and food price in influencing consumer price index.[5] By employing high frequency monthly data and time frame from 2005 to 2012, this study provides more robust empirical results through econometric method of long-run and short-run causality effects.

The findings of this paper have important implications especially for the policy makers in curbing inflating in Malaysia. As the main objective of the central bank is to maintain price stability while remaining supportive of economic growth, thus, the finding of types of inflation is vital in tracing the sources of inflation. If the type of inflation is demand pull, policy makers should curb the inflation through monetary policy. Nevertheless, if the type of inflation is cost-push inflation, it is more challenging for the policy makers to control the inflation. The findings in this paper suggest that demand-pull and international transmission are determinants of consumer price index in the long-run, but producer price index of cost-push inflation is significant determinant of consumer price index in the short-run. These finding imply that monetary policy can be an effective tool in curbing inflation in the long-run. However, due to the significance of cost-push inflation effect in the short-run, it may not yield an easy therapy for the policy makers in controlling and maintaining low and stable inflation.

This paper is organized as follows: Section 2 reviews the literature; Section 3 lays out the empirical model, the econometric method, and the data; Section 4 contains a discussion of the empirical findings; and Section 5 provides a summary and conclusion.

LITERATURE REVIEW

A large number of empirical studies have been conducted to investigate inflation on their specific country area or group of countries using various econometric techniques.[6] For literature that studies a group of countries, some provide evidence which demonstrates that the dominant type of inflation is demand-pull inflation. For example, Jongwanich and Park (2009) examined types of inflation in developing Asia from 2007-2008 using the vector autoregression (VAR) model. Their empirical results show that excess aggregate demand is highly significant in describing inflation in developing Asia compared to cost-push. Jongwanich and Park (2011) extended their investigation of inflation in developing Asia by analyzing the pass-through from global food and oil price shocks. Their empirical results suggest that in developing Asia, the pass-through of global food and oil price shocks to domestic prices had been very limited.

The existing studies of cross-countries or group of countries that find the demand-pull inflation to be in line with monetarist view of inflation, where money supply plays an important role in influencing inflation, are such as Deme and Fayissa (1995), Dwyer and Fisher (2009), Amisano and Fagan (2013). They point out that the money supply or money growth is a positive and statistically significant determinant of inflation. It is widely accepted that money growth and inflation are one-to-one related in the long-run; but in the short run, there are disagreements between money supply and inflation. Many studies demonstrate that money supply

affects inflation in the long run but not in the short run (Christensen 2001; Deme & Fayissa 1995; Dwyer & Fisher 2009). For country specific experience, Dhaka et al. (1994) investigated inflation in United States from 1947-1978 and suggested that money supply is the dominant determinant of inflation. Their empirical results contradicted Castelnuovo (2010), whereby this study shows that the global indicator plays a statistically significant role in shaping forecaster's inflation expectation in US.

With respect to cost-push inflation, Tiwari et al. (2014) examined the relationship between consumer price index (CPI) and producer price index (PPI) for Mexico. Their empirical results demonstrate that there is a bi-directional relationship between CPI and PPI; whereby in a short period (1-7 month period) CPI is leading PPI, while for longer periods (8 to 32 months scale), PPI is a leading variable. Christensen (2001) showed that in the short run, real supply shock is an important factor that affects inflation rather than money growth. He found that the low inflation rates are indeed consistent with relatively higher growth rate in money if the economy is exposed to significantly higher real supply shock.

Numerous studies have attempted to explain international transmission inflation (Juselius 1992; Kim & Hammoudah 2013; Milani 2010; Yang et al. 2006) or the impact of international transmission on domestic inflation. In general, their empirical results show the importance of external factors or foreign output in affecting domestic inflation. The US inflation and global output fluctuations significantly affect domestic inflation. From an empirical point of view, considerable research had found that oil price shocks affect output and inflation (Álvarez et al. 2011; Valcarcel & Wohar 2013). Durevall et al. (2013) suggested that movements in international food and goods prices determined the long-run evolution of domestic prices. In the short run, agricultural supply shocks affect food inflation, causing large deviations from long-run price trends.

In terms of Malaysia's case, Cheng and Tan (2002: 423) highlighted that inflation in Malaysia is mainly caused by external factors or international transmission inflation.[7] They pointed out that in fact, the impact of external factors is relatively more dominant and direct compared to those from domestic factors. Nevertheless, the recent Malaysian inflation rate may be due to cost-push inflation, whereby we can observe that the fuel price, electricity tariff and minimum wages have increased.[8] Therefore, an interesting question is whether the type of inflation in Malaysia is still caused by international transmission, even in the 2000s. In the 2000s, Malaysia faced more challenges in inflation; trade openness or import is wider, and increase in raw and input prices. The government adopted different and new projects, and this poses more challenges to the government and central bank in stabilizing the price of goods and the economic development of Malaysia. Tan and Cheng (1995) examined the causal nexus of money, output and prices in Malaysia. Their empirical results suggest that by controlling money supply, the central bank might be able to successfully stabilize price at producer level, but not at consumer level.

EMPIRICAL MODEL, METHODOLOGY AND DATA

EMPIRICAL MODEL

To test the interactions among the price indices and also to identify the type of inflation in Malaysia (such as demand-pull, cost-push and imported inflation), this study employed the following four-variable vector autoregressive (VAR) model:

$$\begin{bmatrix} CPI_t \\ PPI_t \\ IP_t \\ IM_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} + \begin{bmatrix} \beta_{1,1}(L) & \cdots & \beta_{1,4}(L) \\ \vdots & \cdots & \cdots \\ \vdots & \cdots & \cdots \\ \beta_{4,1}(L) & \cdots & \beta_{4,4}(L) \end{bmatrix} \begin{bmatrix} CPI_t \\ PPI_t \\ IP_t \\ IM_t \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \end{bmatrix} \quad (1)$$

where *CPI* is consumer price index; *PPI* is producer price index; *IP* is industrial production index; *IM* is import price index and $b(L)$ is a matrix of polynomial in the lag operator L. The VAR model is system of equations introduced by Sims (1980) where it treats all the variables as endogenous. In this study, four VAR models will be employed in the analysis, which is specified as follows:

Model 1: $Z_t = [CPI_t, IP_t, PPI_t, IM_t]$
Model 2: $Z_t = [CPI_t, M2_t, PPI_t, IM_t]$
Model 3: $Z_t = [CPI_t, IP_t, PPI_t, OIL_t]$
Model 4: $Z_t = [CPI_t, IP_t, PPI_t, FD_t]$

where Z_t is a 4×1 matrix, *M2* is money supply, *OIL* is crude oil price and *FD* is food price. All variables are in the logarithm form as a means to render homoscedastic observation and it can be interpreted as a percentage relationship.

If producer price index is a statistically significant determinant of consumer price index, then this implies a cost-push phenomenon. On the other hand, if industrial production index (IP) and money supply (M2) are statistically significant determinants of consumer price index, this indicates a demand-pull phenomenon.[9] Following the literature, this study utilizes three price indices, namely import price, oil price and food price to evaluate the international transmission inflation (Álvarez et al. 2011; Durevall et al. 2013; Jongwanich & Park 2011). In addition, the annual report of the Central Bank of Malaysia also states that the oil price and food price affect the domestic price.

ECONOMETRIC ANALYSIS

UNIT ROOT TEST

It is well- known that many macroeconomic time series are typically non-stationary, which means that the variables contain a unit root problem because they are dominated by the trend component. Running regression of the variables that contain unit roots using classical linear regression (OLS) will result in spurious regressions. As the first step of time series analysis, it is required to determine whether the variable is stationary or not, as well as their integration order, I(d). Therefore, this study employed the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root tests proposed by Dickey and Fuller (1979) and Phillips-Perron (1988), respectively. The Schwartz Bayensian Criterion (SBC) was applied to determine the appropriate lag lengths of the models.

JOHANSEN MULTIVARIATE COINTEGRATION TEST

To examine the existence of the long-run relationship among the variables within a multivariate framework, this study employed a cointegration test suggested by Johansen and Juselius (1990). The procedure is a vector autoregressive (VAR)-based test of restrictions imposed by co-integration on the unrestricted VAR. The null hypothesis under consideration is H_0, stating that there are a different numbers of co-integration relationship, against H_1, which states that all series in the VAR are stationary. There are two test statistics, namely trace and maximum eigenvalue, which are used to determine the number of cointegrating vectors.

SHORT-RUN GRANGER CAUSALITY

Once the co-integrating relationship (if any) is present, the next step is to analyse the short-run Granger causality using a vector error correction model (VECM) framework. In this framework, if the variables are co-integrated, the short-run analysis should incorporate the error-correction term (ECT) to model the adjustment for the deviation from its long-run equilibrium. This modified model to which an ECT is added is referred to as the VECM. However, if co-integration does not exist, the analysis may be conducted as a standard VAR model. The Granger causality (or the endogeneity of the dependent variable) test is applied by calculating the *F*-statistic based on the null hypothesis that the set of coefficients on the lagged values of independent variables are not significantly different from zero. If the null hypothesis is not rejected, then it can be concluded that the independent variables do not Granger-cause the dependent variable. In addition to detecting the short-run causal effects, the VECM also allows us to examine the effective adjustment towards equilibrium in the long run through the significance or otherwise of the *t*-test of the lagged ECT of the equation. Through the ECT, an error correction model offers an alternative test of causality (or weak exogeneity of the dependent variable). Furthermore, VECM also captures the short-run dynamic interaction based on first lag differences variable. Thus, VECM gives interactions of both "long-run" and "short-run" (Masih and Masih, 1996; Ibrahim, 2007).

GENERALIZED IMPULSE RESPONSE FUNCTION (GIRF) AND VARIANCE DECOMPOSITION (VDC)

In applied work, it is often of interest to know the response of one variable to an impulse in another variable in a system that involves a number of further variables as well. Granger causality only gives the dynamic interaction between variables within the sample. Thus, to evaluate the test of dynamic interaction between variables, the generalized impulse response function (GIRF) and variance decomposition (VDC) are used, in which both GIRF and VDC can give the forecast of dynamic interaction of variables or estimated VAR over future horizons or periods. The GIRF traces the impact of a one standard deviation shock of variables on itself and in other variables in the system. In other words, the GIRF provides the direction, magnitude and persistence of responses of one variable when there is a shock of another variable.

To reaffirm the significant impact of one shock of variable on another variable, VDC test was applied as it estimates the percentage of the variations or forecast error variance due to shocks or innovations in other variables. VDC provides the relative importance of shocks in the variable that is attributed to its own and other variables of interest. For example, in this study, the VDC can explain the relative importance of PPI, IP and IM in explaining CPI. The results based on VDCs and GIRFs are generally found to be sensitive to the lag length used and the ordering of the variables. In order to circumvent this problem, the generalized IRF (GIRF) is used instead of recursive (Sims' Cholesky Factorization) IRF. The GIRFs are not sensitive to the ordering of the variables and do not assume that when one variable is shocked, all other variables are switched off (Masih and Masih, 2001).

THE DATA

The sources of data are the Department of Statistics Malaysia and International Financial Statistics (IFS). Due to availability constraint on the starting dates of the data on the monthly import price index, oil price index and food price index, the sample period spans from 2005:1-2013:12. Other challenges to measure demand-pull inflation indicator of Gross Domestic Product (GDP) provided only in quarterly and yearly data, therefore, the industrial production (IP) is used as indicator for demand-pull inflation. IP is the best for a monthly indicator of GDP (Salazar et.al. 1997; Mitchell et.al. 2005). In order to present the data series in the same scale, the index of

based year of 2005 is used for all indicators except M2. Figure 2 depicts the time plots of CPI, PPI, IP and IM of Malaysia from 2005 to 2013.

EMPIRICAL RESULTS

UNIT ROOT TEST

Table 1 reports the results of ADF and PP unit root tests with trend and intercept. As shown in Table 1, the unit root results indicate that the null hypothesis of unit roots failed to be rejected when the variables are taken in levels. However, upon taking the first difference of each of the variables, the null of the unit roots is rejected at the 1% significance level. This result implies that all series are non-stationary and integrated of order one or I(1).

TABLE 1. Results of Unit Root Tests

Variable	Level		First difference	
	ADF	PP	ADF	PP
CPI	-2.937	-2.411	-5.810***	-5.778***
IP	-2.377	-2.694	-4.3659***	-5.2584***
M2	-2.206	-2.214	-8.792***	-8.793***
PPI	-2.465	-2.187	-4.091***	-5.656***
IM	-2.807	-2.893	-6.440***	-7.511***
OIL	-3.100	-2.915	-4.654***	-8.526***
FD	-1.651	-1.505	-6.440***	-6.419***

Notes: ***, ** and * denotes significant at 1%, 5% and 10% significance level, respectively. CPI = consumer price index; IP = industrial production index; M2 = money supply; PPI = producer price index; IM = import price index; OIL = crude oil price; FD = food price index.

JOHANSEN MULTIVARIATE COINTEGRATION TEST

The empirical results of Johanson-Juselius (JJ) cointegration test are reported in Table 2, which suggest that the presence of cointegration in Models 1, 2, and 3. In Model 1, the trace statistics suggest that there is a unique cointegration vector in the model, where the null hypothesis of no cointegration is rejected. In contrast, the maximum eigenvalue statistic suggests that there is no cointegration in the model. Lüutkepohl et al. (2001) suggested that the trace test is slightly superior than maximum eigenvalue, and thus, there is one cointegrating vector in Model 1. For Models 2 and 3, both trace and maximum eigenvalue test statistics indicate the presence of cointegration in the models. The null hypothesis of no cointegration ($H_0 = 0$) is rejected, but the null hypothesis of at least one cointegration fails to be rejected at 5% significance level. For Model 4, both trace and maximum eigenvalue tests statistics indicate no cointegration exist in the model.

TABLE 2. Results of Johansen-Juselius Cointegration Test

Model	Null hypothesis			
	None	At most 1	At most 2	At most 3
Model 1 (CPI, IP, PPI, IM)				
Trace	54.325**	27.007	13.527	2.740
Max	27.317	13.480	10.787	2.741
Model 2(CPI, M2, PPI, IM)				
Trace	54.516**	23.162	10.739	2.951
Max	31.355**	12.426	7.788	2.951
Model 3 (CPI, IP, PPI, OIL)				
Trace	55.236**	22.605	10.500	1.941
Max	32.632**	12.103	8.559	1.941
Model 4(CPI, IP, PPI, FD)				
Trace	43.103	24.285	10.983	1.548
Max	18.818	13.302	9.435	1.548

Notes: ** denotes significant at 5% significance level. CPI = consumer price index; M2 = money supply; PPI = producer price index; IM = import price index; OIL = crude oil price; FD = food price index.

THE LONG-RUN COINTEGRATION RELATIONSHIP

By normalizing the vector on CPI to one, we obtained the long-run cointegration relationship through Johansen and Juselius cointegration test. The results are reported in Table 3. As shown in Model 1, the industrial production and import price are statistically significant determinants of consumer price index in the long run. Given the log-log nature of estimated equation, the coefficient can be interpreted as pseudo-elasticities reflecting the relative influence of each variable on CPI. From the result, the finding indicates that 1% increase in IP and IM will result 0.237% and 0.303% increase in CPI, respectively. The industrial production (IP) represents an indicator for output, where higher IP tends to increase the demand for goods as it subsequently increases the price of goods and services. Similarly, higher prices of import goods from abroad also tend to increase domestic prices of goods in services.

Model 2 repeats the same estimation, but with M2 variable in the specification. The result is similar as reported in Model 1, where M2, PPI and IM have a positive effect on CPI. However, only M2 and IM are

TABLE 3. Long-run Cointegration Equation

Model 1: CPI_t =	0.237 IP_t +	0.562 PPI_t +	0.303 IM_t
	(0.063)*	(0.785)	(0.033)**
Model 2: CPI_t =	0.180 $M2_t$ +	0.554 PPI_t +	0.289 IM_t
	(0.000)***	(0.786)	(0.027)**
Model 3: CPI_t =	0.239 IP_t +	0.515 PPI_t +	0.323 OIL_t
	(0.000)***	(0.701)	(0.1251)

Notes: Figures in the parentheses are p-values. *, ** and *** denote significant at 10%, 5% and 1% significance levels, respectively. CPI = consumer price index; IP = industrial production; PPI = producer price index; IM = import price; OIL = crude oil price.

statistically significant determinants of CPI. Specifically, a 1% increase in M2 and IM will increase CPI by 0.18% and 0.289%, respectively. This shows that money supply is strongly significant and affects inflation in the long-run; and in line with the monetarist view of inflation as shown in previous empirical literature (Deme and Fayissa 1995; Dwyer and Fisher 2009; Amisano and Fagan 2013). This finding also implies that when the central bank expands or contracts the money supply, it will affect the inflation rate in the long-run. Increasing money supply from central bank will lead to an increase in demand for goods and services, and this consequently affects the price of goods and services. In terms of international transmission or imported inflation of oil price (OIL) as shown in Model 3, the findings demonstrate that oil price is an insignificant determinant of CPI in the long-run.

RESULTS OF GRANGER CAUSALITY BASED ON VECM

In order to examine the dynamic causal interaction among variables, the VECM is adopted in models 1, 2 and 3. On the other hand, the Granger causality based on VAR is adopted for model 4. The results presented in Table 4 indicate that producer price index Granger causes consumer price index in the short-run in all models. This finding suggests that there is a price transmission from producer to consumer, or cost-push inflation in the short-run. However, there is no causal effect running from IP, M2, IM and Oil prices to CPI.

RESULTS OF GENERALIZED IMPULSE RESPONSE FUNCTIONS (GIRF) AND VARIANCE DECOMPOSITION (VDC)

Finally, the GIRF and VDC are conducted for future assessment of dynamic interaction among the variables. The Granger causality test can only capture the causality within the sample period, while GIRF and VDC can capture the impact of one shock of variables for current and future value of horizons or period for other variables of interest. In this study, the most important thing to know is, which shocks of variables significantly impact the future value of CPI. Figures 3 (a) - (f) depict the results of the GIRF for the four VAR models, where the responses are plotted out to the 20-month. The figures trace out the response of CPI to a one standard error (positive) shock in IP, PPI, IM, Oil and M2. As shown in these figures, the CPI responds positively and is statistically significant to shocks in PPI, IM and M2.

The significant influences of PPI, IM and M2 on CPI are reaffirmed by the VDC. The empirical results of VDC are reported in Table 5. For example, the findings indicate

TABLE 4. Results of Granger Causality Test

Dependent variable	χ^2-test statistics of the first-differenced terms							
	ΔCPI	ΔIP	ΔM2	ΔPPI	ΔIM	ΔOIL	ΔFD	ECT_{t-1} (t-statistics)
Model 1:CPI, IP, PPI, IM								
ΔCPI	-	1.022		15.524***	0.588			-0.178
ΔIP	0.231	-		8.335**	0.039			1.366
ΔPPI	22.963**	25.590***		-	5.517			-0.436***
ΔIM	2.725	1.737		3.196	-			-0.060
Model 2: CPI, M2, PPI, IM								
ΔCPI	-		0.596	12.279**	6.245			-0.172**
ΔM2	1.562		-	2.214	0.361			-0.139
ΔPPI	4.114**		0.594	-	5.005			-0.758***
ΔIM	0.054		5.286	4.945	-			-0.034
Model 3: CPI, IP, PPI, OIL								
ΔCPI	-	3.742		16.060***		3.080		-0.003
ΔIP	4.249	-		4.808		1.651		1.233***
ΔPPI	18.683**	7.854		-		7.019		0.018
ΔOIL	4.227	7.852		2.221		-		-0.711**
Model 4: CPI, IP, PPI, FD								
ΔCPI	-	3.356		17.903***			2.860	-
ΔIP	1.812			10.379**			3.161	-
ΔPPI	9.594**	5.534					14.433	-
ΔFD	0.858	2.578		2.327				-

Notes: ***, ** and * indicate significant at 1%, 5% and 10% levels, respectively. CPI = consumer price index; IP = industrial production; PPI = producer price index; IM = import price; OIL = crude oil price; FD = food price.

TABLE 5. Variance Decomposition

Variance	Period	CPI	IP	M2	PPI	IM	OIL	FD
Model 1: CPI, IP, PPI, IM								
CPI	10	55.46	15.21	-	20.20	9.10	-	-
IP	10	25.78	64.14	-	7.05	3.01	-	-
PPI	10	44.43	26.26	-	24.93	4.36	-	-
IM	10	35.36	14.33	-	18.52	31.76	-	-
Model 2: CPI, M2, PPI, IM								
CPI	10	44.20	-	33.42	11.88	10.49	-	-
M2	10	0.67	-	90.83	1.24	7.25	-	-
PPI	10	38.25	-	37.91	21.68	2.15	-	-
IM	10	8.56	-	25.48	4.87	61.08	-	-
Model 3: CPI, IP, PPI, OIL								
CPI	10	25.40	3.69	-	55.61	-	15.28	-
IP	10	16.81	57.79	-	15.58	-	9.80	-
PPI	10	20.23	7.71	-	63.00	-	9.04	-
OIL	10	17.72	9.54	-	23.66	-	49.05	-
Model 4: CPI, IP, PPI, FD								
CPI	10	18.52	6.00	-	45.97	-	-	29.49
IP	10	2.39	66.38	-	20.71	-	-	10.51
PPI	10	0.46	26.32	-	48.34	-	-	24.86
FD	10	0.56	12.06	-	12.41	-	-	74.95

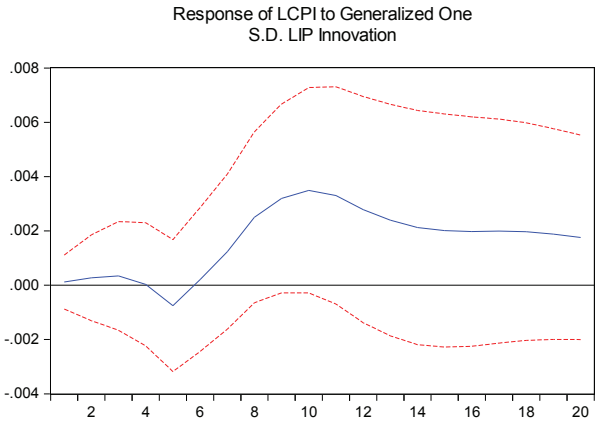

FIGURE 3(a). Response of CPI to Generalized One Standard Deviation Industrial Production (IP) Innovation

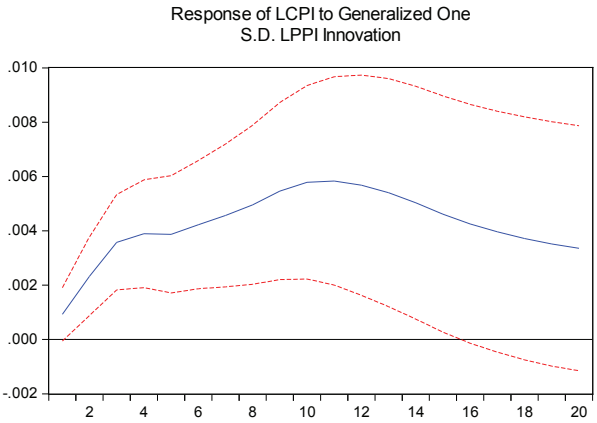

FIGURE 3(b). Response of CPI to Generalizaed One Standard Deviation Producer Production Index (PPI) Innovation

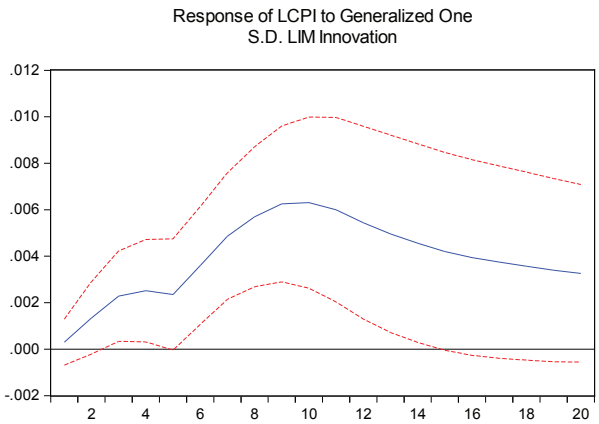

FIGURE 3(c). Response of CPI to Generalized One Standard Deviation Import Price Index (IM) Innovation

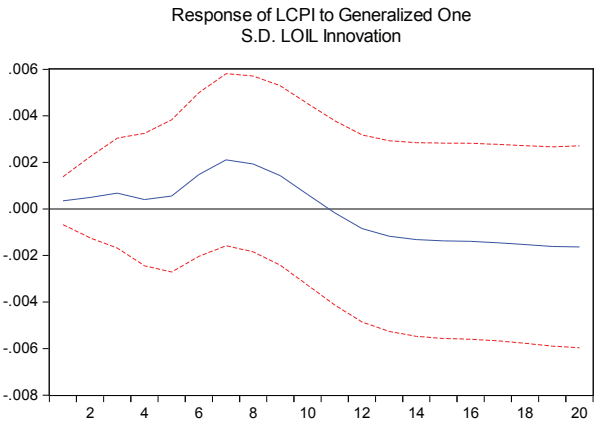

FIGURE 3(d). Response of CPI to Generalizaed One Standard Deviation Oil Price (OIL) Innovation

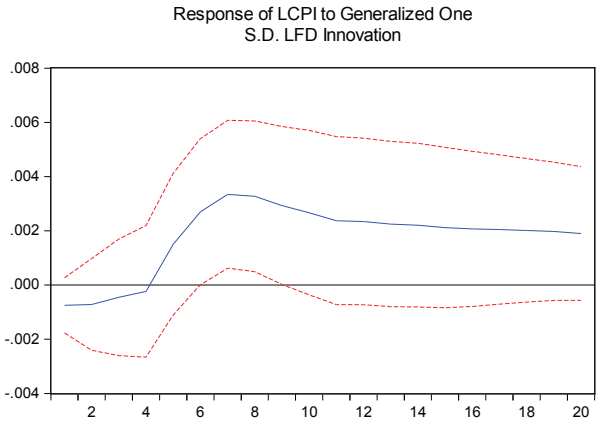

FIGURE 3(e). Response of CPI to Generalizaed One Standard Deviation Food Price (FD) Innovation

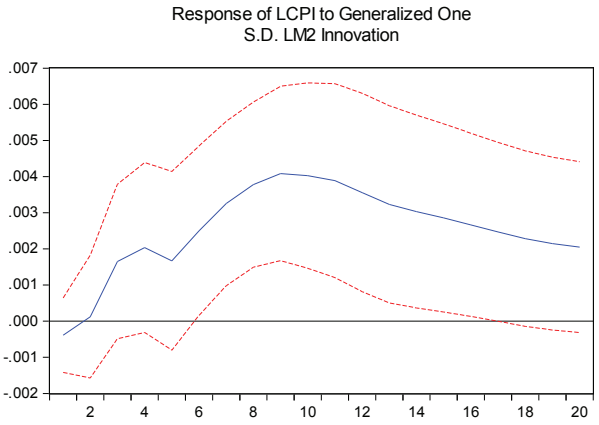

FIGURE 3(f). Response of CPI to Generalizaed One Standard Deviation M2 Innovation

that PPI attributed for simulation of CPI more than 20%, 56% and 46% in Models 1, 3 and 4, respectively.

CONCLUSION

This study examines the dynamic linkages among consumer price, producer price, output and import price in Malaysia from 2005:1 to 2013:12. By examining the linkages among these prices, the type of inflation can also be identified. The time series techniques, which consist of multivariate Johanson cointegration, Granger causality, impulse response function, and variance decomposition are used in the analysis. Four VAR models are employed and each model includes the price indices that measure the demand-pull, cost-push, and international transmission or imported inflation. Besides using the import price index, this study also analyzes oil price and import food price to analyze the international transmission phenomenon.

The empirical findings suggest that industrial production index, money supply and import price are statistically significant determinants of consumer price index in the long-run. This implies that the long-run higher price phenomenon is due to demand-pull and international transmission. In the short-run, the results indicate that the producer price index Granger causes consumer price index, which implies cost-push inflation phenomenon in the short-run. The shocks of producer price index, money supply (M2) and import price are found positively and significantly affecting the consumer price index.

ENDNOTES

1. For example, increasing inflation rates, which means increasing prices of goods, will then result in reduction of savings from households, and also the amount of investment; consequently, it will lead to low financial development and dampen the economic growth. In addition, the increase of inflation rate may lead to people reducing their spending and consequently, it will affect the output of nation. Decreasing in demand of goods will lead to the producer reducing their production and, as a result when this problem worsens, it will lead to unemployment and dampen the economic growth.
2. Until the earlier 1960s, the discussion of inflation focused only on cost-push and demand pull inflation. However, after the 1960s, they also focused on international transmission inflation. Cost-push and demand pull inflation are considered as domestic inflation, while the other is international transmission inflation.
3. We start the sample period from 2005 due to the monthly data sets of import index, oil import index and import food index are available from this period onwards.
4. By utilizing VAR model and multivariate Johansen cointegration procedures, both tests provide benefits to run several models in the system equation rather than using single equation. Previous studies pool many determinants in the single equation models. In this study, four VAR models are employed and each model includes the demand-pull, cost-push, and international transmission or imported inflation. By using the VAR models, the dynamic interaction among the types of inflation and transmission mechanism of inflation can be identified in the system model.
5. The import price indices are included to identify not only the internal factors but also external factors that may influence the inflation rate. Poh and Lee (2015) evaluated the pass through effect of oil price on consumer price index in Malaysia.
6. The previous studies focused on the determinants of inflation in a group of countries or specific country by including a large number of potential determinants in the equation and consequently, it becomes difficult to identify the dynamic linkages among various determinants of inflation. By analyzing the interactions among consumer price, producer price, import price and industrial production, the types of inflation can be identified, namely demand-pull, cost-push and international transmission.
7. Cheng and Tan (2002) included all eleven variables in one system equation in the model. As such, it is difficult to identify the dynamic linkages and causality

among variables in the system. Similarly, with impulse response function and variance decomposition, it quite hard to summarize the dynamics linkages. Their study also excludes the indicator for cost-push inflation. Instead of putting all those variables into one system equation, their paper would have been more convincing if there was just one indicator for each type of inflation in one system model and checked for sensitivity or robustness.

8. As compared with February 2013, the PPI for domestic economy for February 2014 increased by 2.6 per cent, from 126.1 to 129.4 (Department of Statistics Malaysia). Inflation peaked in June at 3.5% as the impact from the upward adjustments in the prices of petroleum products while the retail price of RON97 petrol was adjusted several times in 2010 and 2011. There was also an upward adjustment to electricity tariffs in June 2011 by an average of 7.1%. Starting 1 January 2013, Malaysia implemented a minimum wage policy. The policy sets a minimum wage of RM900 per month for Peninsular Malaysia and RM800 per month (for Sabah, Sarawak and the Federal Territory of Labuan), covering both the local and foreign workforce, except for domestic workers such as domestic helpers and gardeners (Annual Report Bank Negara Malaysia, 2011, 2012). For more details, please refer to Annual Report Bank Negara Malaysia.
9. Following the monetarists' view, if money supply increases inflation, then M2 is classified as demand-pull inflation.

REFERENCES

Álvarez, L.J., Hurtado, S., Sánchez, I., & Thomas, C. 2011. The impact of oil price changes on spanish and euro area consumer price inflation. *Economic Modelling* 28(1–2): 422-431.

Amisano, G., & Fagan, G. 2013. Money growth and inflation: A regime switching approach. *Journal of International Money and Finance* 33: 118-145.

Bank Negara Malaysia, *Annual Report*, various issues.

Castelnuovo, E. 2010. Tracking US inflation expectations with domestic and global indicators. *Journal of International Money and Finance* 29(7): 1340-1356.

Cheng, M.Y. & Tan, H.B. 2002. Inflation in Malaysia. *International Journal of Social Economics 29*(5/6): 411-425.

Christensen, M. 2001. Real supply shocks and the money growth-inflation relationship. *Economics Letters 72*(1): 67-72.

Department of Statistics Malaysia

Deme, M., & Fayissa, B. 1995. Inflation, money, interest rate, exchange rate, and causality: The case of Egypt Morocco, and Tunisia. *Applied Economics* 27(12): 1219-1224.

Dhakal, D., &Kandil, M. 1994. Determinants of the inflation rate in the United States: A VAR investigation. *Quarterly Review Of Economics & Finance* 34(1): 95-112.

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(366a): 427-431.

Durevall, D., Loening, J.L., & AyalewBirru, Y. 2013. Inflation dynamics and food prices in ethiopia. *Journal of Development Economics* 104: 89-106.

Dwyer, G.P., & Fisher, M. 2009. Inflation and monetary regimes. *Journal of International Money and Finance 28*(7): 1221-1241

International Financial Statistics (IFS)

Ibrahim, M.H. 2007. The role of the financial sector in economic development: The malaysian case. *International Review of Economics* 54(4): 463-483

Johansen, S., &Juselius, K. 1990. Maximum likelihood estimation and inference on cointegration—with applications to the demand for money. *Oxford Bulletin of Economics and Statistics* 52(2): 169-210.

Juselius, K. 1992. Domestic and foreign effects on prices in an open economy: The case of denmark. *Journal of Policy Modeling* 14(4): 401-428.

Jongwanich, J., & Park, D. 2009. Inflation in developing Asia. *Journal Of Asian Economics* 20(5): 507-518.

_____. 2011. Inflation in developing asia: Pass-through from global food and oil price shocks. *Asian-Pacific Economic Literature* 25(1): 79-92.

Kim, W.J., & Hammoudeh, S. 2013. Impacts of global and domestic shocks on inflation and economic growth for actual and potential GCC member countries. *International Review of Economics & Finance* 27: 298-317.

Lüutkepohl, H., Saikkonen, P., &Trenkler, C. 2001. Maximum eigenvalue versus trace tests for the cointegrating rank of a VAR process. *The Econometrics Journal* 4(2): 287-310.

Masih, R., & Masih, A.M. 1996. Macroeconomic activity dynamics and granger causality: New evidence from a small developing economy based on a vector error-correction. *Economic Modelling* 13: 407-426

_____. 2001 .Long and short term dynamic causal transmission amongst international stock markets. *Journal of International Money and Finance* 20(4): 563-587.

Milani, F. 2010. Global slack and domestic inflation rates: A structural investigation for G-7 countries. *Journal of Macroeconomics* 32(4): 968-981.

Mitchell, J., Smith, R. J., Weale, M. R., Wright, S., & Salazar, E. L. 2005. An indicator of monthly gdp and an early estimate of quarterly gdp growth. *The Economic Journal* 115(501): F108-F129.

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

Poh, P.X & Lee, C. 2015 Pass-through effect of oil price into consumer price: an empirical study. *International Journal of Economics and Management* 9 (S): 143-161.

Sims, C. 1980. Macroeconomics and Reality. *Econometrica* 48: 1-48.

Salazar, E., Smith, R., Weale, M., & Wright, S. 1997. A monthly indicator of GDP. *National Institute Economic Review* 161(1): 84-89.

Tan, K.G. & Cheng, C.S. 1995. The causal nexus of money, output and prices in Malaysia. *Applied Economics* 27(12): 1245-1251.

Tiwari, A.K., Suresh, K., Arouri, M., & Teulon, F. 2014. Causality between consumer price and producer price: Evidence from mexico. *Economic Modelling* 36: 432-440.

Valcarcel, V.J., & Wohar, M.E. 2013.Changes in the oil price-inflation pass-through. *Journal of Economics and Business* 68: 24-42.

Yang, J., Guo, H., & Wang, Z. 2006. International transmission of inflation among G-7 countries: A data-determined VAR analysis. *Journal of Banking & Finance* 30(10): 2681-2700.

Rafiqa Murdipi
Jabatan Kewangan
Kulliyyah Ekonomi dan Pengurusan Sains
Universiti Islam Antarabangsa
53100 Jalan Gombak
Kuala Lumpur
MALAYSIA
rafiqamurdipi@yahoo.com

Law Siong Hook*
Jabatan Ekonomi
Fakulti Ekonomi dan Pengurusan
Universiti Putra Malaysia
43400 Serdang, Selangor
MALAYSIA
lawsh@upm.edu.my

*Corresponding author

APPENDIX

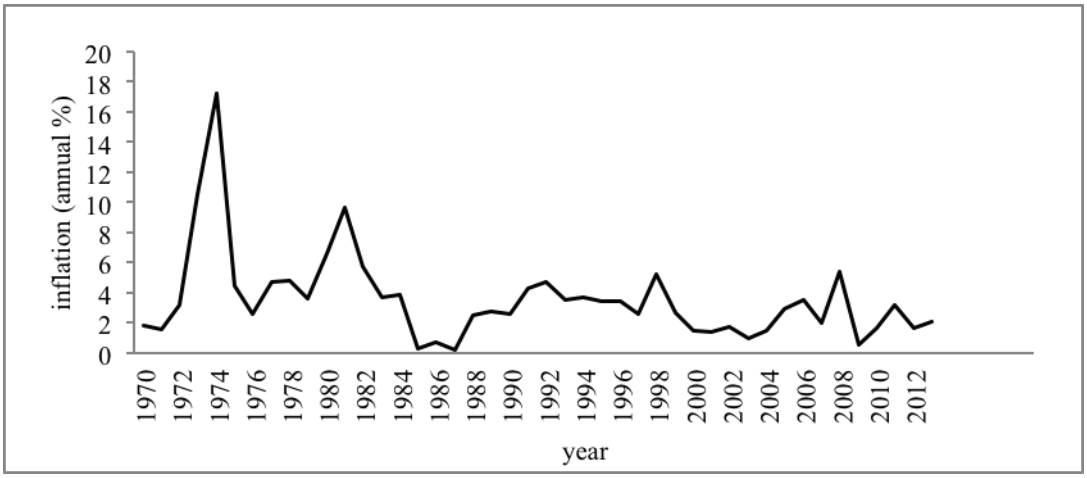

FIGURE 1. Malaysian Inflation Rate (%)
Sources: World Development Indicator (WDI)

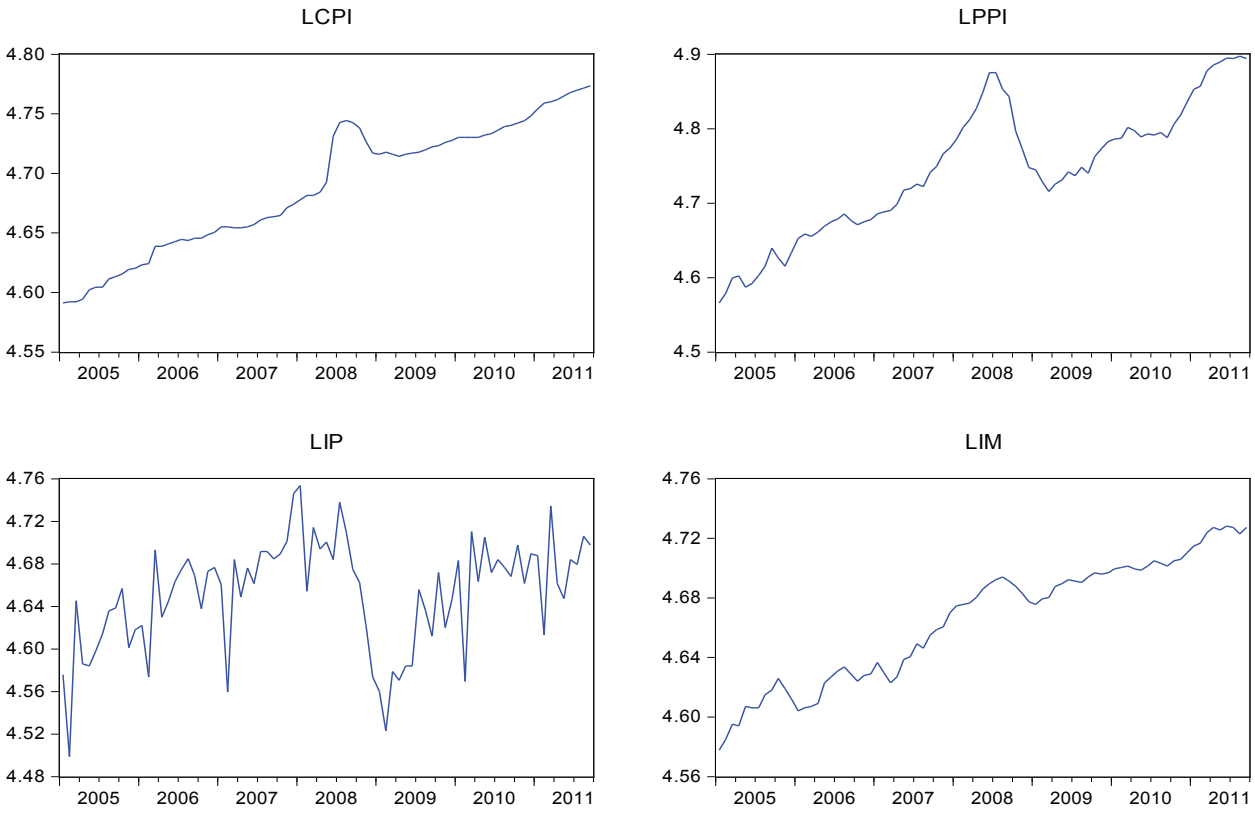

FIGURE 2. Time plots of Consumer Price Index (CPI), Producer Price Index (PPI), Industrial Production (IP) and Import Price Index (IM)