International Food Research Journal 22(5): 1870-1877 (2015)
Journal homepage: *http://www.ifrj.upm.edu.my*

Time series analysis of factors affecting the demand for local rice in Malaysia

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Article history

Received: 26 October 2014
Received in revised form: 28 January 2015
Accepted: 25 February 2015

Keywords

Demand analysis
Malaysia
Local rice
Thai rice
VECM

Abstract

The own price, income and price of a substitute are the determinants of demand in the classical theory of consumer behavior. We used the theory to analyze the demand for local rice in Malaysia by using time series variables. We examined whether there is a long run relationship among the variables by using the unit root and cointegration tests. We then conducted the Granger causality, variance decomposition and impulse response function tests to examine their directions of causality as well as short term dynamics. The results show that there is a long run relationship among the variables and a unidirectional causality from price and income to demand. There are also lagged and short term dynamics among the variables.

Introduction

Rice is a staple food that provides daily caloric needs for Malaysia's 30 million people. It is also a major source of income for rural households in Malaysia, many of whom fall into a category of low income households. Policy makers are keen on maintaining rice affordable for all consumers and at the same time raising paddy farmers' income. Hence, the Malaysian authority has implemented protectionist policies like price controls and offered paddy farmers various types of subsidy to raise local production. However, Malaysia is a net importer of rice as local production still falls short of local consumption. About 30% of the rice demand in Malaysia is fulfilled by import.

The Malaysian rice market has three grades for locally produced rice, e.g. Super Tempatan 15% (ST15), and Super Special Tempatan 5% and 10% (SST5 & SST10). The grade number indicates a proportion of broken rice in the rice composition. The Malaysian authority measures rice quality based on the proportion of broken rice. Hence, local rice is considered homogenous. A relatively small portion of by-products such as broken rice, rice bran and husk is sold as animal feed, powders and biofuel. And specialty rice like Basmati is imported into Malaysia. The majority of imported rice is Thai or Vietnamese rice that directly competes with the local rice SST5.

Total rice consumption has been increasing in Malaysia mainly because of population growth, although Malaysia's per capita consumption of rice has been falling. Steady growth in per capita income has caused a downward trend in per capita rice consumption as it appears to have become an inferior good in Malaysia. Food consumption has diversified towards more wheat, dairy and meat products, fruit and vegetables in Malaysia (Warr *et al*., 2008). Although many researchers used wheat only as a substitute for rice in their empirical studies on rice demand in Malaysia, it can hardly be considered a suitable substitute. Rather, we believe that Thai or Vietnamese rice is a more appropriate substitute for rice, given the fact that rice is deeply attached to the Malaysian diet culture and cannot be extensively substituted by wheat and others.

Thai and Vietnamese rice have comparative advantages in both the quality and costs of rice production. This is why the Malaysian authority has allowed importing only the discrepancy between local production and consumption via BERNAS (the only licensed rice importer in the country) in order to stabilize rice prices (Abdullah *et al*., 2005). The authority also imposes price controls directly to insulate local market from being adversely affected by price volatility in the world market, and other factors that might affect local price and thus the demand for local rice.

In short, we are particularly interested in a relationship between the demand for local rice and the world price of rice as a substitute of local rice, in addition to the other well-established determinants such as own-price and income. Hence,

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we attempt to examine whether there is a long run relationship between the demand for local rice and its major determinants. We also examine their causal and dynamic relationships to see if there is any interdependence among the variables in the short and long run. It may provide some insights into the effectiveness of protectionist policies like price controls imposed by the Malaysian authority in the short and long run.

Literature review

Past empirical studies of rice demand in Malaysia indicated that rice was unresponsive to a change in price and income. Nik Fuad (1985) found the own price and income elasticity to be -0.5 and -0.31, respectively. While in the study by Baharumshah (1990), the own price and income elasticity were respectively -0.309 and -0.16. The price and income elasticity measured by IKDPM (2012) were -0.199 and -0.033, respectively. These studies suggested that the demand for rice was price inelastic and rice is an inferior good. However, another study by Tey *et al.* (2008) using an Almost Ideal Demand System (AIDS) model found that the income elasticity was 0.7104, indicating that rice is a normal good in Malaysia. They argued that higher per capita income would lead to higher demand for rice, based on their observation that Malaysia's GDP and population have experienced steady growth, which leads to higher rice consumption as a whole.

Malaysia imports rice mainly from Thailand, Viet Nam and Pakistan. Specialty rice varieties such as Jasmine or Basmati are imported from Thailand and Pakistan. Tey and Radam (2011) found that the expenditure elasticity for rice import was 1.2015 for Vietnam, 0.9797 for Thailand, 0.6415 for Pakistan and 0.6511 for other countries, indicating that the expenditure for Vietnamese rice was elastic, while those for Thailand, Pakistan and others were inelastic. Tey and Radam (2011) explained that the quality of Vietnamese rice was considered inferior in local standard so that Malaysia imports Vietnamese rice when its price is low, and vice versa. The expenditure for Thai rice was inelastic because it caters for relatively wealthy households who consume superior rice. Hence, Tey and Radam (2011) argued that Thai rice was less likely to affect local consumption substantially.

Juthathip and Donghyun (2011) argued that government policy instruments like price controls and farm subsidies played an important role in reducing or delaying the transmission of price increases from the world market to the local market. Also, Dawe (2002) explained that the world price of rice was stabilized as a result of increases in rice export from Thailand, Viet Nam and the Philippines. Realizing the rice self-sufficiency in highly populated countries like China, India and Indonesia, helped maintain the world price of rice low. Dawe (2008) stated that the effect of price transmission had been largely suppressed, except when the local market was hit by the international food crisis in the late 2000s.

Data and model

The classical demand theory states that own price, income and prices of related goods such as substitutes are the key determinants of demand. Hence, we selected the following time series variables; the Malaysian per capita consumption of rice, the Malaysian wholesale price of rice, the Malaysian GDP per capita and the price of Thai rice. The Malaysian per capita consumption of rice is the dependent variable and a proxy for the local rice demand. It takes into account the population growth in the long-run relationship. The Malaysian wholesale price of rice was chosen instead of the retail price of rice because the wholesale price of local rice has been allowed to float freely and thus reflects the long run relationship more clearly. The price of Thai rice (FOB Bangkok) was assumed to be the price of a substitute for local rice as Thailand is one of the major exporters of rice to Malaysia. The price of Vietnamese rice would be preferred as a better substitute for local rice. However, it was unlikely to find Vietnamese rice in local market as it was disguised or labeled as local rice. Also, the price data on Vietnamese rice was not readily available. All data were annual and collected from the Department of Statistics, Malaysia, for the period 1980 – 2010. We noted that the sample size was deemed small if one used the lag specification of vector autoregressive (VAR) model.

The empirical estimation is based on Eq. (1) below.

$$\text{LCONSPC} = \quad + \theta\ \text{LMWP} + \ \text{LYPC} + \ \text{LTPRICE} + \varepsilon t \quad (1)$$

Where,

LCONSPC = Natural logarithm of Malaysian per capita Consumption of Rice (t/capita)
LMWP = Natural logarithm of Malaysian Wholesale Price of Rice (RM/t)
LYPC = Natural logarithm of Malaysian GDP per capita (RM)
LTPRICE = Natural logarithm of Thai FOB Price of Rice (US$/t)

This is a log linear model where the slope coefficient measures the price and income elasticities of demand. The coefficient of LMWP, θ, is expected to be negative, while the coefficient of LYPC and LTPRICE, and , are expected to be positive. This is in line with the classical demand theory; the quantity demanded decreases when price increases; the quantity demanded increases when income increases. Also, the quantity demanded increases when the price of a substitute increases.

We examined not only the determinants of demand for local rice, but also their interdependence among each other in the short and long run. Hence, we used the vector error correction model (VECM) which has one equation for each variable as in the case of VAR model. Each variable is treated as an endogenous variable, depending on its own lags as well as the lags of other variables. The error correction term refers to the equilibrium error that ties the short run behavior of a variable to its long run value, given that there is a long term or equilibrium relationship among the variables and there exists disequilibrium in the short run.

The VECM model is as follows:

$$\Delta LCONSPCt = \alpha_1 + \sum_{i=1}^{i=k} \beta_{1i} \Delta LCONSPCt\text{-}i + \sum_{i=1}^{i=k} \gamma_{1i} \Delta LYPCt\text{-}i + \sum_{i=1}^{i=k} \delta_{1i} \Delta LTPRICEt\text{-}i + \sum_{i=1}^{i=k} \theta_{1i} \Delta LMWPt\text{-}i + \lambda_1 (LCONSPC - \alpha - \gamma LYPC - \delta LTPRICE - \theta LMWP)_{t-1} + u_{1t} \quad (2)$$

$$\Delta LYPC_t = \alpha_2 + \sum_{i=1}^{i=k} \beta_{2i} \Delta LCONSPC_{t-i} + \sum_{i=1}^{i=k} \gamma_{2i} \Delta LYPC_{t-i} + \sum_{i=1}^{i=k} \delta_{2i} \Delta LTPRICE_{t-i} + \sum_{i=1}^{i=k} \theta_{2i} \Delta LMWP_{t-i} + \lambda_2 (LCONSPC - \alpha - \gamma LYPC - \delta LTPRICE - \theta LMWP)_{t-1} + u_{2t} \quad (3)$$

$$\Delta LTPRICE_t = \alpha_3 + \sum_{i=1}^{i=k} \beta_{3i} \Delta LCONSPC_{t-i} + \sum_{i=1}^{i=k} \gamma_{3i} \Delta LYPC_{t-i} + \sum_{i=1}^{i=k} \delta_{3i} \Delta LTPRICE_{t-i} + \sum_{i=1}^{i=k} \theta_{3i} \Delta LMWP_{t-i} + \lambda_3 (LCONSPC - \alpha - \gamma LYPC - \delta LTPRICE - \theta LMWP)_{t-1} + u_{3t} \quad (4)$$

$$\Delta LMWP_t = \alpha_4 + \sum_{i=1}^{i=k} \beta_{4i} \Delta LCONSPC_{t-i} + \sum_{i=1}^{i=k} \gamma_{4i} \Delta LYPC_{t-i} + \sum_{i=1}^{i=k} \delta_{4i} \Delta LTPRICE_{t-i} + \sum_{i=1}^{i=k} \theta_{4i} \Delta LMWP_{t-i} + \lambda_4 (LCONSPC - \alpha - \gamma LYPC - \delta LTPRICE - \theta LMWP)_{t-1} + u_{4t} \quad (5)$$

where k is the number of lags, which is determined by the residuals of VECM estimate. The residual of the long-run relationship in period t-1 is

$$\varepsilon_{t-1} = \lambda_4 \,(LCONSPC - \alpha - \gamma LYPC - \delta LTPRICE - \theta LMWP)_{t-1}$$

The testing procedures are as follows. First, we conducted a unit root test on all variables to identify their order of integration, where the order of integration is the number of times a time series need to be differenced in order to achieve stationarity. Most of the time series of macroeconomics are non-stationary: the mean, variance and auto-covariance are time varying. The classical OLS regression of non-stationary data produces a spurious relationship and leads to a misleading result. Thus, one must check whether the time series are stationary or non-stationary. Dickey and Fuller introduced a unit root test, which is a test of non-stationarity, testing whether the coefficient of lagged value of Y in AR(1) is 1 or not (Gujarati and Porter, 2008). If it is 1, then there is a unit root and the time series is non-stationary. For example, the unit root exists in $\Delta Y_t = \theta\ Y_{t-1} + \mu_t$ when θ = (ρ - 1) is zero (or ρ = 1) and where Δ is the first difference operator and μt, is a white noise error term. Also, Dickey and Fuller added the lagged values of the dependent variable ΔYt, taking into account the possible serial correlation in the error term μt, which makes the estimators biased. This is known as the Augmented Dickey-Fuller (ADF) test. Additionally, if the unit root test shows non-stationarity, one can transform the data by taking the first difference in order to make it stationary because $\Delta Y_t = (Y_t - Y_{t-1})$ = μt is a white noise term. This is known as the integrated of order 1 or I(1). Similarly, a non-stationary variable that becomes stationary after differencing twice is I (2) and a stationary variable by default is I (0). Most of the economic time series have I (1).

Second, we used the Johansen and Juselius (JJ) cointegration test to identify the number of cointegrating vector, and interpreted the long run equation as well as the adjustment speed of coefficients. Regression of non-stationary time series on another non-stationary time series may produce a spurious regression. However, if taking a linear combination of two non-stationary variables and it produces an error term $\mu_t = Y_t - \beta_1 - \beta_2 X_t$, that is stationary or I (0), then the two variables are said to be cointegrated (Engle and Granger, 1987). When the variables are integrated of the same order, they have a long term or equilibrium relationship in an econometric sense. The JJ test is based on VAR and identifies the number of cointegrating relationship: the trace and maximum eigenvalue test statistics indicate the number of cointegrating equation (Koop, G., 2008).

Third, prior to interpreting the long-run equation, one must test for weak exogeneity in the model. A weak exogeneity test is to test whether a variable is weakly exogenous or endogenous. A variable that is weakly exogenous does not respond or adjust to shocks that cause deviations from the long-run relation or equilibrium. The weak exogeneity test can be conducted by imposing restrictions in the VECM estimation. If the p-value of a long-run relation coefficient is significant, i.e. less than 0.05, then the corresponding variable have a statistically significant relationship with the dependent variable in the long run. Similarly, if the p-value of an adjustment speed coefficient is significant, i.e. less than 0.05, the corresponding variable is endogenous, otherwise it is weakly exogenous.

At last, we conducted the Granger causality test

Table 1. Unit root tests

Variable	Augmented Dickey Fuller: Constant Without Trend	Augmented Dickey Fuller: Constant With Trend	Phillips Perron: Constant Without Trend	Phillips Perron: Constant With Trend
	Level			
LMWP	1.067389	-3.170949	-0.864137	-5.290633***
LYPC	-0.313599	-2.026254	-0.333723	-2.227850
LTPRICE	-1.536176	-1.690865	-1.912126	-1.770758
LCONSPC	-2.608902	-3.308752*	-2.466627	-3.184346
	First Difference			
LMWP	-4.561502***	-4.95904***	-10.30128***	-9.260152***
LYPC	-4.395642***	-4.31247***	-4.343518***	-4.255840**
LTPRICE	-4.748695***	-5.24490***	-4.772403***	-5.254495***
LCONSPC	-7.078151***	-7.12439***	-7.258797***	-7.388488***

*** and ** denotes significant at 1%, and 5% significance level, respectively.

to find out the direction of Granger-causality among the variables. The Granger representation theorem states that, if two variables are cointegrated and each is individually I (1), then there must be causality between the two variables (Koop, G., 2008).Our hypothesis is that only the dependent variable, the rice consumption per capita, is Granger-caused by other variables. Additionally, the Granger causality test shows only the direction of the causality, not the magnitude or impact of the causality. Hence, we also generated the variance decomposition (VDC) and impulse response function (IRF) to examine the effect of a shock in one variable on other variables over the time horizon. The variance decomposition (VDC) estimates the percentage of variations (forecast error variance) as a result of shocks in variables. It examines the relative importance of shocks in all variables to a variable of interest. In other words, one can observe the effect of one variable on another variable over time. The impulse response function (IRF) traces the responses of one variable to shocks in other variables and thus captures the direction, magnitude and persistence of responses. We applied the Sim's Cholesky factorization to simulate the VDC and IRF.

Results and discussion

Unit Root Test

Table 1 shows the absolute value of the tau statistic of each variable compared against the critical tau values at different significance levels. If the tau statistic exceeds the absolute critical tau values, one can reject the hypothesis that $\theta = 0$, meaning that the time series is stationary. The ADF test results show that almost all variables appear to be non-stationary at level, but become stationary at first difference. In other words, they are I(1) for both the constant with trend and without trend. There is another unit root test, known as the Phillips-Perron (PP) test, which takes care of possible serial correlation in the error terms by using nonparametric statistical methods (Phillips and Perron, 1988). The PP tests in Table 1 show the same result except for LMWP, which is highly significant in the level form with the constant and trend. The ADF and PP tests show conflicting results for LMWP. However, it is statistically proven to be better to assume that the variable is I(1) rather than I(0). If LMWP is indeed I(0), but assumed to be I(1), the statistical consequences would be less severe than the other way around. Hence, we chose the ADF tests and assumed that all variables were I(1).

Johansen Juselius cointegration test

The results of Trace and Max-Eigenvalue statistics are shown in Table 2 with their statistical significance. The rank shows the number of cointegrating relationships: Rank = 0 means that there is no cointegration. We compared the Trace and Max-Eigen statistics with their critical values and rejected the hypotheses that Rank = 0 at 5% significance level. It indicates that at least one cointegrating relationship is present. With Rank ≤i1, the test statistic is less than the critical value and thus accept the hypothesis that Rank = 1. There is no evidence of two cointegrating relationships. It indicates the existence of a long run relationship among the variables.

When a long run relationship is identified by the cointegration test, one can construct an error correction model (ECM). It ties the short run behavior to its long run equilibrium as stated above. The JJ test approach provides the estimates of long run equation as well as the error correction term, which is also referred as the speed of adjustment. First, the long-run equation obtained from the VECM estimate is presented in Eq. (6).

$$LCONSPC = 0.947 - 0.6250LMWP + 0.1258LYPC + 0.0996LTPRICE \quad (6)$$

Table 2. Johansen-Juselius cointegration test

Hypothesized No. of CE(s) †	Trace Statistic	Max-Eigen Statistic	Critical Values (5%) Trace	Max-Eigen
r = 0	52.51519**	28.41399**	47.85613	27.58434
r = 1	24.10120	18.73379	29.79707	21.13162
r = 2	5.367411	4.863088	15.49471	14.26460
r = 3	0.504323	0.504323	3.841466	3.841466

** denotes significant at 5% significance level
† CE stands for cointegrating equations

Table 3. Long run coefficients and error correction terms

Null Hypothesis	Long-run relation (p-value)	Adjustment speed (p-value)
LCONSPC	1	-0.6616 (0.0046)
LYPC	-0.1258 (0.2438)	-0.3934 (0.3114)
LTPRICE	-0.0996 (0.0446)	-1.5339 (0.0263)
LMWP	0.6250 (0.0989)	-0.3040 (0.1535)

Table 3 also shows the long-run coefficients, the adjustment speed coefficients and their respective p-values. It indicates that LYPC and LMWP are weakly exogenous because their p-values are statistically insignificant in the weak-exogeneity test. This means that LYPC and LMWP do not respond to shocks that cause deviations from the long run relation or equilibrium. It may imply that price controls is effective in preventing local price from being disturbed by external shocks. On the other hand, LCONSPC and LTPRICE are endogenous. They adjust to shocks that cause deviations from the long run relation.

For the long run relation, LMWP and LTPRICE are found to be significant, whereas LYPC is not significant. The interpretation of the long run relation is as follows. A 1% increase in LYPC increases LCONSPC by 0.1258%. In other words, the income elasticity of demand is 0.1258. The income elasticity of demand has the correct positive sign, indicating that rice is a normal good in Malaysia. Also, rice is highly income inelastic, but it is statistically insignificant.

Similarly, the price elasticities of LCONSPC with respect to LTPRICE and LMWP are 0.0996 and -0.6250, respectively. The price elasticity of demand with respect to the price of Thai rice has the correct positive sign and is statistically significant. When the price of Thai rice as a substitute increases, local rice becomes more attractive and its demand increases. However, the elasticity is only 0.0996, hence the long run effect seems to be weak. Lastly, the price elasticity of LCONSPC with respect to LMWP has the correct negative sign and is statistically significant at 10%. The price elasticity of LCONSPC is 0.6250: a 1% increase in LMWP increases LCONSPC by 0.6250%. It is much higher than the price elasticity of LTPRICE, but, still below one, indicating that rice is price inelastic. The adjustment speed coefficient of LCONSPC is significant at -0.6616, indicating that 66.16% of the deviation of Malaysian per capita consumption of rice from its long run equilibrium is corrected in one year. Likewise, the adjustment speed coefficient of LTPRICE is significant at -1.5339, indicating that 153.39% of the deviation of the price of Thai rice from the long run equilibrium is corrected in one year.

Granger causality test

After examining the long run relationship among the variables, the short run dynamics of the model can be further examined by the Granger causality test. Table 4 shows the chi-squared test statistic and the p-values from the Granger causality test. It shows that LYPC and LMWP Granger-cause LCONSPC at 1% significance level; the income and price of local rice Granger cause the consumption of local rice. However, LTPRICE does not Granger-cause LCONSPC and LMWP. LTPRICE appears to Granger-cause LYPC at 10% significance level, but it is very unlikely that the price of Thai rice would have any effect on the Malaysian per capita income. It does not make an economic sense. However, it is barely significant at 10% so one can disregard it. In short, LYPC, LTPRICE and LMWP are not Granger-caused by other variables in the model, which indicates some level of exogeneity. There are no dynamic interactions among them.

Variance decomposition (VDC)

The Granger causality test shows the direction of the Granger-causality, not the impact or magnitude. Hence, we use the variance decomposition or also known as Cholesky factorization to examine the short-run dynamics of the model. The order of variables for Cholesky factorization is LYPC,

Table 4. Granger causality test

Dependent Variable	Chi Square statistics of lagged 1st differenced term [p-value]			
	LCONSPC	LYPC	LTPRICE	LMWP
LCONSPC	--	6.7493*** [0.0094]	1.2259 [0.2682]	6.7339*** [0.0095]
LYPC	0.1960 [0.6580]	--	2.8947* [0.0889]	1.7756 [0.1827]
LTPRICE	1.2605 [0.2616]	0.1833 [0.6685]	--	0.2251 [0.6352]
LMWP	0.4248 [0.5146]	0.0433 [0.8352]	0.0069 [0.9340]	--

*** and * denotes significant at 1% and 10% significance level, respectively

Table 5. Variance Decomposition of LCONSPC, LMWP, LTPRICE and LYPC

Variance Decomposition of LCONSPC					
Period	S.E.	LCONSPC	LMWP	LTPRICE	LYPC
1	0.051779	80.99548	7.124988	6.867946	5.011586
2	0.067136	49.63535	8.462717	4.199286	37.70265
5	0.103924	21.5518	35.38701	3.638347	39.42284
10	0.151982	10.14059	49.41596	6.183433	34.26002
Variance Decomposition of LMWP					
Period	S.E.	LCONSPC	LMWP	LTPRICE	LYPC
1	0.089805	0.000000	93.86476	0.511561	5.623677
2	0.101668	6.857613	86.93295	1.599183	4.610253
5	0.139530	7.029071	82.71451	2.361917	7.894498
10	0.183505	8.291427	79.18269	3.566440	8.959442
Variance Decomposition of LTPRICE					
Period	S.E.	LCONSPC	LMWP	LTPRICE	LYPC
1	0.194051	0.000000	0.000000	91.10607	8.893928
2	0.288176	1.986329	3.580370	80.94801	13.48529
5	0.530403	5.177838	9.111610	76.00241	9.708141
10	0.825807	6.395297	11.94597	74.38636	7.272374
Variance Decomposition of LYPC					
Period	S.E.	LCONSPC	LMWP	LTPRICE	LYPC
1	0.065945	0	0	0	100
2	0.103885	0.932296	0.05874	2.613795	96.39517
5	0.169903	2.364521	0.148811	2.459156	95.02751
10	0.241302	2.942285	0.272137	2.091708	94.69387

Variance Decomposition of LTPRICE

LTPRICE, LMWP and LCONSPC from the least endogenous (or exogenous) to the most endogenous, respectively. One can construct a different combination of Cholesky ordering, but there are no significant differences if the correlations among the VECM residuals are lower than 0.25. The correlation matrix among the variables did not deviate too far from 0.25. Hence, the Cholesky ordering does not severely affect the VDC or IRF.

The variance decompositions of LCONSPC, LYPC, LTPRICE and LMWP are presented in Table 6. It shows that 81% of the forecast error variance in LCONSPC is generated by its own shock in period 1, but this proportion sharply decreases to 49.64% in period 2. Meanwhile, the LYPC proportion steeply increases from 5.01% in period 1 to 37.70% in period 2, indicating that the income effect on consumption starts to show up in period 2, and lasts into period 10. The LMWP proportion of variations also gradually grows from 7% in period 1 to 50% in period 10. Hence, both LMWP and LYPC appear to have lagged and growing effects on LCONSPC. Economically speaking, rice is the staple food and therefore income inelastic. Malaysian households take time to adjust rice consumption when their income changes. Rice is also price inelastic. It takes a long time to adjust consumption when rice price changes. The demand for local rice is not substantially affected by the price of Thai rice as indicated by the low proportion of LTPRICE. For the variance decomposition of LMWP, LTPRICE and LYPC, most of their variations are generated by own shocks. Shocks from other variables have a minimal effect on them. The price controls regime imposed in Malaysian market fends off shocks from other variables so that the price of local rice can remain relatively stable. Also, Thailand is the largest exporter of rice in the global market so that the Malaysian income, consumption and price of local rice would not have significant effects on the price of Thai rice. Malaysia is one of the newly industrialized countries that have seen a diminishing contribution of agricultural sector to the national GDP. Hence, rice consumption and price would not have significant effects on the Malaysian

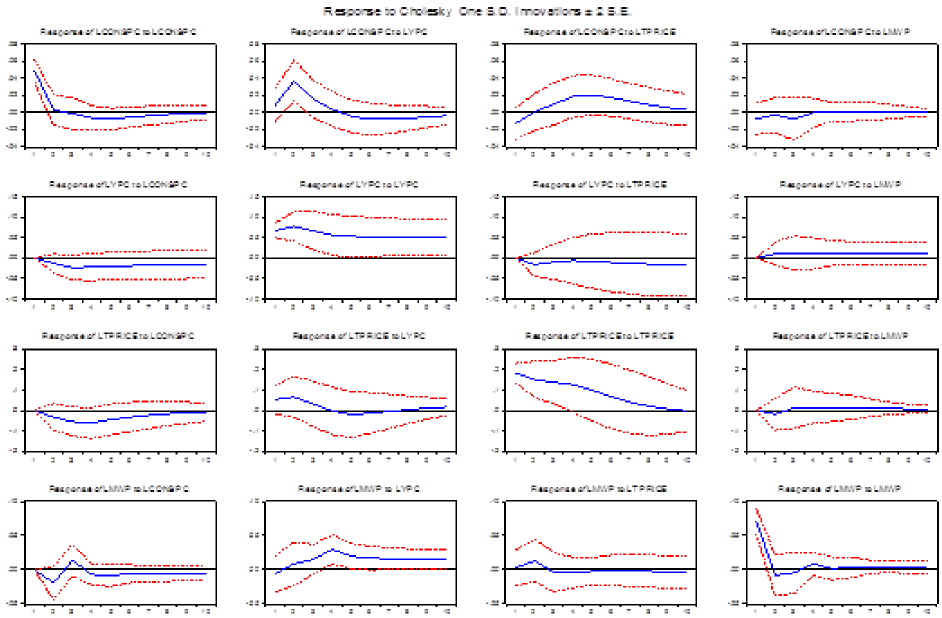

Figure 1. Impulse response function

income per capita. In short, the VDC reconfirms the Granger causality test in Table 5; there are no significant effects from LCONSPC to LYPC and LMWP, but LYPC and LMWP Granger causes LCONSPC. It implies that the direction of causality is unidirectional. There is no significant effect from LTPRICE to LCONSPC either. LMWP, LTPRICE and LYPC are not significantly caused by other variables. There are no dynamic interactions among the variables.

Impulse response function (IRF)

The IRF shows the effect of a unit impulse (or a shock) in the error term of one variable on other variables over the time horizon. It has a size of one standard deviation of the error term. The Cholesky ordering is the same as that for VDC. Figure 1 shows that the impact of an own shock in the error terms of LTPRICE, LMWP and LCONSPC is temporary. The impact lasts for 1 period for LMWP and LCONSPC, whereas it lasts for 3.5 periods for LTPRICE. The impact of an own shock on the error term of LYPC is permanent. The response of LCONSPC to LYPC shows that LYPC has a significant effect on LCONSPC in period 2. This is consistent with the Granger causality test and the VDC, although the impact becomes weaker after period 3. The response of LMWP to LYPC is permanent after period 3. The others do not show any significant response to a shock from other variables.

Conclusion

There is a long run relationship among the variables, which conforms to the classical theory of consumer behavior. The Malaysian wholesale price of rice has a statistically significant and negative relationship with the consumption of local rice in the long run. However, there are lagged effects of price on consumption as rice is the staple food and is price inelastic. It takes time for households to adjust consumption in response to changes in rice price. The empirical analysis indicates that income does not significantly affect the consumption of local rice in the long run, although it has a positive relationship. The consumption is inelastic to income, although there are temporary and lagged effects of income on rice consumption, partially explaining that normal households do not abruptly change rice consumption in response to changes in income in the short run. The price of Thai rice has a statistically significant and positive relationship with the consumption of local rice; however, it does not Granger-cause the consumption of local rice and its long run effect appears to be weak. The price of Thai rice does not significantly affect the price of Malaysian rice or income, either. Hence, it may imply that the protectionist policies like price controls are effective in preventing lasting effects of price shocks in the long run. There are no dynamic interactions among the variables as only the local price and income appear to Granger-cause the consumption of local rice.

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