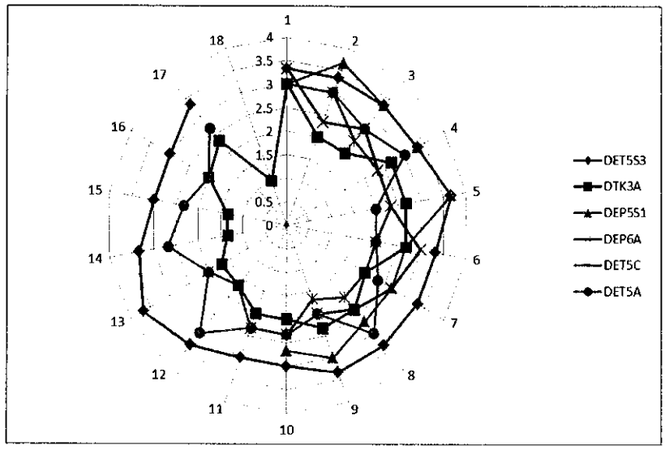

Figure 3.0: Comparison of Final Results For POPBL Method and conventional

ESTIMATING DEMAND FUNCTION OF RICE IN MALAYSIA

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Abstract

This paper reexamines the demand analysis of rice in Malaysia during the period 1980 until 2011 by employing Vector Error Correction Model (VECM). Annual time series data of rice consumption, price of rice, price of wheat, gross national income and population were used for analysis. It test whether there have been a long run equilibrium relationship between rice consumption of rice in Malaysia and a set of price and non-price factors that influence it. The Augmented Dickey Fuller shows that all the series are non- stationary at levels but stationary after first differencing at 1% percent significance level except for price of wheat which was stationary at level at the 1% significance level. The Johansen co- integration approach indicates the presence of a co- integrating relationship in the model. Findings suggest that in the long run the price of wheat, gross national income and population have a significant effect on the rice consumption, however in the short run only population influence the demand for rice. The error correction term had the negative coefficient of (-0.403) which is significant at 5%. The estimation for the short- run demand price elasticity and the long run price elasticity (-0.049,-0.016) are inelastic and not significant. This present study supports the hypothesis that the rice is an inferior good. In the long run, the production of rice in Malaysia has to be increased in order to fulfil the rice demand for the growing population.

Keywords: Consumption of rice, Vector Error Correction Model, Johansen Co-integration Test

1.0 Introduction

Rice is being the staple commodity and the pillar of Malaysia food security. It has been recorded that there is a strong economy growth with an average of 6% to 7% from the year 2000. Malaysia produces rice for domestic consumption and at the same time imports rice from Thailand as domestic demand for rice exceeds its domestic supply (Bernas, 2013). In 2011, Malaysia's current population is about 29,062 million and growing steadily at an annual rate of about 1.6 % (Economic Planning Unit, 2012). Due to the steady increase in the standard of living, Malaysia purchasing power has increase (Sheng *et al*, 2008) .However, the increasing per capita consumption is for wheat and meats (particularly poultry) while the per capita consumption of the important staple food, rice in Malaysia is decreasing (Department of Statistics Malaysia, 2010). Huang and Bouis (1996) argued that this sharp decline in staple food consumption is attributed to the rural urban migration. In Malaysia, urbanization has viewed as a solution to poverty as the employment opportunities and income level are higher in urban areas. Statistically, there is decrease in annual per capita rice consumption at 80.29 kg in 2010 down from 118.8 kg in 1970 (International Rice Research Institute, 2011).

Moreover, according to Malaysia Agribusiness Report Second Quarter 2010, the rice consumption has been expected to rise by 4.9% to 2.6mn tonnes in 2014 driven by population growth because as income rise and more people are brought within reach of modern retail price thus per capita consumption is likely began to fall as consumer increase the intake of food such wheat based and meat. Indeed a study by University Putra Malaysia had proved that the per capita of bread will double by 2010. The objective of this study is to estimate the econometric model to analyse the effect of own price elasticity of rice, substitute elasticity, income elasticity and population elasticity on the consumption of rice in Malaysia. This is in regards to the income elasticity of demand for rice whether per capita rice consumption goes up or down as the income increase and to see whether rice consumption increase with population. Thus, to study the own-price elasticity of demand for rice that shows how consumers react towards the price change of rice.

2.0 Literature Review

Goldman (1975) investigates the staple food sufficiency and the distributive impact of Malaysia rice policy. The result shows that the average of price elasticity of demand for rice in Malaysia was -0.40 for both high and low quality of rice.

Koo *et al* (1985) use general model of demand for rice to estimate the demand of rice in Indonesia. The empirical model was as follows:

$$Qd_t = f(Pr_t, Pm_t, Pc_t, Y_t)$$

where, Qd is quantity of rice demanded per capita per year, Pr is retail price of rice per kilogram, Pm is retail price of maize per kilogram and Pc is retail price of cassava per kilogram. Based on above equation the demand elasticity with respect to its own price is (-0.13), cross-price elasticity with respect to maize was 0.30 while coefficient of income is not statically significant.

Barker et al (1985) use demand for rice (D) in 8 Asia's countries as function of the constant term (a) total population (T), the per capita income (Y), income elasticities demand for rice (n), retail price of rice(P)and price elasticity of demand for rice ϵ .The demand equation of rice are specified as follow:

$$D=aTY^{n}PC^{e}$$

The result shows that, although the income elasticity of demand for rice in Malaysia is less than 0.1 however population alone can generate an increased demand of 0.37 between 1980 and 2000

Baharumshah (1991) use consumption of rice as a function of their own prices, the price of substitute's goods and per capita income. The consumption equation of rice was specified as follow:

$$DDR_t = b1_0 + b_{11}PC_t + b_{12}DPS_t + b_{13}YM_t + e_{2t}$$

The result shows that own price elasticity from the model were (-0.309) and (-0.320) for rice and wheat respectively. The income coefficient is -0.24 which means as income increase the demand for rice decrease while the demand for wheat increases. From the estimated equation also price and income elasticities of demand were significant.

Ishida (1995) use conventional demand theory to estimate the total demand of rice in Peninsular Malaysia. The demand equation for rice was specified follows:

$$\ln(CON_t/POP_t) = e_0 + e_1(RCIP_t/CPI_t) + e_2(WHIP_t/CPI_t) + e_3(GNP_t/CPI_t)$$

where, CON_t/POP_t is the per capita consumption of rice, RIP_t is retail price in Peninsular Malaysia in year (RM/kg),GNP_t is the per capita gross national production year t (RM), $WHTP_t$ is the price of wheat flour in the Peninsular Malaysia in year t (RM/kg) and
CPI_t is CPI in Peninsular Malaysia for all items in year t (1980=1.00).Results show that own price elasticity of rice demand was the expected sign (-0.304), cross price elasticity with respect to the retail price of wheat 0.808 suggest a relatively strong substitution relationship in consumption of rice and wheat. Negative income elasticity (-0.321) indicates that rice is an inferior good.

Gunawardana (2000) used the consumer demand function for open market rice to estimate the demand of rice in the open market and the consumption of rice in the Sri Lanka. The empirical forms for the demand equation were presented below:

$$Qo = \alpha + \beta_1 Po + \beta_2 Pw + \beta_3 QCr + \beta_4 QCf + \beta_5 Y^{*} + \epsilon$$

Where the Qo per capita quantity of rice demanded in the open market, Po is retail price of rice, Pw retail price of wheat flour, QCr is per capita quantity of rice issued to consumer under non targeted schemes, QCf per capita quantity of rice issued to consumer under the targeted rationing and food stamp schemes and Y* per capita real income. From the estimated equation, the price elasticity of rice is -0.33, income coefficient was 0.12 and income coefficient was positive 3.9.

3.0 Methodology

Theoretically, quantity demanded for the consumption of rice in Malaysia is expected to be influenced by the price of rice, income, price of substitute commodities and population. A new model has been developed based on previous research made by (Baharumshah, 1991; Ishida, 1995; Gunawardana, 2000).
The empirical form of the demand equation to be estimated is specified as below:

$$\ln RC_t = \alpha + \ln \beta_1 POR_t + \ln \beta_2 POW_t + \ln \beta_3 GNIP_t + \ln \beta_4 POP_t + e$$

Where RC_t is the rice consumption (MT) in year t. RP_t is the price of rice (RM/MT) in year t. All variables are expressed in the natural logarithm. It is hypothesized that own-price is expected to have a negative sign. The variable POR_t represents the price of wheat (RM/MT) in year t. It is expected to have a positive sign. The variable $GNIP_t$ represent the gross national income (RM) in year t. It is expected to have either positive (normal good) or negative (inferior good) and, POP_t is population in year t. The sign on the coefficient POP is expected to be positive.

The data being used in this paper are annually based from the year 1980 to 2011. The annual data for rice consumption is extracted from the International Rice Research Institute, whereas the price of rice and price of wheat are proxy to world price are extracted from Index Mundi. The gross national income and population are obtained from Department of Statistics Malaysia. All data are being converted into log-log equation for time series processing. Thus, the coefficient can be interpreted as elasticity.

The method used in this study is Vector Error Correction Model VECM. Through the method, firstly, unit root test is employed. ADF test is used to determine the stationary of the time series data whether they are integrated at I(0) or I(1). Secondly, Johansen-Juselius Cointegration method was used to test the cointegration of the variables as well as to show the long run relationship between the variables. Finally, the Vector Error Correction Model was employed to evaluate the short run of the co-integrated data.

4.0 Discussion

In order, to test the stationary of the variables, Augmented Dicker Fuller (ADF) test is being employed. The result in table 1 below shows the ADF test statistic for a unit root test in terms of level and first difference. The result above shows that the null hypothesis of unit root could not be rejected for the price of wheat (POW) in the level. However, in the first difference of ADF test, all the variable's null hypothesis is rejected. Thus, this indicate that the first difference of consumption of rice, price of rice, price of wheat, gross national income and population are stationary indicating that all the five variables are integrated at I(1). Since, all the variables are stationary, and then it will be appropriate to check whether all the variables are co-integrating.

Table 1: Unit Root Tests Results

	ADF test statistic for a unit root	
Variables	*Level*	*First Difference*
LRC	2.034285	4.08859***
LPOR	2.02805	5.479423***
LPOW	5.101095***	4.920262***
LGNI	2.262388	4.647694***
LPOP	1.291634	4.045448***

Note: *** 1%, ** 5%, * 10% level of significance

Johansen cointegration test is used in this study to determine the existence of the long-run relationship or there is a co-movement between the variables in the long-run. Based on the table 2 below, the result shows that there are three cointegrating vector at 5% in trace test whereas there is only one cointegrating vector at 5% in max-eigen test. Indirectly, it means that the rice consumption and other explanatory variables price of rice, price of wheat, gross national income and population are moving closely to achieve long run equilibrium. Thus, the result shows that rice consumption and all four variables are cointegrated and there is a long-run relationship between them. The normalized coefficients as reported in the table 2 below estimates the long run elasticities of consumption of rice with respect to the price of rice, price of wheat, gross national income and population. There is negative relationship between the rice consumption and price of rice, gross national income, whereas there is a positive relationship between rice consumption and price of wheat and population. The long-run equation is as below:

$$LRC = -0.0163\ LPOR + 0.0915\ LPOW - 0.608\ LGNI + 1.647 LPOP$$

$$(0.029) \quad (0.023)^* \quad (0.079)^* \quad (0.290)^*$$

From the above estimated equation the estimated elasticity for rice is about (-0.0163) which is smaller (Baharumshah 1991; Ishida, 1995; Gunawardana 2000) and shows that the rice consumption is inelastic to the changes of the price of rice. The price of wheat elasticity was 0.0915, means that wheat is a substitute good for rice in Malaysia. The income coefficient obtained (-0.608), the results support the hypothesis that rice is an inferior good in Malaysia. It is in line with study done by (Baharumshah, 1991; Ishida 1995) where the incomes have negative relationship with consumption of rice. The population elasticity was 1.647 shows that the rice consumption will increase as the population increase. The result supported by the Barker et al (1985), population leads to increase in rice consumption in Malaysia. The findings indicate that price of wheat, price of rice and gross national income have played significance role in determining the consumption of rice in Malaysia

Table 2: Johansen Co-integration Tests and Regression Equation Normalized

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	*Eigenvalue*	*Trace Statistic*	*0.05 Critical Value*	*Prob.***
None *	0.705545	89.45788	69.81889	0.0006
At most 1 *	0.514477	52.77902	47.85613	0.0161
At most 2 *	0.438366	31.10314	29.79707	0.0352
At most 3	0.257234	13.79597	15.49471	0.0887
At most 4 *	0.149977	4.874759	3.841466	0.0272

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	*Eigenvalue*	*Max-Eigen Statistic*	*0.05 Critical Value*	*Prob.***
None *	0.705545	36.67887	33.87687	0.0225
At most 1	0.514477	21.67588	27.58434	0.2375
At most 2	0.438366	17.30717	21.13162	0.1580
At most 3	0.257234	8.921207	14.26460	0.2928
At most 4 *	0.149977	4.874759	3.841466	0.0272

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

1 Cointegrating Equation(s): Log likelihood 291.9613

Normalized cointegrating coefficients (standard error in parentheses)

LCR	LPOR	LPOW	LGNIP	LPOP
1.000000	-0.016377	0.091505	-0.608747	1.647319
	(0.02956)	(0.02344)	(0.07976)	(0.29079)

Next, the short run dynamics between variables in the cointegration equation are estimated. Estimating error correction model involve regressing the first difference of each variable in the cointegration equation on the lagged value of the first differences of all variables and the lagged value of the error term (e_{t-1}) obtained from the cointegrated regression. The VECM result are presented in table 3.The magnitude of error correction coefficient term is (-0.403) indicates the speed of the adjustment of any disequilibrium toward long run equilibrium state. The error correction term is significant which measure the speed of adjustment towards long run equilibrium carries expected sign and highly significant at the 5% level of significant. There is negative relationship between consumption of rice and price of rice, population, whereas there is positive relationship between rice consumption and price of rice, gross national income. Besides that, the result indicated that price of rice, price of wheat, and gross national income turned out insignificant, only population is significant at 1% significant level. Population yield a negative coefficient of (-9.217) which implies that 1% increase in population will lead to 9.217% decrease of consumption of rice in the short run.

Table 3: Vector Error of Correction Model

Error Correction:	*D(LCR)*	*D(LPOR)*	*D(LPOW)*	*D(LGNIP)*	*D(LPOP)*
CointEq1	-0.403103	-1.105905	-2.265151	-0.351987	-0.015109
	(0.16903)	(0.90097)	(2.27488)	(0.31568)	(0.00396)
	[-2.38481]	[-1.22746]	[-0.99572]	[-1.11502]	[-3.81049]
D(LCR(-1))	-0.043518	1.270108	2.049424	-0.019430	0.004420
	(0.16936)	(0.90274)	(2.27936)	(0.31630)	(0.00397)
	[-0.25695]	[1.40694]	[0.89912]	[-0.06143]	[1.11263]
D(LPOR(-1))	-0.049645	-0.213670	-0.682254	-0.143047	0.000128
	(0.03857)	(0.20561)	(0.51916)	(0.07204)	(0.00090)
	[-1.28699]	[-1.03918]	[-1.31415]	[-1.98560]	[0.14126]

D(LPOW(-1))	0.016413	0.036857	-0.294859	0.006332	0.000438
	(0.01999)	(0.10657)	(0.26909)	(0.03734)	(0.00047)
	[0.82091]	[0.34584]	[-1.09577]	[0.16959]	[0.93403]
D(LGNIP(-1))	0.019689	-0.110368	-1.136313	-0.010221	-0.008833
	(0.16964)	(0.90425)	(2.28316)	(0.31683)	(0.00398)
	[0.11606]	[-0.12206]	[-0.49769]	[-0.03226]	[-2.21956]
D(LPOP(-1))	-9.216567	-26.66268	-34.74438	-7.356631	0.834832
	(3.19969)	(17.0551)	(43.0629)	(5.97569)	(0.07506)
	[-2.88046]	[-1.56332]	[-0.80683]	[-1.23109]	[11.1228]
C	0.241930	0.648372	0.940113	0.271935	0.004333
	(0.08732)	(0.46546)	(1.17524)	(0.16308)	(0.00205)
	[2.77051]	[1.39299]	[0.79993]	[1.66745]	[2.11529]

5.0 Summary and Conclusion

This study presents the rice demand response in Malaysia over the period 1980-2011. Annual time series data of rice consumption, price of rice, price of wheat, gross national income and population were used for analysis. The Augmented Dickey Fuller was used to test the stationary of the individual series. All the time series data was used to test for unit root test. The results of the unit root tests showed that all the series are non-stationary at levels except for price of wheat which is stationary at level. However as expected all the non- stationary series become stationary after first differencing. In Johansen cointegration test, there were three cointegrating vector at trace test and one cointegrating vector at max-eigen value test are significant at 5%. Cointegrating indicate that there are strong long-run equilibrium relationship exists among variables, because it is known that the more stable the specified relationship is, the greater the number of cointegrating vector (Berg and Jayanetti, 1993). The Vector Error Correction Modelling (VECM) evaluated all variable except price of rice are significant in the long run but in the short run only population have significant relationship with consumption of rice. Price of rice and gross national income has negative relationship with consumption of rice and price of wheat and population have positive relationship in long run. Meanwhile in short run, price of rice and population have negative relationship with consumption of rice and other two variables have positive relation with consumption of rice. Both result in the short run and long run shows that rice is an inferior good in Malaysia and it shows that the importance of wheat based products in Malaysia can be noticed in their daily intakes as it increases over the time. In the long run, the productions of rice have to be increase in order to fulfil the rice demand for the growing number of population.

References

Baharumshah Z. Ahmad. (1991). A Model of the Rice and Wheat Economy in Malaysia: An Empirical Assessment of Alternative Specifications. Pertanika, 14(3), 383-391.

Barker, R., Herdt, R. W., & Rose, B. (1985). The Rice Economy of Asia (Vol. 2).Washington D.C: Resource for the Future Inc.

Berg HVD, Jayanetti SC. (1993). A Novel Test of the Monetary Approach Using Black Market Exchange Rates and the JohansenJuselius Cointegration Method. Econ. Lett, 41(4),413-418.

Bernas. (2013, November 7). Rice Importation & Rice Distribution. Retrieved July 13, 2015, from Bernas Padi Beras Nasional Berhad: http://www.bernas.com.my/index.php/2013-11-07-09-29-58.

Department of Statistics Malaysia. (2010). Report on Household Expenditure Survey 2009/2010. Retrieved July 20, 2015, from Department of Statisitcs Malaysia: https://www.statistics.gov.my/index.php. ?r=column/cone&menu_id=ZHJlbWFBSTVEcHY1ait6akR3WmtVUT09.

Economic Planning Unit, P. M. (2012). Malaysia Economic Figures 2012. Retrieved July 25, 2015, from Economic Planning Unit: http://www.epu.gov.my/documents/10124/72ac36d7-fe5a-489b-a34c-a2cb2be073a6.

Fuller, W. (1976). Introduction to Statistical Time Series. New York: John Wiley.

Goldman, R.H. (1975). Staple Food Self- Sufficiency and the Distributive Impact of Malaysia Rice Policy. Food Research Institute Studies, 14(3), 251-293.

Huang J., Bouis, H. (1996): Structural changes in the demand for food in Asia. Food, Agriculture, and the Environment Discussion paper No. 11, International Food Policy Research Institute, Washington, DC.

International Rice Research Statistics. (2011).World Rice Statistics. Retrieved June 26 2015, from International Rice Research Institute: http://ricestat.irri.org:8080/wrs2/entrypoint.htm.

Ishida, A. (1995). An econometric analysis of rice economy in Peninsular Malaysia. Agricultural Economic Papers of Kobe University, 28-29, 77-97.

Johansen, S., and K. Juselius. (1990). Maximum Likehood Estimation and Inference on Cointegration with Application to the Demand for Money. Oxford Buletin of Economics and Statistics 52, 169-210.

Koo, W.W., Maman H. Kamona, G. W., Erlandson, G. W. (1985). Analysis of Demand and Supply of Rice in Malaysia, North Dakota: Agricultural Economics Report No. 202.

Malaysia Agribusiness Report - Q2 2010 (2010). London: Business Monitor International.

P.J. Gunawardana, (2000). Concessional sales, Open Market Demand and Consumption of Rice in Sri Lanka. International Journal of Social Economics, 27(7), 847-861.

Yeong-Sheng Tey, Mad Nasir Shamsudin, Zainalabidin Mohamed, Amin Mahir Abdullah & Alias Radam (2008). Demand Analyses of Rice in Malaysia, Munchen: Munich Personal RePEc Archieve. (MPRA Paper; No. 15062).