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by

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ABSTRACT

One distinct change in Malaysians' food consumption behavior has been the preference towards meat products. The entire agri-food industry is impacted by changes in food consumption behaviors. This study attempts to provide a better understanding of meat consumption behaviors, by estimating income and price elasticities in Malaysia. Expenditure and price elasticities are estimated by Linear Approximate Almost Ideal Demand System (LA/AIDS) model in the first stage, followed by estimation of Engel function in the second stage in order to obtain the estimates of income elasticities for the meat products using Household Expenditure Survey 2004/05 data. The estimated positive and inelastic income elasticities indicate that all meat products are normal and necessity goods, except other meats. The estimates of the own-price elasticities of demand for all the meat products are greater than unity. This study shows that there would be increasing demand for major meat products among Malaysians in the future.

Keywords: *Meat, Linear Approximate Almost Ideal Demand System model, Demand elasticity*

JEL code: D12

1.0 INTRODUCTION

One distinct change in Malaysians' food consumption behavior has been the preference towards meat products. As the per capita income increases, Malaysians are consuming more meats than staple and grain foods. Chern *et al.* (2003) suggested that since there is a limit on total calorie intake, the ratio of the meat products in food basket becomes larger in comparison to other grain commodities. Hence, meat consumption is increasingly important in Malaysians' diet. This is mainly attributed to the government subsidies and ceiling price control that have made poultry affordable and the most important homogeneous meat among Malaysians.

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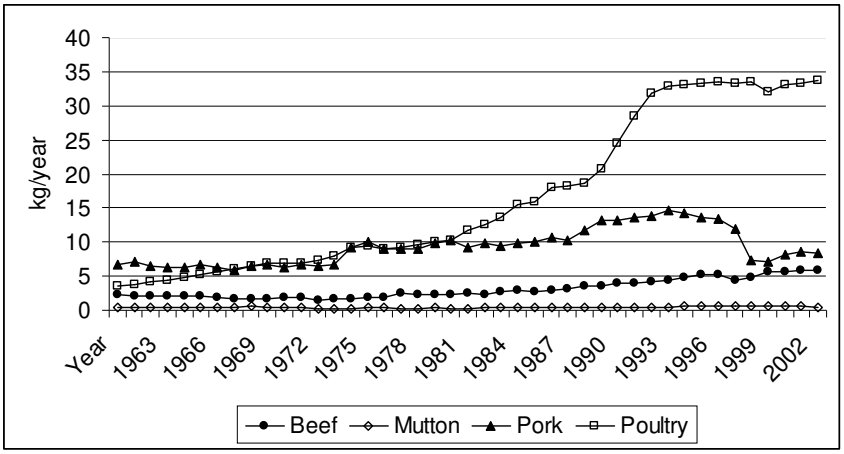
The entire agri-food industry is impacted by changes in food consumption behaviors. The main purpose of this meat demand analysis is to analyze meat consumption behaviors in Malaysia. To be more specific, this study attempts to provide a better understanding of meat consumption behaviors, by estimating income and price elasticities in Malaysia. These meat products comprise of beef, pork, poultry, mutton, and other meats. It is important to take note that fish is not included in this demand analysis. This is because there are many heterogeneous groups for fish.

2.0 STYLIZED FACTS

There are two main characteristics of meat consumption in Malaysia over the last four decades. One is the increasing trend of poultry and meat consumption, and the other is the increasing dependence on imports for beef and mutton to fulfill domestic consumption, which implies lower self-sufficiency levels in these meats.

Figure 1 presents annual per capita beef, pork, poultry, and mutton consumption in Malaysia, 1960-2005. From the figure, per capita consumption of poultry had increased steadily since 1960 and reached the peak in 1990s. On average, the consumption of beef had been increasing steadily over the last forty years while the consumption of mutton had been considerably low compared to poultry, pork, and beef. In 1960, the per capita consumption of poultry, pork, beef, and mutton were 3.46kg, 14.43kg, 1.56kg and 2.25kg respectively. Recent observation recorded the per capita consumption of poultry, pork, beef, and mutton were 34.3kg, 7.67kg, 5.5kg and 0.75kg respectively in 2005.

FIGURE 1: Annual per capita consumption of meats in Malaysia, 1960-2005

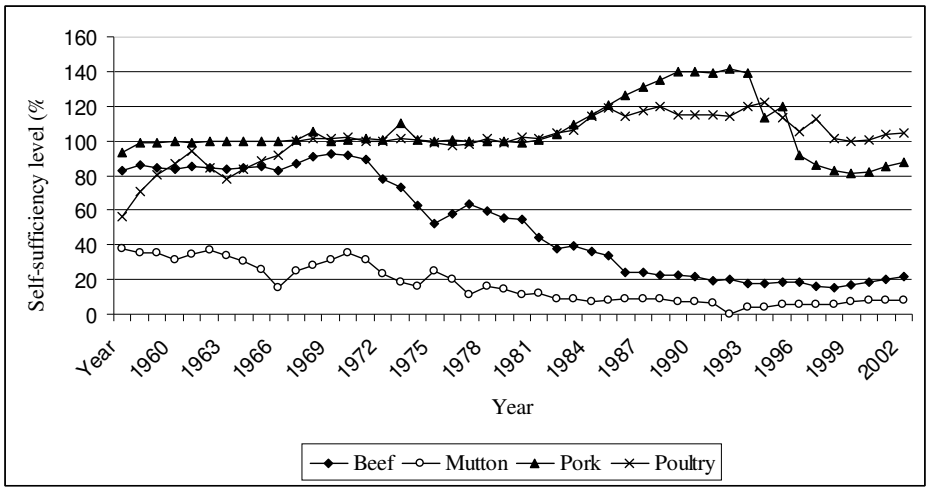


Source: Food and Agriculture Organization of the United Nations, 2007.

Figure 2 presents annual self-sufficiency levels of beef, pork, poultry, and mutton in Malaysia, 1960-2005. Though the beef and mutton production had been growing steadily but the self-sufficiency levels of beef and mutton had decreased drastically from 82.5% and 37.9% in 1960 to 21.49% and 8.15% in 2000 respectively. The low self-sufficiency levels imply that Malaysia is increasingly dependence on the imports for beef and mutton to fulfill domestic demand. On another hand, Malaysia had always been self-sufficient in

poultry and pork. Self-sufficiency level of poultry had increased remarkably from 56.4% in 1960 to 104.31% in 2005.

FIGURE 2: Annual self-sufficiency levels of meats in Malaysia, 1960-2005



3.0 LITERATURE REVIEW

Baharumshah and Mohamed (1993), Nik Mustapha *et al.* (1994) employed Linear Approximate Almost Ideal Demand System (LA/AIDS), a linear form of Almost Ideal Demand System (AIDS) in the meat demand analyses in Malaysia. This is mainly due to the difficulty to estimate the original non-linear form of the AIDS model developed by Deaton and Muellbauer (1980).

In Baharumshah and Mohamed (1993), the estimated expenditure elasticities for poultry, pork, beef, and mutton are 1.432, 1.152, 0.906, and 1.117 respectively; own-price elasticities are -3.736, -0.593, -0.873, and -0.420 respectively. The study indicated that Malaysian consumers were expected to increase their demand for all types of meat, where the demand for poultry was more likely to grow faster than other types of meat.

However, empirical previous studies (Buse, 1994; Hahn, 1994; Alston *et al.*, 1994; Asche and Wessells, 1997; Moschini, 1995) found that the LA/AIDS model has difficulty capturing the effects of non-linear Engel curves. Similarly, demand elasticities yield from the LA/AIDS model are mostly overestimated. In order to maintain the simple estimation procedure of the LA/AIDS model, Alston *et al.* (1994), Asche and Wessells (1997), Moschini (1995) suggested a replacement of Stone price index by Laspeyres price index or other price indexes.

Empirically, Chern *et al.* (2003) and Chern (2000) substituted the Stone price index with Laspeyres price index. On another hand, Jung and Koo (2000 and 2002) applied a finite change version of the Divisia Volume Index in the analyses of demand for meat and fish products in Korea. Chern *et al.* (2003), Chern (2000), and Jung and Koo (2000 and 2002) found that the application of the price indexes yielded similar demand elasticities like the original AIDS model.

4.0 DATA AND ESTIMATION PROCEDURES

This study uses cross-sectional data, Household Expenditure Survey 2004/2005 data rather than time-series data. Chern *et al.* (2003) suggested that cross-sectional data produces more plausible and reliable estimates of demand elasticities than time-series data. The Household Expenditure Survey 2004/2005 data consists of 14,084 respondents. The large number of households provides higher degrees of freedom in econometric estimation than time-series data.

Table 1 presents the percentage of Malaysian households with zero consumption in 2004/2005. Zero consumption happens when households did not purchase a meat during the survey period. Averagely, zero consumption is found to be the highest in other meats (98.55%), followed by mutton (97.37%), pork (82.19%), beef (63.26%), and poultry (24.23%).

TABLE 1: Percentage of respondents with zero consumption, 2004/2005

Meat	Percentage (%)
Beef	63.26
Pork	82.19
Mutton	97.37
Poultry	24.23
Other meats	98.55

Source: Household Expenditure Survey 2004/2005, Malaysia

As the zero consumption rates are considerably high in the data, the estimation procedures are deemed necessary to utilize two-step estimator developed by Heien and Wessells (1990) to obtain the inverse Mills ratios (IMRs) via probit model. The ultimate purpose is to correct the possible bias created by the presence of zero consumption in the meat products.

The IMRs are then incorporated into LA/AIDS model. The LA/AIDS model for the 5 meat products can be estimated as follows:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log(p_j) + \beta_i \log(x / P^L) + \sum_k \gamma_k H_k + \theta_i imr_i + \mu_i \quad (1)$$

where i, j = 1, 2, ……., 5 meat products, w_i is the budget share of the *i*th meat product, p is the price of the *i*th meat product, x is the aggregate total expenditure of meat, H_k includes household size and dummy variable of urban, μ_i's are random disturbances assumed with zero mean and constant variance, and P^L is Laspeyres price index for the aggregate food that can be defined by:

$$\log(P) = \sum_i \overline{w_i} \log(P_i) \quad (2)$$

The adding up, homogeneity and symmetry restrictions are imposed for the LA/AIDS models. The adding-up restriction is satisfied with given $\sum_i w_i = 1$ for all j:

$$\sum_i \alpha_i = 1, \sum_i \gamma_{ij} = 0, \sum_i \beta_i = 0, \sum_i \theta_i = 0 \text{ and } \sum_i \kappa_{ki} = 0 \quad (3)$$

The homogeneity restriction is satisfied for the LA/AIDS model in and only if, for all j:

$$\sum_k \gamma_{jk} = 0 \quad (4)$$

The symmetry is satisfied by:

$$\gamma_{ij} = \gamma_{ji} \quad (5)$$

Followed procedures of Green and Alston (1990), the demand elasticities of the LA/AIDS models can be computed at sample means. The expenditure elasticities can be estimated by:

$$e_i = \frac{\beta_i}{\overline{w_i}} + 1 \quad (6)$$

The Marshallian measures of price elasticities can be computed by:

$$s_{ij} = -\delta_{ij} + \left(\frac{\gamma_{ij}}{\overline{w_i}}\right) - \left(\frac{\beta 1_i}{\overline{w_i}}\right)\overline{w_j} \quad \forall i, j = 1..., n \quad (7)$$

where δ_{ij} is the Kronecker delta that is unity if $i = j$ and zero otherwise.

Since the LA/AIDS model does not provide a direct estimate of income elasticity, Chern *et al.* (2003) and Chern (2000) suggested that an estimation of Engel function is useful to derive income elasticity from expenditure elasticity. The Engel function can be expressed as:

$$\log x = \alpha_0 + \alpha_1 \log X + \beta \log P^L + \sum_k \gamma_k H_k + \varepsilon \quad (8)$$

where x is total expenditures of the meat products, X is total expenditures of food and non-food consumer goods and services, P^L is Laspeyres price index for the aggregate food, and ε is random disturbances assumed with zero mean and constant variance.

The responsiveness of expenditure on food items by income change can be derived by,

$$. e_e = \frac{\partial x}{\partial X}\frac{X}{x} \quad (10)$$

Hence, income elasticity can be estimated as follows:

$$e_y = e_i * e_e \quad (11)$$

5.0 RESULTS

Table 3 reports the estimated demand elasticities at sample mean, namely expenditure, income and own-price elasticities. Though many previous studies used expenditure elasticities as proxies for income elasticities, the estimated expenditure elasticities in this study are indeed against Engel's law. This is because as income rises, the proportion of income spent on food falls, even if actual expenditure on food rises. In other words,

income elasticity of demand for food must be less than 1[i]. Thus, it is more appropriate to obtain the estimates of income elasticity in this study.

The estimates of income elasticity are yielded by multiplying the estimated expenditure elasticities with the responsiveness of expenditure on food items by income change from Engel's curve. All the estimates of income elasticities show that pork (0.6487), mutton (0.4975), poultry (0.4841), and beef (0.3179) are normal and necessity goods, except other meats (-5.0449). This is due to the fact that the other meats comprised of exotic meats (eg: horse meat) in the data. As per capita income increases, it is expected that Malaysian consumers are likely to increase their consumption for major meat products.

All the estimates of own-price elasticities conform to the law of demand with negative signs. The estimated own-price elasticities of meat products range between -1.2743 (poultry) and -10.4535 (other meats). It is noteworthy that the own-price elasticity for poultry (-1.2743) is the least elastic and followed by beef (-2.3840), mutton (-2.7838), pork (-5.6610), and other meats (-10.4535). This probably indicates the importance of poultry in Malaysians' diet compared to other meat products.

Table 2: Estimated demand elasticities of meat, Malaysia, 2004/2005

Meat	Expenditure Elasticity	Income elasticity	Own-price elasticity
Beef	0.7136	0.3179	-2.3840
Pork	1.4560	0.6487	-5.6610
Mutton	1.1168	0.4975	-2.7838
Poultry	1.0866	0.4841	-1.2743
Other meats	-11.3242	-5.0449	-10.4535

6.0 CONCLUSIONS

This study aims to analyze meat consumption behaviors in Malaysia by estimating income and own-price elasticities. Expenditure and own-price elasticities are estimated by Linear Approximate Almost Ideal Demand System (LA/AIDS) model in the first stage, followed by estimation of Engel function in the second stage in order to obtain the estimates of income elasticities for the meat products using Household Expenditure Survey 2004/05 data.

Though this study shows that there would be increasing demand for major meat products among Malaysians in the future, the role of the meat products has diminished from luxury goods to become normal and necessity goods. Such indication has very important implication to meat producers wondering Malaysian consumers are increasing consuming more meats whether in the form of quantity or quality.

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[i] As explained by Holcomb *et al.* (1995), note that $w = pq / y$ w, where p is price of food and q is the quantity of food, respectively. According to Engel's law, $\partial w / \partial y < 0$. But, $\partial w / \partial y = (p / y)(\partial q / \partial y) - (w / y)$. Then $p(\partial q / \partial y) < w$ under the condition that $\partial w / \partial y < 0$. Hence, $\eta < 1$, where η is income elasticity.

Another perspective of this study observes that the estimates of the own-price elasticities of demand for all the meat products are greater than unity. It means that Malaysian consumers are generically sensitive to the changes in own-price of the major meat products. In the case of beef market, it is then reasonable to open the market to more abattoirs. This move will definitely make the beef more affordable and further introduce higher quality of beef to Malaysians.

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Appendix 1: Maximum likelihood estimates of the LA/AIDS model

	Beef	**Pork**	**Mutton**	**Poultry**	**Other meats**
	Coefficient (Std. Error)	**Coefficient (Std. Error)**	**Coefficient (Std. Error)**	**Coefficient (Std. Error)**	**Coefficient (Std. Error)**
Intercept	0.1072	0.2211	-0.1217	-0.0219	0.8154
	(0.0203)***	(0.0136)***	(0.0085)***	(0.0181)	-
Log (price of beef)	-0.2355	-0.0649	-0.0083	-0.1068	0.4154
	(0.0040)***	(0.0028)***	(0.0017)***	(0.0054)***	-
Log (price of pork)	-0.4133	-0.4133	0.0106	-0.7086	1.5246
	(0.0086)***	-	(0.0064)*	(0.0201)***	-
Log (price of mutton)	-0.3263	-0.0185	-0.0185	-0.6841	1.0474
	(0.0925)***	(0.0359)	-	(0.1257)***	-
Log (price of poultry)	-0.3245	0.1095	-0.1945	-0.1945	0.6040
	(0.0258)***	(0.0187)***	(0.0106)***	-	
Log (price of other meats)	1.2996	0.3872	0.2106	1.6940	-3.5914
	-	-	-	-	
Log (*x*/Laspeyres price index)	-0.0506	0.0401	0.0012	0.0517	-0.0424
	(0.0030)***	(0.0021)***	(0.0013)***	(0.0037)***	-
Log (household size)	0.0096	0.0006	0.0005	0.0315	-0.0422
	(0.0006)***	(0.0005)	(0.0003)*	(0.0009)***	-
Urban dummy	-0.0468	0.0417	0.0052	-0.0038	0.0037
	(0.0031)***	(0.0022)***	(0.0013)***	(0.0042)	-
IMR	0.3661	0.6241	0.5314	-0.0219	0.8154
	(0.0033)***	(0.0053)***	(0.0040)***	(0.0181)	-

Note: Significance levels are denoted by *** for 1%, ** for 5%, and * for 10%.

Appendix 2: Regression results for Engel curve analyses

	Coefficient	**(Std. Error)**
Intercept	0.3984	(0.1120)***
Log (total expenditure)	0.4455	(0.0077)***
Laspeyres price index	0.6629	(0.0486)***
Log (household size)	0.0291	(0.0088)***
Urban	-0.1240	(0.0103)***

Note: Significance levels are denoted by *** for 1%, ** for 5%, and * for 10%.