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Household Size Economies: Malaysian Evidence

Thaiyoong Penny Mok[1]
The Treasury,
Wellington 6140,
New Zealand
(Email: penny.mok@treasury.govt.nz)

and

Gillis Maclean
Lincoln University,
PO Box 84, Lincoln 7647,
New Zealand
(Email: Gillis.Maclean@lincoln.ac.nz)

and

Paul Dalziel
AERU Research Unit, Lincoln University,
PO Box 84, Lincoln 7647,
New Zealand
(Email: Paul.Dalziel@lincoln.ac.nz)

Abstract: People live in households with different size and composition and they consume a variety of goods; categorised as private and public goods. With the existence of public goods in the household, doubling the household size need not increase the consumption expenditure twofold to maintain the same standard of living. Using households' per capita expenditure from the Household Expenditure Survey 2004-2005, we estimate the household size economies indices for household consumption goods through the Seemingly Unrelated Regression. The results suggested that the lower income households enjoy savings from a wider range of public goods compared to the higher income households.

I. INTRODUCTION

The strong negative correlation between household size and consumption (or income) per capita in developing countries has lead to the conclusion that larger families tend to be poorer. This is misleading as household size affects the standards of living. People live in households with

[1] Corresponding author: penny.mok@treasury.govt.nz. All views in this paper are those of the authors and should not be attributed to the Treasury.

different size and composition and they consume a variety of goods; categorised as private and public goods. Public goods can be shared within the members of the households where two or more persons would obtain the same satisfaction as a single person consuming the same services. Private goods such as food away from home, clothing and healthcare are attributed to individuals in the household.

The notion of household economies emerged from the existence of public goods in the household. Hence, doubling the household size need not increase the consumption expenditure twofold to maintain the same standard of living. Lazear and Michael (1980) have demonstrated that a household of two adults would spend 31-35% lower in comparison with two households of single adult each, holding income constant. Sharing opportunities are observed in the costs of shelter and energy by sharing common spaces and furnishing, economizing services such as food preparation and savings from bulk purchases of food (see Deaton and Paxson 1998, Griffith, Leibtag, Leicester and Nevo 2009, Kakwani and Son 2005, Nelson 1988, Vernon 2010). The excess resources from sharing would be allocated toward private and public goods consumption. Many goods have some private and some public characteristics. Clothing can be shared and passed down amongst family members (Kakwani and Son 2005). This could be viewed as savings which might be essential for the lower income households. Thus, a simple comparison of aggregate household consumption will not be a good representative of the welfare in a given household without considering the possibility of household economies. Despite its importance in poverty research, there is no consensus on the appropriate method to measure household economies.

The estimation of the economies of scale in consumption has been developed based mainly on two models: Engel's and Barten's model. Engel's method has been dominantly applied in household size economies estimation due to its simplicity, using food share as welfare indicator of different sized households (Deaton and Muellbauer 1980, Lanjouw and Ravallion 1995). Under Engel's assumption and interpretation, the existence of household economies of scale would make a larger household with the same per capita expenditure (PCE) as a smaller household better-off. Hence, this would yield a lower food share for the larger household. Holding PCE constant, this can only occur when there is a fall in food expenditure per capita. Deaton and Paxson (1998) argued that this contradicts what is expected when welfare increases due to increase in household size with the presence of economies of scale. The increase in welfare due to the economies of scale would cause households to consume more food, especially in low income countries.

Deaton (1997) indicated that the Engel method works but makes no sense. Deaton and Paxson (1998) (hereafter Deaton-Paxson) draw from Barten's model in their attempt to estimate the household scale. An increase in household size, at constant PCE, would allow the expenditure released by the sharing of public goods to be spent on both public and private goods. Thus, the food budget share will increase, assuming that it is a normal good. Nonetheless, Deaton-Paxson failed to prove its validity. In comparison to Lanjouw and Ravallion (1995) who estimated the size economies using the Engel method, Deaton-Paxson showed different conclusions which are sourced from the underlying assumptions made. The controversial implications concluded by Deaton-Paxson have instigated several researchers to further analyse the theoretical models and their underlying assumptions. Gan and Vernon (2003) proved the applicability of Barten's model in estimating the household economies through food share in food and other public goods as opposed to food share in total expenditure. Gibson (2002) demonstrated that the measurement errors in household expenditure surveys for large households caused Engel estimates of household scale to be overstated.

The conventional method using Engel's model also assumed that the household elasticities of substitution are zero, thus all households will have the same degrees of economies of scale for each good (Lanjouw and Ravallion 1995). Consequently, if all goods including private and public goods have the same degrees of economies of scale, then it will be constant across all households. Kakwani and Son (hereafter Kakwani-Son) argued that the household elasticities of substitution are non-zero, as they depend on the household utility and composition. They postulated that the degree of economies of scale for different goods depends upon household's expenditure and household composition. Thus, the economies of scale should differ across goods and households.

The consideration of the household economies of scale has been limited in the official poverty measurement in Malaysia. The recent poverty line re-estimation only considered the savings in housing into the non-food poverty line estimation (United Nations Development Programme [UNDP] 2007). Lazear and Michael (1980) have demonstrated that the largest savings from household consumption were observed in food and shelter while smaller in services such as personal care and medical. While it is agreed that housing would have the highest degree of savings, failure in considering the possibility of other goods' savings would have resulted in inaccurate poverty measurement. It is important to public-policy analysts, to have a reliable estimate of household size economies to address social-security issues across different family types of the poor.

The objective of this paper is twofold; theoretical and empirical. This research tests and extends Kakwani-Son's secondary assumption that the degrees of economies of scale will be different for different households, depending on how well-off the household is and what the household's composition is by using different percentile PCE households in Malaysia. In particular, this paper estimates the household size economies for the poor, in comparison to the more affluent households. The estimated household size economies will be tested for their implications on headcount ratio.

This paper is organised as follows: Section II discusses the frameworks of the Engel and Barten model which form the basis of this paper. Section III describes the data and methodology. The empirical results and implications of the estimated household scales on the headcount rates are discussed in Section IV. Section V discusses and concludes.

II. ECONOMIES OF SCALE MODELS

2.1 The Engel Model

The most influential functional form of Engel curve parametric analysis is based on the model introduced by Working (1943), who postulated a linear relationship between the share of the budget on individual goods and the logarithm of total expenditure. The model was extended to include the household demographic composition. Lanjouw and Ravallion (1995) adopted the Engel method in their estimation of household economies of scale using a Working-Leser model as below:

$$w_f = \alpha + \beta \ln(x / n^{1-\sigma}) + \sum_{r=1}^{R-1} \delta_r a_r + \eta . z + u \tag{1}$$

where w_f is the budget share for food; x denotes total expenditure; n denotes household size; $a_r = n_r / n$ is the proportion of persons in household in r demographic group; z is a vector of the household characteristics (region, adult employment rate); and u is an error term. Parameters to be estimated are α, β, δ, σ and η.

Lanjouw and Ravallion (1995) proved that the question of whether large households are poorer depends on the extent of dispersion in family sizes and the size elasticity of the equivalence scale. Applying the Engel method imposed several strict assumptions: size elasticity is independent of utility and prices are independent of household size. Thus, the method would underestimate the size elasticity once the assumption of larger households buying cheaper food through bulk discounts and price elasticity of demand for food is less than unity is considered. The existence of public goods would create substitution effects in favour of private goods, other than food. Households could be exactly compensated for an increase in household size. Thus, holding utility constant, food share will fall as household size increases. Consequently, the size elasticity of welfare would be underestimated.

Deaton (1997) tested Engel's method using a utility theoretic model; $c(u, p, n)$ through two cost of living functions for household size n that achieve utility level u at prices p. The same food Engle curve was derived from both the functions but the estimated size elasticities of cost with respect to the household size differed. The result suggested that the true economies of scale were not captured by the Engel curve estimates, thus indicating the lack of identification.

2.2 The Barten Model

Further extension on household economies based on utility theoretic model was introduced by Barten (1964). Deaton and Paxson (1998) applied a similar food share model to equation (1) with public and private goods within the households. An increase in household size, at constant PCE, would allow the expenditure released by sharing of public goods to be spent on both private and public goods. Hence, there is a negative substitution effect and a positive income effect on the demand for private goods such as food. Thus, food shares would increase with household size due to two reasons. Firstly, as food has limited substitutes, its own-price elasticity would be lower than the income elasticity in absolute value. This is true especially in lower income countries. Secondly, food has smaller economies of scale than housing as shown in equation (4). Thus, the food budget share will increase, assuming that it is a normal good. This model conflicts with the Engel's Law, which predicts the food budget share will fall with household size.

Deaton and Paxson tested the conditions with the food share model:

$$w_f = \alpha + \beta \ln(x / n) + \gamma \mathrm{h}\ n + \sum_{r=1}^{R-1} \delta_r a_r + \eta . z + u \tag{2}$$

where w_f is the budget share for food; x denotes total expenditure; n denotes household size;

$a_r = n_r / n$ is the ratio to household size of household members who fall in one of r groups defined by age and sex; z is a vector of the household characteristics (including fraction of working adults in the household, rural/urban areas and region of residence); and u is an error term. Parameters to be estimated are α, β, γ, δ and η. Notably, equation (2) is identical to equation (1) as $\gamma = \beta\sigma$.

Previous studies estimated the economies of scale for individual goods using the prices of individual goods that are paid by the households (Lazear and Michael 1980, Nelson 1988). In the absence of these prices in most household expenditure surveys, household surveys have been matched with the goods' market prices. Kakwani-Son argued that this was problematic due to the complications of matching the goods between the survey and price data. They also opposed the conventional assumption that households face the same prices. This is well supported by Broda, Leibtag and Weinstein (2009) and Griffith *et al*. (2009) that showed that poorer households pay different prices by choosing cheaper and lower quality goods. Aguiar and Hurst (2007) suggested that prices people pay are related to the value of time and the amount of time that people decide to invest in shopping. Generally, the poor are willing to spend more time shopping in order to pay less. In view of this complication, Kakwani-Son developed a model to estimate the economies of scale indices for overall and individual goods without the need of price information. Kakwani-Son drew from Barten's model which included the substitution effects and made further assumptions pertaining to the nature of goods consumed by households to overcome the under-identification problem from the models.

Kakwani-Son's intuition of the economies of scale is that an increase in λ % of all persons in different demographic categories requires the increase of less than λ % of the cost or income to maintain the same level of utility as before for the *i*th good. The variation of budget shares for different goods depends upon household's expenditure and composition. They argued that the assumption made by the conventional methods of uniform economies of scale for all goods was unrealistic, since the economies of scale should differ across goods. They assumed that the family composition effect on the household consumption will be different for different goods, through the function $m_i\ (a_1, a_2, \ldots, a_R)$ being different for each good.

The proposed economies of scale indices for different goods are obtained from the elasticities of Hicksian demand functions through the Marshallian demand functions, where the latter could be observed from household survey data. The relationship between the Hicksian and Marshallian demand elasticities is explored through the Slutsky equation. The proposed index of economies of scale:

$$\phi_i^* = \varepsilon_i \phi^* + \theta_i + \sum_{j=1}^{n} \theta_j \varepsilon_j \tag{3}$$

where ϕ_i^* denotes economies of scale for the *i*th good; ε_i is the income elasticity; ϕ^* is the overall economies of scale; θ_i is the total elasticity of household composition (m) with respect to the number of person in the *r*th demographic (a_r) for the *i*th good; θ_j is the total elasticity of household composition (m) with respect to the number of person in the *r*th demographic (a_r) for the *j*th good; ε_{ij} is the Marshallian price elasticity of the *i*th good with respect to the price of the *j*th good. If $\phi_i^* < 1$, the *i*th good generates economies of scale to the household but if $\phi_i^* = 1$, the *i*th good does not generate economies of scale. If $\phi_i^* > 1$, diseconomies of scale in consumption are incurred. An increase in a_r changes all the prices, which has income and substitution effects on household consumption. Further differentiation of the Marshallian demand with respect to a_r gives:

$$\eta_{ir} = \delta_{ir} + \sum_{j=1}^{n} \varepsilon_j \delta_{jr} \tag{4}$$

where η_{ir} denotes the Marshallian elasticity of demand for the ith good with respect to a_r; δ_{ir} is the elasticity of m_i with respect to a_r; and δ_{jr} is the elasticity of m_j with respect to a_r. Thus,

$$\phi_i = \theta_i + \sum_{j=1}^{n} \theta_j \varepsilon_j \tag{5}$$

where $\phi_i = \sum_{r=1}^{R} \eta_{ir}$.

Substitute equation (5) into equation (3) gives:

$$\phi_i^* = \varepsilon_i \phi^* + \phi_i \tag{6}$$

The economies of scale indices for individual goods (ϕ_i^*) are derived from the estimation of overall index of economies of scale (ϕ^*) and parameters ϕ_i and ε_i . The two latter parameters are estimated from the Marshallian demand equations using the household expenditure data. The estimation of ϕ^* is based on assumptions of the nature of goods. Kakwani-Son proposed to assume that healthcare is purely private consumption. Thus, ϕ_i^* which denotes the economies of scale for the ith good is unity for expenditure for medical and healthcare. Substituting the assumption into equation (6) with the estimates of ε_i and ϕ_i for healthcare would enable the estimation of ϕ^* . Alternatively, Kakwani-Son suggested applying equal economies of scale for housing furnishing and household services into equation (6) for economies of scale estimation. Hence, ϕ_i^* for other individual goods would be estimated using equation (6). The differing assumptions applied for the economies of scale estimation yield different indices for individual and overall goods but consistent rankings of goods by their economies of scale indices. Kakwani-Son computed the Marshallian elasticities based on the Working-Leser model:

$$w_i = \alpha_i + \beta_i \log x + \sum_{r=1}^{R} \gamma_{ir} a_r + \mu \tag{7}$$

where w_i is the budget share devoted to the ith good; x is the household total expenditure; a_r is the number of individuals with the rth characteristics in the household; and μ denotes the error term. Equation (7) can be estimated using Zellner's (1963) seemingly unrelated regressions procedure.

The income elasticity and Marshallian elasticity, respectively, are derived as follows:

$$\varepsilon_i = 1 + \frac{\beta_i}{w_i} \tag{8}$$

$$\eta_{ir} = \frac{\gamma_{ir} a_r}{w_i} \tag{9}$$

where w_i is the weighted average value of the budget share devoted to the *i*th good; and a_r is the weighted average number of individuals with the *r*th characteristic in the household. The calculations of standard errors are based on bootstrap procedure to test the significance of the parameters for individual and overall economies of scales.

III. METHOD

We argued that the degree of economies of scale for different goods depends upon household expenditure and household composition. Thus, the economies of scale should differ across goods and households. As poorer households face different prices and they might choose cheaper and lower quality goods, thus an increase in a household member would have different impact on household scales. We estimate the household size economies across goods using different percentiles of household PCE.

In particular, the behaviour of the poor should be focused when adopting the household scales in poverty measurement. The selection of the households follows the common practice for poverty line estimation, which is based on the prior estimates of poverty incidence for the country (Pradhan, Suryahadi, Sumarto & Pritchett, 2001). The official poverty rates of the country were 5.9% and 8.7%, using household-based and individual-based calculation respectively in 2004 (UNDP, 2007). The selection of the 10^{th} and 20^{th} percentiles PCE households is based on the unweighted average of the PCE to contrast with the results of the aggregate sample size.

3.1 Data

This research uses the Household Expenditure Survey (HES) conducted by the government in 2005. It is a comprehensive expenditure of households including durables, semi-durables and services for 12 months, from June 2004 to May 2005. The survey covers urban and rural areas of Peninsular Malaysia, Sabah and Sarawak except the interior areas of Sabah, Sarawak and the indigenous settlements (the Orang Asli). The sample was selected using stratified multi-stage design. The first level of stratum comprised all 16 states of Malaysia while the second stratum is made up of urban and rural strata within the primary stratum. For this research, a sample of 4,362 households for the whole of Malaysia has been used. The survey provides sample weights but does not provide information on geographical stratum and stratum identifiers. Total household expenditure is measured as expenditure on all items, including durable goods. Expenditure on food includes food consumed at and away from home.

The survey showed that the average monthly consumption expenditure of households in Malaysia was RM 1,953 (equivalent to US$ 513) per month. On average, households spent about 69% of their monthly expenditure on four main groups, namely: housing, water, electricity, gas and other fuels which comprised 22%; food and non-alcoholic beverages (20%); transport; and restaurants and hotels comprising 16% and 11% respectively. Households spent the least on healthcare (1%), alcoholic beverages and tobacco, and education which comprised 2% of their expenditure respectively. The proportion of expenditure on food and non-alcoholic beverages decreases as the household expenditure level increases. Households in the lowest expenditure class (less than RM 500) spent 39% of their expenditure on food and non-alcoholic beverages as compared to 9% spent by the households in the expenditure class of RM 5,000 and above. Interestingly, the highest expenditure class spent most of their expenditure (28%) on transport. The average household size in Malaysia is 4.3 persons and about 56% were small size households (less than 5 person), 37% were medium size (5-7 persons) and 8% were large (8 or more persons). On average, a single member household spent about RM 1,026 as opposed to RM 2,226 and RM 2,500 spent by households of 5 persons and 10 persons and above respectively. In terms of proportion, a single member household spent about 11% on food and non-alcoholic beverages while a larger household of 10 persons and more spent about 28% of their expenditure on food and non-alcoholic beverages. In contrast, a single member household spent about 15% on food away from home as compared to household size 10 and above who spent about 8%.

The survey revealed that the lowest household expenditure group was headed by relatively young householder of 24 years and below. The expenditure increased with older head of the household with the highest expenditure recorded by household head between the ages of 35 and 44. Subsequently, the expenditure declined for head of household from the age of 45 with the largest decline by household head above 65 years old. This is consistent with the view that households will smooth their consumption in the course of one's lifetime. Households headed by males spent 1.3 times more than households headed by females with each spending about the same proportion of expenditures on housing; water; electricity, gas and other fuels; food and non-alcoholic beverages; transport; and restaurants and hotels. Further analysis on the head of the households revealed that the highest level of expenditure (RM 3,552 per month) were headed by household employed in the legislators, senior officials and managers occupation category, followed by households headed by those employed in the professional category (RM 3,361) and technicians and associate professionals category (RM 2,336). Not surprisingly, households headed by skilled agricultural and fishery workers recorded the lowest expenditure of RM 1,157, spending about 27% on food and non-alcoholic beverages. In contrast, households headed by those employed in the professional category allocated 22% of their expenditure on transport.

Official data on income is not available due to the sensitivity issue of income variation between races in the country. One of the main concerns in equation (2) is that the errors in w_f and $ln(x/n)$ are correlated. Thus, the standard measurement error in $ln(x/n)$ would bias the estimate of β and γ, the parameters of interest. Note that $ln(x/n)$ is equivalent to $ln(PCE)$. Deaton and Paxson (1998) proposed to use the logarithm of per capita income as the instrument for PCE. The Malaysia HES data do not contain the information of household income. Similarly to Gibson (2002), we proposed the use of age of household head and the average adult household years of education as instruments for PCE. The F-tests for the instruments are highly significant at 420.92, suggesting that the instruments are highly correlated with the endogenous variable, $ln(PCE)$. Over-identification tests also showed that the two variables do not correlate with the respective dependent variables. Thus, both are good predictors of PCEs. The Durbin-Wu-Hausman tests from this research suggest no significant difference between the OLS and the IV estimates for the overall selection of samples. Thus, OLS estimations are conducted in all models.[2] The models follow Deaton and Paxson (1998) weighted least squares linear regression,

2 IV estimates are suitable for the whole sample as the Durbin-Wu-Hausman test statistic of 38.98 is higher than the critical value of chi-squared at the 5% significance level (32.67). For the lower percentiles of the household samples, it is found that there is no significant difference between the OLS and the IV estimates.

with weights inversely proportional to the sampling weight provided by the survey. The standard errors in Kakwani-Son's method are computed from the bootstrap.

3.2 Poverty Line

This paper uses PCE as a measure of welfare. The measure includes the total values of food and non-food consumption items (purchases, home-produced items, gifts and concessionaire lodging received), as well as the imputed use-values for owner-occupied housing. Thus, the poverty line reflects the expenditure on food and non-food items which are deemed essential for a person to maintain a minimum acceptable standard of living. It is widely accepted that the developing countries should use household consumption expenditure as an indicator of living standards as income varies more significantly than consumption. Prior poverty studies in Malaysia showed high incidence of poverty in the rural areas of Sabah and Sarawak (UNDP 2007). Since most of the households in the rural areas are involved in agricultural sector, it is defensible to apply the consumption expenditure approach in poverty measurement as income might be understated.

For the purpose of this paper, the per capita poverty line of RM 143.80 for Malaysia is used as the reference point to evaluate the implications of different household scales on the headcount rates. The poverty line is adjusted for economies of scale in household consumption using the equation below:

$$PL_{hn} = \kappa * MPL_n * HS_h^{(\theta n-1)} \qquad (10)$$

where θ_n is the economy of scale; HS_h is the size of the hth household; and κ is the parameter to scale up the poverty line so that the mean of PL_{hn} across households is equal to MPL_n to ensure that the adjustment for economies of scale does not change the population mean of each of the food and non-food components (see Kakwani and Sajaia, 2004). Diseconomies of scale are not considered in this paper for simplicity.

IV. EMPIRICAL RESULTS

4.1 Household Size Elasticities

Summary statistics are reported in *Table 1*. The poorest households, are below the 10th percentile household PCE spend almost 50% of their total expenditure on food. The expenditure on shelter which is classified as public good is about 24% of the total expenditure for the poorest two deciles. These are represented by (w_i) in *Table 4* and *5*.

Table 2 shows the overall results of the negative relationship between the food share and household size. These corroborate the Deaton-Paxson paradoxical conclusion of Barten's model. A 10% increase in the logarithm of household size *ln(n)* decreases the food share by the proportion of 0.015, 0.012 and 0.007, respectively for all three household percentiles. The effects are less prominent for the higher deciles, which is consistent with the Barten model.

According to the Engel method, the economies of scale parameter σ are estimated from the ratio of the coefficients on *ln(n)* and *ln(PCE)*. The economies of scale σ are estimated to be 0.22, 0.21 and 0.43 for the 10^{th}, 20^{th} percentiles and aggregate households respectively.

Table 1: Descriptive Data (According to PCE Percentiles)

Variables	Aggregate sample		20th percentile		10th percentile	
	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Food share	0.34	0.14	0.43	0.14	0.47	0.14
ln food expenditure per capita	4.94	0.62	4.22	0.34	4.08	0.32
ln non-food expenditure per capita	5.56	0.91	4.39	0.61	4.08	0.67
ln per capita expenditure	6.04	0.74	5.06	0.30	4.84	0.25
ln household size	1.29	0.60	1.70	0.42	1.77	0.40
rm04	0.04	0.10	0.06	0.11	0.07	0.11
rm59	0.05	0.10	0.07	0.10	0.08	0.11
rm1014	0.05	0.10	0.07	0.11	0.07	0.11
rm1529	0.14	0.24	0.10	0.15	0.11	0.14
rm3054	0.16	0.19	0.14	0.12	0.14	0.12
rm55+	0.08	0.17	0.06	0.11	0.05	0.09
rf04	0.03	0.09	0.06	0.11	0.07	0.11
rf59	0.04	0.09	0.06	0.10	0.07	0.10
rf1014	0.04	0.09	0.06	0.09	0.06	0.09
rf1529	0.12	0.19	0.11	0.13	0.11	0.13
rf3054	0.17	0.17	0.15	0.11	0.15	0.12
rf55+	0.08	0.18	0.07	0.14	0.05	0.12
Adult earners ratio	0.45	0.36	0.29	0.23	0.28	0.22
School years of adults	8.65	3.49	6.92	3.09	6.53	3.15
Household head age	46.18	14.06	47.23	13.02	46.51	12.79

Notes: rm04 represents the ratio of the number of males aged 0-4 to total household numbers. Other variables beginning with *r* are demographic ratios, for their respective gender and age group. Means and standard deviations are calculated using household sampling weights.

Table 2: Food Engel Curve (Instrumental Variable)

Variables	Food in total expenditure		
	Aggregate households	20th percentile	10th percentile
ln(n)	-0.07 (0.01)	-0.12 (0.03)	-0.15 (0.04)
ln(PCE)	-0.16 (0.01)	-0.56 (0.17)	-0.68 (0.19)
R^2	0.30		
Size economies s	0.43	0.21	0.22

Notes: The parameters are estimated using weighted least squares, with weights inversely proportional to the sampling weight in the survey. Refer to Table A1 in the Appendix for detailed estimates. Parentheses denote standard errors.

The estimated size economies for the lowest two deciles are equivalent but the coefficient for the aggregate sample is twice that for the poorest deciles. The size economies of 0.43 suggest that ten individuals, each spending \$1 a day in separate single-person households will achieve the same welfare level as a 10-person household with total expenditures of \$3.72 a day ($10^{0.57} = 3.72$). The estimated size economies using the aggregate household sample display a rather large fall in food spending per person for households in Malaysia. However, if the size economies of 0.22 is used, the same welfare level requires total expenditures of \$6.03 a day ($10^{0.78} = 6.03$). If the size economies estimated from the aggregate sample is used for poverty estimation instead of the 10th percentile PCE, this would under-estimate the poverty headcount for the country.

The Barten model predicts that poor households who have fewer substitutes for some private good will increase consumption of that particular private good more than the higher income households when household size increases. If food is the private good that is not easily substituted, the elasticity of per capita food expenditure should be larger for poorer households. Further analysis on the elasticity of per capita food expenditure with respect to household size is estimated as -0.32, -0.27 and -0.20 for the 10th, 20th percentile and aggregate households, respectively. These are estimated using γ / w_f, with the respective average food shares displayed in *Table 1*. The elasticity of food expenditure in absolute terms is higher for the poorest percentiles, as predicted by the Barten model.

The results above are estimated on the assumption that the household size economies are constant across goods and households. In contrast, Kakwani-Son postulated that the household size economies vary across goods and households. The estimates of size economies using the specification of Kakwani-Son are reported in *Table 3*.

Table 3: Economies of Scale Indices

Goods	Top 20th percentile		20th percentile		10th percentile		Aggregate sample	
	ϕ_i	ϕ^*_i	ϕ_i	ϕ^*_i	ϕ_i	ϕ^*_i	ϕ_i	ϕ^*_i
Food	0.18	0.75	0.19	0.72	0.19	0.67	0.18	0.81
	(0.04)	(0.03)	(0.04)	(0.03)	(0.05)	(0.04)	(0.01)	(0.01)
Clothing	0.16	0.81	0.16	1.05	0.03	0.92	0.21	1.00
	(0.08)	(0.06)	(0.12)	(0.07)	(0.17)	(0.11)	(0.03)	(0.03)
Housing	-0.10	0.79	-0.15	0.59	-0.16	0.54	-0.13	0.71
	(0.06)	(0.04)	(0.07)	(0.05)	(0.12)	(0.09)	(0.02)	(0.02)
Furnishing	0.30	1.41	-0.22	0.97	-0.41	0.58	0.06	1.25
	(0.13)	(0.11)	(0.12)	(0.09)	(0.18)	(0.12)	(0.04)	(0.05)
Medical	-0.02	1.00	0.38	1.00	0.36	1.00	-0.28	1.00
	(0.30)	(0.20)	(0.30)	(0.24)	(0.46)	(0.39)	(0.11)	(0.09)
Transport	-0.24	1.23	-0.32	1.16	-0.12	1.09	-0.20	1.28
	(0.10)	(0.06)	(0.12)	(0.08)	(0.18)	(0.12)	(0.03)	(0.03)
Communication	0.06	0.96	-0.37	1.35	-0.77	1.05	-0.18	1.02
	(0.07)	(0.05)	(0.19)	(0.15)	(0.40)	(0.27)	(0.04)	(0.04)
Education	-0.26	1.95	0.02	1.35	-0.14	1.12	-0.04	1.60
	(0.45)	(0.28)	(0.20)	(0.16)	(0.25)	(0.19)	(0.09)	(0.08)
Personal goods	0.10	1.27	-0.09	1.09	-0.07	0.94	0.12	1.28
	(0.09)	(0.07)	(0.11)	(0.07)	(0.19)	(0.11)	(0.03)	(0.03)
Miscellaneous	-0.08	0.92	-0.23	0.94	-0.48	0.57	-0.23	0.96
	(0.1)	(0.06)	(0.15)	(0.14)	(0.22)	(0.14)	(0.04)	(0.04)
Total ϕ^*		0.97		0.81		0.71		0.93
		(0.21)		(2.60)		(0.71)		(0.07)

Notes: Standard errors are in parentheses, computed from the bootstrap method. These variables are estimated using the SUR method without weights.

The overall index of size economies (ϕ^*) are 0.71, 0.81 and 0.93 for the 10th, 20th percentile and aggregate households, respectively.[3] This shows that 29%, 19% and 7% of total expenditure can be saved in the larger households of respective deciles without affecting their standards of living. As high income households are included in the estimation of size economies, the index gets larger. Further analysis of the top 20th percentiles households give the value of ϕ^* = 0.97, indicating only 3% of savings obtained with an additional member in the household. This concurs with the findings of Salcedo, Schoellman and Tertilt (2009) that suggest that as households get richer, the household public goods become relatively less important. Thus, this suggests that richer households devote higher budget shares on private goods. This paper shows that the ϕ^* and ϕ^*_I varies substantially as postulated by Kakwani-Son, depending on the household deciles used as reference groups.

The ϕ^*_I values in the 10th percentile PCE households indicate a wider range of savings in consumption compared to the higher income households. Economies of scale are present in six consumption goods; housing, miscellaneous, furnishing, food, clothing and personal goods for the poorest deciles and display larger degrees of savings than for the top deciles PCE. The current housing cost provides the highest size economies for all households, except for the top deciles. Although food and clothing are usually regarded as privately consumed goods, this indicates they provide economies of scale. This concurs with Kakwani-Son's findings using Australian households (Kakwani and Son 2005). The value of ϕ^*_I for food is 0.67, which translates into savings of 33% for the poorest households in Malaysia. The household savings on food decreases with household expenditure. The top deciles display a lower savings of 25% as the household size increases. This could be explained by the fact that the poor might save more than their affluent counterparts through the choices of bulk purchases, economy generic food brands and purchase on sale (Griffith *et al*. 2009). Economies of scale for the aggregate Malaysian households are present for housing, food and miscellaneous expenditure.

Clothing provides rather small economies of scale to the poor with the index of 0.92. Interestingly, the effect is larger for the top deciles. This corroborates the initial supposition that clothing could be passed down to family members. The effect disappears when the 20th percentile and aggregate households are used to estimate the size economies. Clothing is a privately consumed good, providing no economies of scale, with indices of 1.0 for the 20th percentile and aggregate households.

Diseconomies of scale in consumption are present when $\phi^*_I > 1$. For all the households, education has the largest diseconomies of scale. The negative values of ϕ_I for education suggest that the expenditure on education will fall as the household size increases holding income or expenditure constant. Further analysis of Marshallian elasticities in *Table 4* shows that the increase in household members aged 6 to 17 years increases the expenditure on education but not for the other household members of the poorest deciles. Education is essentially a privately consumed good and large number of children is observed in poor households. Expenditure on education tends to decrease for the additional increase of a household member over 17 years old,

[3] This is estimated using Seemingly Unrelated Regression model (unweighted), through natural logarithm specification. The SUR model using logarithm base 10 produced slightly higher indices: 0.80, 1.37, 0.90 and 0.68 for 10th, 20th, top 20th percentiles, respectively and aggregate sample. The size economies for the 20th percentile do not seem robust under this specification.

suggesting that the demand for tertiary education is low amongst the poor. When the household size increases, the poor will reallocate their resources to other private consumption goods such as food and medication which are deemed essential to their livelihoods, rather than education.

A low degree of diseconomies of scale is present in expenditure on transport and communication for the poorest deciles. Both goods could be interpreted as pure privately consumed goods as their indices are near 1.0. Communication expenditure is also a pure privately consumed good for aggregate households. The negative ϕ^*_i for both goods suggest that the poor will reduce their consumption on these goods when household size increases. This could be explained by the inclusion of goods such as school bus fares, bicycles and other expenses which do not provide consumption economies of scale to the larger households. Thus, it is logical that the poor will reduce their consumption on these goods by seeking alternatives and reallocate their expenditures to food and clothing which is more essential.

On the contrary, the aggregate households show diseconomies of scale for consumption on furnishing, transport, education and personal goods. The presence of diseconomies of scale in household consumption contrasts with the results of Kakwani and Son (2005) using the Australian Household Expenditure survey of 1984, where the latter showed household economies of scale for all the goods consumed. Plausible explanations for this difference could be due to the different level of country development and market institutions. Malaysia, as a developing country lacking in social security benefits and market linkages which limit the opportunities for household economies of scale would have a different household consumption pattern than a developed country such as Australia.

Table 4: Income and Marshallian Elasticities, 10^{th} Percentile

Goods	w_i	ε_i	Marshallian elasticities with respect to age					
			0-5	6-14	15-17	18-24	25-64	65+
Food	0.47	0.68	0.05	0.03	0.01	0.03	0.07	0.01
		(0.05)	(0.02)	(0.02)	(0.01)	(0.01)	(0.03)	(0.01)
Clothing	0.04	1.27	0.01	0.03	0.02	0.05	-0.07	-0.01
		(0.13)	(0.04)	(0.06)	(0.03)	(0.03)	(0.09)	(0.02)
Housing	0.24	0.98	-0.05	-0.05	-0.01	-0.02	-0.03	0.01
		(0.11)	(0.03)	(0.04)	(0.02)	(0.02)	(0.09)	(0.01)
Furnishing	0.03	1.41	-0.03	-0.09	-0.06	0.01	-0.24	-0.02
		(0.15)	(0.06)	(0.07)	(0.03)	(0.03)	(0.09)	(0.02)
Medical	0.01	0.91	0.06	-0.10	0.018	-0.13	0.51	-0.00
		(0.31)	(0.23)	(0.12)	(0.09)	(0.08)	(0.38)	(0.06)
Transport	0.07	1.71	-0.03	-0.02	-0.00	-0.06	0.012	-0.02
		(0.14)	(0.05)	(0.07)	(0.03)	(0.03)	(0.10)	(0.02)
Communication	0.02	2.57	-0.17	-0.49	-0.02	-0.09	-0.04	0.05
		(0.27)	(0.11)	(0.15)	(0.05)	(0.06)	(0.25)	(0.05)
Education	0.02	1.78	-0.01	0.22	0.18	-0.19	-0.29	-0.04
		(0.22)	(0.09)	(0.12)	(0.06)	(0.05)	(0.13)	(0.02)
Personal goods	0.07	1.43	-0.02	0.19	0.01	-0.02	-0.21	-0.03
		(0.17)	(0.05)	(0.07)	(0.03)	(0.03)	(0.08)	(0.02)
Miscellaneous	0.04	1.48	-0.09	-0.16	-0.08	-0.03	-0.12	-0.01
		(0.19)	(0.06)	(0.08)	(0.03)	(0.04)	(0.14)	(0.03)

Notes: Standard errors are in parentheses, computed from the bootstrap method.

The negative value of ϕ_i for expenditure on housing across households implies that households will decrease their housing expenditure as the household size increases, assuming income or expenditure is constant. As ϕ_i provides information about the household reallocation mechanism, the positive values for expenditure on food across households confirm Barten's prediction that households will increase expenditure on private consumption goods (food) and decrease expenditure on public consumption goods (housing) as the household size increases. For the 10th percentile PCE household, positive values of ϕ_i are also observed in clothing and medical expenditures. For the aggregate households, the positive values of ϕ_i are observed in food, clothing, furnishing and personal goods expenditures. Thus, for the poorest households, public sharing with some economies of scale could be observed from housing, furnishing, personal goods and miscellaneous goods. From the savings allowed through public good consumption, the poorest group chooses to reallocate resources to food, clothing and medical goods which are deemed essential.

Different estimates of ϕ_i^* across households reflect the differences in household consumption patterns where the higher income households shift from public to private consumption goods when they have more income at their disposal. Moving from the poorest to richest deciles, higher income (or expenditure) households are spending more ($\phi_i > 0$) on furnishing, communication and personal goods which do not yield economies of scale (high ϕ_i^*) with respect to household size. These are regarded as privately consumed goods by the richest deciles as $\phi_i^* \geq 1$ but not by the poorest deciles. Housing and miscellaneous goods are regarded as publicly consumed goods by all households. All households face diseconomies of scale in transportation and reduction in expenditure with respect to household size.

Tables 4 and *5* show the income and the Marshallian elasticities with respect to household size and age for the poorest deciles and the aggregate households. Refer to Table A2 and A3 in the Appendix for the estimates using the 20th percentile and top 20th percentiles. The income elasticities (ε_i) supported the above conclusion that households at different incomes have different consumption behaviour, which will result in different household size economies across households. Goods are classified as luxury if $\varepsilon_i > 1$. For the poorest two deciles, goods such as food, housing and medication are viewed as necessities ($0 < \varepsilon_i < 1$). For the top deciles, necessity goods encompass a wider range. They are observed in consumption on food, housing, clothing and communication. One possible explanation for the differences would be that the poor who normally consume less food calories are more vulnerable to sickness. Hence, expenditure on medication for the poor would be less responsive to income than the wealthier households.

Further deductions can be made from these estimates. For the poorest deciles, goods which are regarded as luxuries are normally shared amongst household members. This can be observed in goods such as clothing, furnishing, personal goods and miscellaneous goods where certain degrees of economies of scale occurred. Goods which are regarded as necessities by the poor such as food, medication and housing are consumed privately and publicly. On the contrary, goods which are regarded as luxuries and necessities by the richest deciles are consumed privately amongst household members, except housing and miscellaneous goods.

The ϕ_i indices display the choice of goods amongst households. The savings from housing, furnishing, food, miscellaneous and personal consumption by the poor are usually obtained through bulk purchases, lower quality of goods and possibly over-crowding in housing

Table 5: Income and Marshallian Elasticities, Aggregate Sample

Goods	w_i	ε_i	Marshallian elasticities with respect to age					
			0-5	6-14	15-17	18-24	25-64	65+
Food	0.34	0.05	0.02	0.012	0.01	0.03	0.11	0.011
		(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Clothing	0.03	1.28	0.04	0.08	0.01	0.02	-0.09	-0.02
		(0.04)	(0.01)	(0.02)	(0.00)	(0.00)	(0.01)	(0.00)
Housing	0.24	0.32	-0.02	0.01	-0.00	-0.01	0.06	0.02
		(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Furnishing	0.04	2.55	0.09	-0.05	-0.07	-0.04	-0.31	-0.02
		(0.32)	(0.03)	(0.01)	(0.03)	(0.01)	(0.08)	(0.01)
Medical	0.01	1.02	0.15	-0.11	-0.01	-0.06	0.25	0.04
		(0.01)	(0.05)	(0.03)	(0.00)	(0.02)	(0.05)	(0.02)
Transport	0.13	2.13	-0.01	-0.04	-0.00	-0.00	-0.08	-0.05
		(0.13)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.02)
Communication	0.06	3.37	-0.06	-0.13	-0.03	-0.06	-0.22	-0.01
		(0.16)	(0.02)	(0.02)	(0.01)	(0.00)	(0.01)	(0.00)
Education	0.02	4.03	-0.07	0.31	0.06	-0.11	-0.57	-0.02
		(0.18)	(0.01)	(0.03)	(0.01)	(0.01)	(0.05)	(0.00)
Personal goods	0.07	2.42	0.03	0.08	0.04	-0.01	-0.18	-0.01
		(0.21)	(0.01)	(0.02)	(0.00)	(0.00)	(0.02)	(0.00)
Miscellaneous	0.07	1.53	-0.08	-0.08	-0.04	-0.03	-0.03	-0.00
		(0.56)	(0.17)	(0.11)	(0.08)	(0.05)	(0.03)	(0.01)

Notes: Standard errors are in parentheses, computed from the bootstrap method.

(Griffith *et al.* 2009). The choice made by the poor indicates the actual minimum expenditure on each good for a decent livelihood. In contrast to the poorest deciles, the richest deciles display positive reallocation of resources to goods such as furnishing and personal goods as the household size increases.

For statistical significance checking of ϕ^*, the standard errors of the parameters of the economies of scale are computed through a bootstrap method using 1000 replications (see Kakwani and Son 2005). Households will have significant economies of scale if the value of ϕ^* is significantly different from one. Thus, to test the hypothesis, t values of $(1-\phi^*)$ are computed. The t value for the 10th percentile and aggregate sample of $(1-\phi^*)$ were computed as equal to 0.41 and 1.02, respectively which are not significant at the 5% level of significance.[4] However, the ϕ_i^* are statistically significant at the 5% level of significance for the 10th percentile and aggregate sample households. We question the applicability of the assumption of a unity index of economies of scale for medical and healthcare expenditure in the Malaysian household context. The bootstrapped standard error is derived from the assumption that the medical expenditure is purely private consumption. The bootstrap samples are drawn repeatedly from the sample. However, not all households have significant expenditure on

[4] OLS using weighted-least squares and instrumental variables produced unreliable economies of scale indices for each percentile; 1.56, 1.65 and 0.90 respectively for 10th, 20th percentile and aggregate sample. OLS using weighted-least squares without instrumental variables produced lower economies of scale: 0.53, 0.34 and 0.43 respectively for the 10th, 20th percentile and aggregate sample. These indices are higher than the indices estimated using Engel method.

medical goods as it is provided free by the government, especially to the poor. The medical expenditure for the households is low, which is about RM26 per household per month or 1% of the total household expenditure. The income elasticity of medical expenditure is 1.02 for the entire sample, in contrast to 0.71 from Kakwani-Son's findings. Thus, using medical and healthcare expenditure may not be a good base for the economies of scale index estimation for Malaysia; this in turn would affect the significance test of the index.

4.2 Poverty Measurements

The household size economies estimations were applied to the poverty measurements using headcount rates and are displayed in *Table 6*. For all reference groups, the average per capita poverty lines in Table 6 decline monotonically with household size. Arguably, this might be due to two reasons. First, larger households have more children and the food poverty will decline with household size due to the lower food poverty line for children. Secondly, larger households will experience savings in public good consumption such as housing and food preparation. We also compare our results with the Malaysia's current method which only considered the household size economies in housing.

Table 6: Poverty Line Per Capita by Household Size for Different Methods

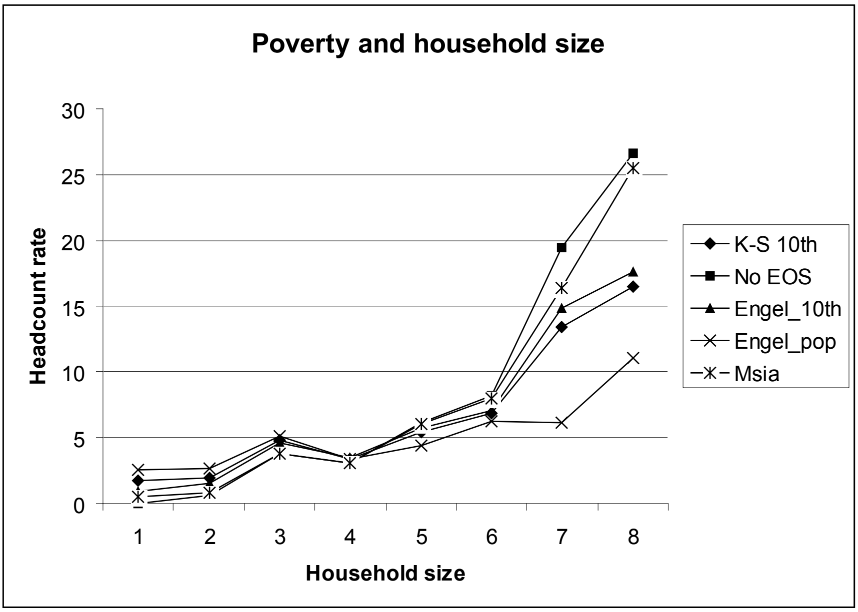
Hh size	Kak-Son[a]	Head-count[a]	No EOS	Head-count	Engel method[b]	Head-count[b]	Engel method[c]	Head-count[c]	M'sia method[d]	Head-count[d]
1	223.23	1.7	143.80	0.0	198.01	0.9	262.30	2.6	166.65	0.5
2	179.20	1.9	143.80	0.6	170.00	1.5	194.70	2.7	153.44	0.8
3	158.18	4.8	143.80	3.8	155.50	4.6	163.54	5.1	147.46	3.8
4	145.05	3.4	143.80	3.1	146.00	3.5	144.51	3.4	143.84	3.1
5	135.77	5.4	143.80	6.1	139.0	5.7	131.30	4.4	141.34	6.0
6	128.72	6.9	143.80	8.2	133.51	7.1	121.40	6.2	139.48	8.0
7	123.12	13.4	143.80	19.5	129.05	14.8	113.60	6.1	138.03	16.4
8	118.51	16.5	143.80	26.6	125.32	17.6	107.26	11.1	136.85	25.5
Mean	143.80	10.2	143.80	10.2	143.80	10.2	143.80	10.2	143.80	10.2

Notes: Headcount rates are calculated using the population weights of the survey.
a estimates are based on the φ^*i from the 10th percentile PCE. The size economies are incorporated in the food and non-food poverty line for different household sizes.
b estimates are based on the σ from the 10th percentile PCE.
c estimates are based on the σ from the aggregate households.
d estimates are based on the Malaysia's estimates of household economies of scale for housing (0.474), using the authors' estimated poverty lines.

The per capita poverty lines show a decreasing trend with household size but the headcount rates increase with household size. The poverty measurements appear to be sensitive to the methods used to estimate the economies of scale, as shown in *Table 6* and *Figure 1*. When no allowance is made for size economies, the poverty rate increases rapidly with household size. Households with 8 or more members have a 27% poverty rate. When the size economies estimated from the 10th percentile group with the Deaton-Paxson specification is used ($\sigma = 0.22$), the smallest households have 1% poverty rate but the 8-person households have a poverty rate of 18%. The household size economies estimated from the 10th percentile PCE with the Kakwani-Son method produce a 2% poverty rate for the smallest households and a 17% poverty rate for the largest households. Using the size economies estimated from the 10th percentile group, the headcount rates calculated from the Kakwani-Son and the Deaton-Paxson are similar. The headcount rates for the Deaton-Paxson specification using the aggregate sample are the lowest amongst all methods, suggesting that it would under-estimate the poverty rate.

The Malaysian government estimated the household size economies of housing at 0.474 (UNDP 2007). The headcount rates estimated from the official household size economies display a similar trend to the headcount rates without household size economies. Both headcount rates increase rapidly with household size. For the 10th percentile household, the method proposed by Kakwani-Son which includes household size economies for all individual goods produce lower headcount rates, as opposed to the official method. Thus, the official size economies in poverty measurement might have over-estimated the poverty rate in the country.

Figure 1: Poverty and Household Size



V. CONCLUSIONS

This research utilized comprehensive expenditure of household data (HES) which included durables and semi-durables and services in 2005. The survey revealed that households in different expenditure groups behave differently. For example, households in the lowest expenditure group spent most of their expenditure (39%) on food and non-alcoholic beverages whereas households in the highest expenditure group allocate most of their expenditure (28%) on transport.

We confirm our earlier supposition that the degree of economies of scale vary across goods and households. The estimations of size economies differ depending on the deciles and methods used. Assuming that households in similar per capita expenditure percentiles share the same preferences, the estimated household size economies for the lower income households are larger than the higher income households using a common benchmark of analysis. This could best be explained by the choice of the richer households who consume relatively more private goods as opposed to poorer households. The overall economies of scale indices proposed by Kakwani-Son produce similar size economies to the Deaton-Paxson specification for the poorest two deciles reference groups, which result in a similar trend for headcount ratios. The poverty measurements for different reference groups used to estimate the household size economies show trends consistent with the poverty measurements produced in the poverty lines estimation. The official household size economies which only considered household savings in housing expenditure had over-estimated the headcount ratio in larger households. The results shown in the 10th and 20th percentile PCE household are robust, provide a better alternative to estimate the household economies of scale index for poverty measurement in Malaysia's context.

The detailed economies of scale information on every consumption good of the household is well represented by the expenditure system derived by Kakwani-Son. The method proved the validity of the Barten model for food expenditure. The positive values ϕ_i for expenditure on food for all the percentiles using the Kakwani-Son specification show that household expenditure on food increases when the household size increases, holding income or expenditure constant. This method proved to be a good alternative to the conventional economies of scale estimation using the Engel method which was regarded as not sensible by Deaton-Paxson. The ϕ_i^* indices offer rich information on the allocation of resources and the choice of goods amongst poor households. It could be used as an alternative indicator to complement poverty measurement.

The economies of scale for consumption of individual goods are significant but the overall size economies (ϕ^*) is not. The bootstrapped standard errors are derived from the assumption that medical expenditure is pure private consumption. This paper questions the applicability of the assumption of the unity index of economies of scale for healthcare expenditure as proposed by Kakwani-Son when the income elasticity of medical goods is high and the budget share for the good is low. The 10th percentile PCE shows the presence of household size economies for food, housing, clothing, furnishing, personal goods and miscellaneous goods. The results suggest that the household economies of scale from food preparation and food bulk purchase are rather high for the lower income households. It also shows the presence of diseconomies of scale mainly in education consumption. Adopting the specification to the entire sample indicates the presence of size economies in food, housing and miscellaneous expenditures.

In interpreting these results, the presence of measurement errors in expenditure surveys needs to be acknowledged. Gibson (2002) found that the Engel estimates of household size economies are sensitive to the method used to collect household expenditure data. Gibson found that the household size economies estimated by Lanjouw and Ravallion for Pakistan was biased upwards by the use of recall data. This was due to the measurement errors in expenditures being correlated with household size. Most household expenditure surveys, including the Malaysian HES, are based on the combination of diary and recall methods.

Despite the limitation described above, this study contributes in validating Barten's model in estimating the household economies of scale.

REFERENCES

Aguiar, M. and E. Hurst (2007). Lifecycle Prices and Production, *American Economic Review*. 97: 1533-1559.

Barten, A.P. (1964). *Family Composition, Prices and Expenditure Patterns,* in: P.E. Hart, G. Mills, and J.K. Whitaker (eds.) Econometric Analysis for National Economic Planning. London: Butterworths.

Broda, C., E. Leibtag, and D.E. Weinstein (2009). The Role of Prices in Measuring the Poor's Living Standards, *Journal of Economic Perspectives*. 23: 77-97.

Deaton, A. (1997). *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy*. Baltimore: Johns Hopkins University Press.

Deaton, A., and J. Muellbauer (1980). *Economics and Consumer Behavior.* Cambridge: Cambridge University Press.

Deaton, A. and C. Paxson (1998). Economies of scale, Household Size and the Demand for Food, *Journal of Political Economy*. 106: 897-930.

Department of Statistics (2006). Report on Household Expenditure Survey Malaysia 2004/05. Putrajaya.

Economic Planning Unit (2006). Ninth Malaysia Plan 2006-2010. Putrajaya.

Gan, L. and V. Vernon (2003). Testing the Barten Model of Economies of Scale in Household Consumption: Toward Resolving a Paradox of Deaton and Paxson, *Journal of Political Economy*. 111: 1361-1377.

Gibson, J. (2002). Why does the Engel method work? Food demand, Economies of Scale and Household Survey Methods, *Oxford Bulletin of Economics and Statistics*. 64: 341-359.

Griffith, R., E. Leibtag, A. Leicester, and A. Nevo (2009). Consumer Shopping Behavior: How Much do Consumers Save?, *Journal of Economic Perspectives*. 23: 99-120.

Kakwani, N. and Z. Sajaia (2004). *New Poverty Thresholds for Russia*, Paper Presented at the Russia Poverty Project, Konobeevo Retreat, Russia, 24-26 June.

Kakwani, N. and H.H.Son (2005). Economies of Scale in Household Consumption: With Application to Australia, *Australian Economic Papers*. 44:134-148.

Lanjouw, P. and M. Ravallion (1995). Poverty and Household Size, *Economic Journal*. 105:1415-1434.

Lazear, E. and R. Michael (1980). Family Size and the Distribution of Per capita Income, *American Economic Review*. 70: 91-107.

Nelson, J.A. (1988). Household Economies of Scale in Consumption: Theory and Evidence, *Econometrica*. 56: 1301-1314.

Pradhan, M., A. Suryahadi, S. Sumarto, and L. Pritchett (2001). Eating like which 'Joneses?' An Interative Solution to the Choice of a Poverty Line 'Reference Group', *Review of Income and Wealth*. 47: 473-487.

Salcedo, A., T. Schoellman, and M. Tertilt (2009). Families as Roommates: Changes in U.S. Household Size from 1850 to 2000, NBER Working Paper No. 15477, Cambridge.

United Nations Development Programme (2007). *Malaysia: Measuring and Monitoring Poverty and Inequality*. Kuala Lumpur: UNDP.

Vernon, V. (2010). Marriage: For love, For money…and for time?, *Review of the Economics of the Household*. 8: 433-457

Zellner, A. (1962). An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias, *Journal of the American Statistical Association*. 57: 348-368.

APPENDIX

Table A1: IV Estimates of Food Engel Curve

Variable	Food in total expenditure		
	Aggregate sample	20th percentile	10th percentile
ln per capita expenditure	-0.16 (0.01)	-0.56 (0.17)	-0.68 (0.19)
ln household size	-0.07 (0.01)	-0.12 (0.03)	-0.15 (0.04)
Rm04	-0.03 (0.03)	0.03 (0.09)	-0.14 (0.13)
Rm59	-0.06 (0.02)	0.04 (0.08)	0.14 (0.14)
Rm1014	-0.05 (0.03)	0.16 (0.12)	-0.02 (0.12)
Rm1529	0.00 (0.02)	0.04 (0.07)	0.00 (0.11)
Rm3054	0.01 (0.02)	0.14 (0.10)	0.03 (0.12)
Rm55+	0.02 (0.03)	0.18 (0.11)	0.07 (0.19)
Rf04	-0.03 (0.02)	0.19 (0.11)	-0.10 (0.13)
Rf59	-0.06 (0.03)	-0.02 (0.10)	-0.07 (0.15)
Rf1014	-0.07 (0.03)	-0.01 (0.10)	-0.17 (0.15)
Rf1529	-0.01 (0.02)	0.06 (0.08)	0.10 (0.12)
Rf3054	0.02 (0.02)	0.05 (0.07)	-0.14 (0.12)
Adult employment	0.03 (0.01)	0.00 (0.03)	-0.10 (0.05)
Ethnic 1	-0.01 (0.01)	0.02 (0.02)	-0.00 (0.03)
Ethnic 2	0.04 (0.01)	0.06 (0.03)	0.04 (0.05)
Ethnic 3	0.01 (0.02)	0.03 (0.04)	0.05 (0.05)
State 1	-0.01 (0.01)	0.02 (0.03)	0.04 (0.04)
State 2	-0.04 (0.01)	-0.01 (0.03)	0.01 (0.03)
Area	0.02 (0.01)	0.02 (0.02)	0.05 (0.02)
Constant	1.43 (0.06)	3.37 (0.91)	4.02 (1.02)
R^2	0.30		
Durbin-Wu-Hausman $\chi^2_{(2)}$	38.98		
Hansen $\chi^2_{(1)}$	2.81		

Notes: Standard errors are in parentheses. Instruments for *ln* (PCE) are the average number of school years of adults in household and the age of the household head.

Table A2: Income and Marshallian Elasticities, 20th Percentile

Goods	w_i	ε_i	Marshallian elasticities with respect to age					
			0-5	6-14	15-17	18-24	25-64	65+
Food	0.43	0.66	0.04	0.02	0.01	0.03	0.08	0.01
		(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Clothing	0.04	1.10	0.04	0.07	0.022	0.07	-0.02	-0.02
		(0.09)	(0.03)	(0.04)	(0.02)	(0.02)	(0.06)	(0.01)
Housing	0.25	0.91	-0.05	-0.03	-0.01	-0.02	-0.06	0.02
		(0.06)	(0.01)	(0.02)	(0.01)	(0.01)	(0.05)	(0.01)
Furnishing	0.03	1.47	-0.00	-0.10	-0.04	0.03	-0.11	-0.00
		(0.09)	(0.04)	(0.05)	(0.02)	(0.02)	(0.08)	(0.02)
Medical	0.01	0.76	0.046	-0.07	0.05	-0.07	0.38	0.05
		(0.24)	(0.10)	(0.07)	(0.05)	(0.04)	(0.26)	(0.04)
Transport	0.08	1.83	-0.03	-0.07	-0.03	-0.05	-0.10	-0.05
		(0.10)	(0.03)	(0.05)	(0.02)	(0.02)	(0.08)	(0.02)
Communication	0.03	2.12	-0.13	-0.27	-0.06	-0.03	0.10	0.03
		(0.13)	(0.05)	(0.06)	(0.03)	(0.03)	(0.13)	(0.03)
Education	0.02	1.64	-0.11	0.35	0.15	-0.14	-0.19	-0.04
		(0.16)	(0.06)	(0.07)	(0.05)	(0.04)	(0.11)	(0.03)
Personal goods	0.07	1.46	-0.01	0.15	0.04	-0.04	-0.19	-0.04
		(0.09)	(0.03)	(0.04)	(0.02)	(0.02)	(0.06)	(0.01)
Miscellaneous	0.04	1.44	-0.04	-0.14	-0.05	-0.02	0.01	0.00
		(0.13)	(0.04)	(0.05)	(0.03)	(0.03)	(0.11)	(0.03)

Notes: Standard errors are in parentheses, computed from the bootstrap method.

Table A3: Income and Marshallian Elasticities, Top 20th Percentile

Goods	w_i	ε_i	Marshallian elasticities with respect to age					
			0-5	6-14	15-17	18-24	25-64	65+
Food	0.26	0.58	-0.00	0.01	0.00	0.02	0.14	0.01
		(0.03)	(0.00)	(0.01)	(0.00)	(0.01)	(0.03)	(0.01)
Clothing	0.03	0.68	0.00	0.03	0.00	0.06	0.09	-0.03
		(0.06)	(0.01)	(0.01)	(0.01)	(0.02)	(0.06)	(0.01)
Housing	0.23	0.91	-0.01	0.00	-0.01	-0.01	-0.08	0.02
		(0.06)	(0.01)	(0.01)	(0.01)	(0.02)	(0.04)	(0.01)
Furnishing	0.04	1.15	0.07	0.04	-0.02	-0.04	0.19	0.06
		(0.11)	(0.02)	(0.03)	(0.01)	(0.02)	(0.10)	(0.04)
Medical	0.02	1.05	0.03	-0.09	-0.02	-0.10	0.05	0.12
		(0.21)	(0.03)	(0.04)	(0.02)	(0.05)	(0.24)	(0.05)
Transport	0.18	1.52	0.03	-0.01	0.00	-0.01	-0.21	-0.04
		(0.10)	(0.01)	(0.02)	(0.01)	(0.02)	(0.08)	(0.01)
Communication	0.07	0.93	-0.03	-0.02	0.00	0.02	0.08	-0.01
		(0.06)	(0.01)	(0.01)	(0.01)	(0.02)	(0.05)	(0.01)
Education	0.02	2.28	-0.06	0.07	0.13	0.15	-0.45	-0.10
		(0.43)	(0.04)	(0.06)	(0.06)	(0.11)	(0.33)	(0.04)
Personal goods	0.08	1.21	-0.01	0.00	0.02	-0.00	0.10	-0.00
		(0.09)	(0.01)	(0.02)	(0.01)	(0.03)	(0.07)	(0.01)
Miscellaneous	0.08	1.02	-0.03	-0.04	-0.02	-0.02	0.06	-0.02
		(0.08)	(0.01)	(0.02)	(0.01)	(0.02)	(0.07)	(0.01)

Notes: Standard errors are in parentheses, computed from the bootstrap method.