ESTIMATING HOUSEHOLD ECONOMIES OF SCALE FOR THE POOR IN MALAYSIA

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Abstract

Despite the importance of economies of household size in poverty measurement, there is no consensus on the appropriate method to measure it. In the Malaysian context of poverty measurement, the adoption of household size economies is limited to the expenditure on housing. This paper aims to estimate the indices for household consumption goods, focus on the 10th and 20th percentile of the households' per capita expenditure from the Malaysian Household Expenditure Survey using the Barten model. The results show that the poor enjoy savings from a wider range of goods as compared to the richer households.

JEL Classifications: D1; D63; I31.

Keywords: Household size economies; Barten model; public goods; poverty measurement; Malaysia.

1. 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 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 percent lower in comparison with two households of single adult each, holding income constant. Sharing opportunities are observed in the costs of shelter, economizing services such as food preparation and savings from bulk purchases of food (see Deaton & Paxson, 1998; Griffith et al., 2009; Kakwani & Son, 2005; Nelson, 1988). 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 pass down amongst family members (Kakwani & Son, 2005). This could be viewed as savings which are essential for the poor 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 it due to its nature of complexity.

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 to in household size economies estimation due to its simplicity, using food share as welfare indicator of different sized households (Deaton & Muellbauer, 1980; Lanjouw & 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 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 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 had instigated several researches to further analyse the theoretical models and their underlying assumptions. Gan and Vernon (2003) (hereafter Gan-Vernon) 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 assumed that the household elasticities of substitution are zero, thus all households will have the same degrees of economies of scale for each goods (see Lanjouw & 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 it depends 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 had been limited in the official poverty measurement in Malaysia. The recent poverty line re-estimation had 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.

This paper aims to apply the models to explain and estimate the economies of scale for the households in Malaysia. This research adopts the methods proposed by Deaton-Paxson and Kakwani-Son using Barten's model, in comparison to Engel's method. This paper 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, using the estimated poverty lines.

This paper is organised as follows. Section 2 discusses the framework of the Engel and Barten model which forms the basis of this paper. Section 3 describes the data and methodology. The empirical results and implications of the estimated household scales on the headcount ratio are discussed in Section 4. Section 5 discusses and concludes.

2. Economies of Scale Models

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) had adopted the Engel method in their estimation of household economies of scale using a Working-Leser model as below:

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

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 $\alpha, \beta, \delta, \sigma$ 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. Household 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 the 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.

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 proposed a household consumption of two goods: food (q_f) and non-food, such as housing (q_h). The household size for the consumption of each good is $\phi_i(n)$.

The commodity-specific scale is assumed to be functional to family size and is measured as:

$$\sigma_i = 1 - \frac{\partial \ln \phi_i(n)}{\partial \ln n} \tag{2}$$

where σ_i is the scale elasticity for the ith good. It represents the degree of sharing amongst family members. If $\sigma_i = 0$, then $\phi_i = n$ to indicate that the good is a private good which could not be shared. If $\sigma_i = 1$, then $\phi_i = 1$ to indicate that the good is a public good.

The per capita food consumption function is derived from the first order conditions:

$$\frac{p_f q_f}{n} = \frac{p_f \phi_f(n)}{n} g_f\left[\frac{x}{n}, \frac{p_f \phi_f(n)}{n}, \frac{p_h \phi_h(n)}{n}\right] \tag{3}$$

where p_f and p_h are prices of food and non-food, respectively; x denotes household total expenditure; and $g_f(x, p_f, p_h)$ denotes the food consumption function for a single adult household. Differentiating (3) with respect to *ln(n)*, holding per capita expenditure (*x/n*) constant:

$$\sigma_h(\varepsilon_{fx} + \varepsilon_{ff}) - \sigma_f(1 + \varepsilon_{ff}) > 0 \tag{4}$$

where ε_{ff} and ε_{fx} are the own-price elasticity and income elasticity of food. Equation (4) indicates that the per capita food consumption will increase with household size. This will hold as long as non-food contains some public goods (so $\sigma_h \neq 0$); food is a normal private good which has limited substitutes (so ε_{ff} is small in absolute value); and food has less economies of scale than housing (so σ_f / σ_h is small). Gibson (2002) suggested that the increase of per capita food consumption and food budget shares with household size is strongest in lower income countries.

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

$$w_f = \alpha + \beta \ln(x/n) + \gamma \ln n + \sum_{r=1}^{R-1} \delta_r a_r + \eta.z + u \tag{5}$$

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 $\alpha, \beta, \gamma, \delta$ and η. The parameter $\hat{\gamma}$ is expected to be positive if condition (4) holds, as opposed to the Engel method. Notably, equation (5) 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 & 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 percent of all persons in different demographic categories requires the increase of less than λ percent of the cost or income to maintain the same level of utility as before for the ith 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 ($a_1, a_2, \ldots, a_R$) to be 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:

$$\phi_i^* = \varepsilon_i \phi^* + \theta_i + \sum_{j=1}^{n} \theta_j \varepsilon_{ij} \tag{6}$$

where ϕ_i^* denotes economies of scale for the ith 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 rth demographic (a_r) for the ith good; θ_j is the total elasticity of household composition (m) with respect to the number of person in the rth demographic (a_r) for the jth good; ε_{ij} is the Marshallian price elasticity of the ith good with respect to the price of the jth good. If ϕ_i^* <1, the ith good generates economies of scale to the household but if ϕ_i^* =1, the ith good does not generate economies of scale. If ϕ_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:

$$\eta_{ir} = \delta_{ir} + \sum_{j=1}^{n} \varepsilon_{ij} \delta_{jr} \tag{7}$$

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,

$$\phi_i = \theta_i + \sum_{j=1}^{n} \theta_j \varepsilon_{ij} \tag{8}$$

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

Substitute equation (8) into equation (6) gives:

$$\phi_i^* = \varepsilon_i \phi^* + \phi_i \quad (9)$$

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 *i*th good is unity for expenditure for medical and healthcare. Substituting the assumption into equation (9) 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 (9) for economies of scale estimation. Hence, ϕ_i^* for other individual goods would be estimated using equation (9). Kakwani-Son proved that 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:

$$w_i = \alpha_i + \beta_i \log x + \sum_{r=1}^{R} \gamma_{ir} a_r + \mu \quad (10)$$

where w_i is the budget share devoted to the *i*th good; x is the household total expenditure; a_r is the number of individuals with the *r*th characteristics in the household; and μ denotes the error term. Equation (10) can be estimated using Zellner's (1963) seemingly unrelated regressions procedure.

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

$$\varepsilon_i = 1 + \frac{\beta_i}{w_i} \quad (11)$$

$$\eta_{ir} = \frac{\gamma_{ir} a_r}{w_i} \quad (12)$$

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.

The Malaysia Method

Prior to 2005, Malaysia's poverty measurement was conducted without acknowledging the differences of costs of living between urban and rural areas and the presence of economies of scale in household consumption. The government had recently re-estimated the poverty line and acknowledged the importance of the economies of scale in household consumption in poverty measurement, but considered only the possibility of scale economies in housing. The estimation of scale economies was based on the rent paid by the *j*th household in Kuala Lumpur (KL) prices. Thus, the rents paid by household *j* in other areas are measured relative to that paid by households in KL. The model was:

$$X_{Hj} = \beta_H N_j^{\alpha} + \varepsilon_j \quad (13)$$

where X_{Hj} is the rent paid by the *j*th household in Kuala Lumpur (KL) prices; β_H denotes rent paid by a single person in poor household, in KL prices; N_j is the number of persons in the *j*th household; ε_j denotes the error term; and α denotes economies of scale. If α =1, then it is pure private goods where there is no scale economies. If α =0, then it is pure public goods where rent is independent of household size. The scale economies in housing estimated using equation (13) was 0.47.

While this method has the advantage of being simple, it requires the sample to include all household sizes and prices for non-food components. Two complications emerged from this method. Firstly, it is difficult to obtain the sample to represent each of the household sizes for every region and area. Consequently, the government had estimated the rent paid by single person (β_H) using the average rent paid by the lowest quintile ranked by the PCE of the survey. While this could be an appropriate proxy, this average value might not represent the poor's actual cost of housing due to the differences in costs of living. Secondly, the complications arising from the need for price information (rental) has been well argued by Kakwani and Son (2005). As non-food prices information is absent in most household expenditure surveys, the effort in matching the goods in the survey with market prices will increase the possibility of measurement errors. In addition, it is argued that individual households face different market prices for their consumption in comparison to the average market prices. Thus, the alternative method of estimating the economies of scale without the price information remains attractive.

Most importantly, the official estimation of household economies of scale indicated a weak justification on the possibility of scale economies of other consumption such as food and clothing. Previous research found the existence of significant economies of scale in the consumption of food, shelter, clothing, furnishing and transportation (Lazear & Michael, 1980; Nelson, 1988). While previous research proved that housing would have the highest degree of saving, not considering the possibility of other goods' savings would have resulted in inaccurate poverty measurement.

3. Methodology

In adopting the household scales in poverty measurement, the behaviour of the poor should be focused. 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. The main contribution of this paper is to estimate the household scales of the poor using the lowest PCE of the households. 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 et al., 2005). The official poverty rates of the country were 5.9 percent and 8.7 percent, using household-based and individual-based calculation, respectively in 2004 (UNDP, 2007). The selection of the 10th and 20th percentiles PCE households is based on the unweighted average of the PCE to contrast with the results of the aggregate sample size.

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 of 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 4,361 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 durables goods. Expenditure on food includes food consumed at and away from home. 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 (5) 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. Notably, *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), he 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, with the exception of the 20th percentile PCE using Kakwani-Son's model.[1] The models follow Deaton and Paxson (1998) weighted least squares linear regression, with weights inversely proportional to the sampling weight provided by the survey. The standard errors in Kakwani-Son's methodology are computed from the bootstrap.

Poverty Line Estimation

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 was 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.

We estimated the per capita poverty line for Malaysia to be RM 143.80 using specification proposed by Kakwani and Sajaia (2004). This poverty line is used as reference point. The food poverty line is constructed by multiplying the calorie cost of the respective reference groups by the calorie requirement per person, taking into consideration of the age and gender of the person in the household. The non-food poverty line is estimated based on household actual expenditure on items deemed essential for the poor. This includes clothing and footwear; housing; water, electricity and gas; furnishing and household equipment; health; transport; communication; and education. The poverty lines are shown in Table 8.

4. Empirical Results

Summary statistics is reported in Table 1. The poorest households which is represented by the 10th percentile household PCE spend almost 50 percent of their total expenditure on food. The expenditure on shelter which is classified as public good is about 22 and 23 percent of the total expenditure for the poorest two deciles.

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 percent 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. One plausible explanation could be due to savings from food preparation and congestion of the housing conditions which are prominent amongst the poor households in Malaysia.

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 10th, 20th percentiles and aggregate households respectively. 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. Following the interpretations of Lanjouw and Ravallion (1995) and Gibson (2002), 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

[1] IV estimates are suitable for the aggregate sample as the Durbin-Wu-Hausman test statistic of 38.98 is higher than the critical value of chi-squared at the 5 percent 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. However, Durbin-Wu-Hausman test suggests that the IV estimation is appropriate for the 20th percentile in Kakwani-Son's model.

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 -0.311, -0.256 and -0.191 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. However, due to its negative sign, the elasticity of food expenditure is not reliable.

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. The overall index of size economies (ϕ^*) are 0.71, 0.81 and 0.93 for the 10th, 20th percentile and aggregate households, respectively.[2] This shows that 29, 19 and 7 percent of total expenditure can be saved in the larger households of respective deciles without affecting their standards of living. The estimated size economies using the poorest two deciles are similar to the estimation produced by the Engel method using the Deaton-Paxson specification. As the higher income households are included in the estimation of size economies, the index gets larger. Further analysis of the 80th percentile households give the value of ϕ^* = 0.97, indicating only 3 percent of savings obtained with an additional member in the household. This concurs with the findings of Salcedo, et al. (2009) that suggests 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 degree of savings than for the top percentile PCE. The current housing cost provides the highest size economies for all households, except for the top percentile. Although food and clothing are usually regarded as privately consumed goods, our results indicate 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 percent for the poorest households in Malaysia. The household savings on food decreases with household expenditure. The 80th percentile displays a lower savings of 25 percent 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. The effect is also present for the top percentile. This corroborates the initial supposition that clothing could be passed down to family members. The effect disappeared 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 ϕ_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, 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, telephone bills, parking fees, 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 other 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.

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

[2] 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, 80th and 100th percentiles, respectively. The size economies for the 20th percentile do not seem robust under this specification.

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 (ϕ_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 to 6 show the income elasticities and the Marshallian elasticities with respect to household size and age for the poorest and richest deciles. 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 ε_i >1. For the poorest two deciles, goods such as food, housing and medication are viewed as necessities (0< ε_i <1). For the 80th percentile, 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 (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. Thus, the ϕ_i indices provide an alternative form to complement the poverty measurement.

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 as proposed by Kakwani-Son. According to this specification, 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 percent level of significance.[3] However, the ϕ_i^* are statistically significant at the 5 percent level of significance for the 10th percentile and aggregate sample.

One implication could be deduced from this result. This questions 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 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 percent 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.

The poverty measurements by household size displayed in Table 7. For all reference groups, the average per capita poverty lines in Table 7 decline monotonically with household size, as postulated by Kakwani-Son. Two reasons were offered to explain the phenomenon. 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. Thus, taking economies of scale into poverty line estimation will result in lower per capita poverty lines for larger households.

The per capita poverty lines show a decreasing trend with household size but the headcount ratio increases with household size. The poverty measurements appear to be sensitive to the methods used to estimate the economies of scale, as shown in 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 percent poverty rate. When the size economies estimated from the 10th percentile group with the Engel method is used (σ = 0.22), the smallest households have a percent poverty rate but the 8-person households have a poverty rate of 18 percent. The household size economies estimated from the

[3] 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 10th, 20th percentile and aggregate sample. These indices are higher than the indices estimated using the Engel method.

10th percentile PCE with the Kakwani-Son method produce a 2 percent poverty rate for the smallest households and a 17 percent poverty rate for the largest households. Using the size economies estimated from the 10th percentile group, the headcount ratios calculated from the Kakwani-Son and the Engel methods are similar. The government estimated the household size economies of housing at 0.474 (UNDP, 2007). The headcount ratios start to fall after the 4-person household for the government's official household size economies. Beyond the 4-person households, the headcount ratios for the official household size economies are the lowest. Thus, using this size economies in poverty measurement might have under-estimated the poverty rate in the country.

5. Conclusions

This chapter confirms Kakwani-Son's 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. The estimated household size economies for the poor are higher than the richer households using a common benchmark of analysis. The overall economies of scale indices proposed by Kakwani-Son produce similar size economies to the Engel method for the poorest two deciles reference groups, which result in a similar trend for headcount ratios. The results shown in the 10th percentile PCE household are robust, suggesting it should be used 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 are 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. It validates the theory postulated by Deaton-Paxson. 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 research 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 modest for the poor households. It also shows the presence of diseconomies of scale mainly for education. Adopting the specification to the entire sample indicates the presence of size economies in food, housing and miscellaneous expenditures. The economies of scales indices estimated for both sets of samples differ.

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. Hence, the interpretation of the index should be made with caution. Despite the limitation described above, this study contributes in validating Barten's model in estimating the household economies of scale.

Acknowledgements

I would like to acknowledge helpful comments received by my thesis supervisors, Paul Dalziel and Gillis Maclean. All views in this paper are those of the author and should not be attributed to the Ministry of Economic Development.

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Table 1. Descriptive of the data (according to PCE percentiles)

Variables	Aggregate sample		20th percentile		10th percentile	
	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Food share	0.362	0.137	0.454	0.137	0.489	0.144
ln food expenditure per capita	4.942	0.617	4.223	0.342	4.079	0.321
ln non-food expenditure per capita	5.558	0.906	4.394	0.610	4.083	0.667
ln PCE	6.039	0.736	5.058	0.295	4.837	0.249
ln household size	1.294	0.599	1.698	0.423	1.773	0.400
rm04	0.043	0.098	0.063	0.106	0.072	0.109
rm59	0.047	0.097	0.070	0.102	0.081	0.105
rm1014	0.046	0.099	0.070	0.111	0.069	0.108
rm1529	0.141	0.241	0.102	0.145	0.107	0.139
rm3054	0.162	0.189	0.136	0.117	0.135	0.123
rm55+	0.077	0.168	0.055	0.111	0.045	0.092
rf04	0.033	0.086	0.062	0.107	0.065	0.106
rf59	0.041	0.091	0.064	0.103	0.069	0.102
rf1014	0.040	0.090	0.057	0.092	0.056	0.089
rf1529	0.121	0.189	0.108	0.133	0.107	0.128
rf3054	0.165	0.170	0.146	0.114	0.145	0.116
rf55+	0.083	0.182	0.065	0.143	0.050	0.118
Adult earners ratio	0.448	0.362	0.286	0.225	0.281	0.218
School years of adults	8.65	3.492	6.92	3.087	6.53	3.149
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		
	10th percentile	20th percentile	Aggregate households
ln(n)	-0.152	-0.116	-0.069
	(0.04)	(0.03)	(0.01)
ln(PCE)	-0.676	-0.559	-0.162
	(0.19)	(0.17)	(0.01)
R^2			0.30
Size economies σ	0.22	0.21	0.43

Notes: The parameters are estimated using weighted least squares, with weights inversely proportional to the sampling weight in the survey.
Parentheses denote standard errors.

Table 3. Economies of scale indices

Goods	Top percentile		20th percentile		10th percentile		Aggregate sample	
	ϕ_i	ϕ_i^*	ϕ_i	ϕ_i^*	ϕ_i	ϕ_i^*	ϕ_i	ϕ_i^*
Food	0.183	0.747	0.186	0.724	0.187	0.665	0.178	0.808
	(0.037)	(0.025)	(0.035)	(0.025)	(0.053)	(0.037)	(0.012)	(0.011)
Clothing	0.158	0.813	0.156	1.049	0.029	0.924	0.207	1.00
	(0.084)	(0.060)	(0.117)	(0.072)	(0.173)	(0.114)	(0.031)	(0.031)
Housing	-0.095	0.786	-0.151	0.587	-0.155	0.539	-0.132	0.708
	(0.059)	(0.040)	(0.073)	(0.050)	(0.123)	(0.091)	(0.019)	(0.018)
Furnishing	0.299	1.412	-0.222	0.966	-0.414	0.582	0.059	1.254
	(0.131)	(0.109)	(0.116)	(0.087)	(0.178)	(0.120)	(0.042)	(0.047)
Medical	-0.019	1.00	0.382	1.00	0.356	1.00	-0.284	1.00
	(0.298)	(0.201)	(0.295)	(0.237)	(0.464)	(0.386)	(0.107)	(0.088)
Transport	-0.237	1.232	-0.321	1.161	-0.122	1.087	-0.198	1.275
	(0.101)	(0.062)	(0.124)	(0.079)	(0.175)	(0.116)	(0.034)	(0.028)
Communication	0.060	0.961	-0.366	1.348	-0.770	1.048	-0.182	1.024
	(0.065)	(0.045)	(0.197)	(0.145)	(0.395)	(0.272)	(0.036)	(0.039)
Education	-0.256	1.952	0.019	1.351	-0.136	1.119	-0.038	1.599
	(0.448)	(0.277)	(0.20)	(0.160)	(0.249)	(0.191)	(0.094)	(0.079)
Personal goods	0.101	1.273	-0.088	1.093	-0.067	0.940	0.122	1.284
	(0.091)	(0.074)	(0.112)	(0.065)	(0.189)	(0.113)	(0.029)	(0.029)
Miscellaneous	-0.075	0.916	-0.226	0.938	-0.478	0.570	-0.230	0.962
	(0.10)	(0.058)	(0.154)	(0.135)	(0.222)	(0.139)	(0.04)	(0.038)
Total ϕ^*		0.967		0.811		0.706		0.934
		(0.206)		(2.60)		(0.711)		(0.065)

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

Table 4. Marshallian elasticities and economies of scale indices, 10th percentile

Goods	ε_i	Marshallian elasticities with respect to age					
		0-5	**6-14**	**15-17**	**18-24**	**25-64**	**65+**
Food	0.676	0.046	0.031	0.008	0.027	0.071	0.005
	(0.049)	(0.015)	(0.017)	(0.007)	(0.008)	(0.034)	(0.005)
Clothing	1.268	0.012	0.027	0.019	0.047	-0.066	-0.011
	(0.132)	(0.044)	(0.058)	(0.026)	(0.029)	(0.09)	(0.015)
Housing	0.983	-0.054	-0.053	-0.011	-0.017	-0.027	0.006
	(0.109)	(0.032)	(0.04)	(0.016)	(0.018)	(0.088)	(0.011)
Furnishing	1.410	-0.029	-0.086	-0.057	0.013	-0.238	-0.017
	(0.149)	(0.055)	(0.07)	(0.03)	(0.034)	(0.088)	(0.019)
Medical	0.913	0.058	-0.097	0.018	-0.129	0.508	-0.001
	(0.309)	(0.233)	(0.122)	(0.089)	(0.078)	(0.380)	(0.06)
Transport	1.711	-0.034	-0.017	-0.004	-0.064	0.012	-0.015
	(0.144)	(0.048)	(0.071)	(0.028)	(0.027)	(0.102)	(0.024)
Communication	2.574	-0.169	-0.498	-0.024	-0.095	-0.037	0.053
	(0.274)	(0.106)	(0.148)	(0.05)	(0.058)	(0.246)	(0.047)
Education	1.777	-0.006	0.216	0.177	-0.186	-0.297	-0.041
	(0.218)	(0.095)	(0.120)	(0.062)	(0.048)	(0.127)	(0.022)
Personal goods	1.426	-0.017	0.194	0.01	-0.015	-0.214	-0.026
	(0.166)	(0.046)	(0.072)	(0.028)	(0.027)	(0.082)	(0.015)
Miscellaneous	1.483	-0.090	-0.156	-0.076	-0.029	-0.117	-0.009
	(0.192)	(0.059)	(0.082)	(0.031)	(0.041)	(0.137)	(0.03)
Total	0.706						
	(1.935)						

Notes: See Table 3.

Table 5. Marshallian elasticities and economies of scale indices, 20th percentile

Goods	ε_i	Marshallian elasticities with respect to age					
		0-5	6-14	15-17	18-24	25-64	65+
Food	0.663	0.044	0.023	0.009	0.027	0.078	0.005
	(0.03)	(0.009)	(0.011)	(0.005)	(0.006)	(0.023)	(0.005)
Clothing	1.103	0.038	0.068	0.022	0.069	-0.022	-0.019
	(0.088)	(0.029)	(0.038)	(0.018)	(0.02)	(0.062)	(0.013)
Housing	0.911	-0.051	-0.025	-0.014	-0.023	-0.057	0.018
	(0.06)	(0.017)	(0.023)	(0.01)	(0.011)	(0.051)	(0.009)
Furnishing	1.467	-0.001	-0.103	-0.037	0.03	-0.107	-0.004
	(0.095)	(0.035)	(0.049)	(0.021)	(0.024)	(0.075)	(0.018)
Medical	0.763	0.046	-0.068	0.046	-0.065	0.375	0.048
	(0.241)	(0.10)	(0.074)	(0.049)	(0.041)	(0.263)	(0.042)
Transport	1.829	-0.033	-0.066	-0.025	-0.054	-0.097	-0.046
	(0.099)	(0.031)	(0.047)	(0.02)	(0.02)	(0.075)	(0.017)
Communication	2.115	-0.138	-0.274	-0.055	-0.03	0.101	0.029
	(0.126)	(0.05)	(0.062)	(0.03)	(0.031)	(0.134)	(0.027)
Education	1.643	-0.108	0.350	0.149	-0.143	-0.185	-0.044
	(0.157)	(0.06)	(0.066)	(0.046)	(0.036)	(0.112)	(0.03)
Personal goods	1.456	-0.009	0.148	0.037	-0.035	-0.194	-0.036
	(0.094)	(0.027)	(0.043)	(0.02)	(0.017)	(0.055)	(0.013)
Miscellaneous	1.436	-0.035	-0.136	-0.051	-0.016	0.012	0.002
	(0.125)	(0.038)	(0.053)	(0.028)	(0.028)	(0.112)	(0.026)
Total	0.811						
	(5.993)						

Notes: See Table 3.

Table 6. Marshallian elasticities and economies of scale indices, top percentile

Goods	ε_i	Marshallian elasticities with respect to age					
		0-5	6-14	15-17	18-24	25-64	65+
Food	0.582	-0.002	0.014	0.004	0.019	0.136	0.012
	(0.030)	(0.004)	(0.007)	(0.003)	(0.008)	(0.028)	(0.005)
Clothing	0.676	0.003	0.033	0.000	0.061	0.088	-0.026
	(0.061)	(0.008)	(0.012)	(0.008)	(0.024)	(0.062)	(0.008)
Housing	0.909	-0.014	0.003	-0.011	-0.014	-0.077	0.019
	(0.058)	(0.007)	(0.010)	(0.006)	(0.017)	(0.042)	(0.007)
Furnishing	1.15	0.068	0.044	-0.022	-0.043	0.189	0.064
	(0.107)	(0.023)	(0.026)	(0.014)	(0.024)	(0.098)	(0.035)
Medical	1.053	0.033	-0.095	-0.018	-0.102	0.048	0.115
	(0.206)	(0.033)	(0.035)	(0.017)	(0.052)	(0.243)	(0.045)
Transport	1.518	0.033	-0.012	0.003	-0.014	-0.210	-0.037
	(0.096)	(0.014)	(0.018)	(0.012)	(0.022)	(0.075)	(0.009)
Communication	0.931	-0.025	-0.016	0.004	0.022	0.081	-0.007
	(0.056)	(0.007)	(0.011)	(0.007)	(0.016)	(0.048)	(0.009)
Education	2.281	-0.059	0.072	0.130	0.154	-0.452	-0.101
	(0.428)	(0.041)	(0.062)	(0.056)	(0.111)	(0.33)	(0.037)
Personal goods	1.211	-0.013	0.002	0.019	-0.001	0.096	-0.003
	(0.093)	(0.011)	(0.021)	(0.012)	(0.030)	(0.067)	(0.013)
Miscellaneous	1.024	-0.030	-0.039	-0.021	-0.018	0.055	-0.022
	(0.082)	(0.011)	(0.016)	(0.009)	(0.021)	(0.072)	(0.010)
Total	0.967						
	(0.206)						

Notes: See Table 3.

Table 7. Poverty line per capita by household size for different methods

Hh size	Kakwani-Son [1]		No EOS		Engel method[2]		Engel method[3]		M'sia method[4]	
	PL	Headcount	PL	Headcount	PL	Headcount	PL	Headcount	PL	Headcount
1	223.23	0.017	143.80	0.00	198.01	0.009	262.30	0.026	295.65	0.045
2	179.20	0.019	143.80	0.006	170.00	0.015	194.70	0.027	205.32	0.039
3	158.18	0.048	143.80	0.038	155.50	0.046	163.54	0.051	165.89	0.052
4	145.05	0.034	143.80	0.031	146.00	0.035	144.51	0.034	142.59	0.029
5	135.77	0.054	143.80	0.061	139.0	0.057	131.30	0.044	126.80	0.033
6	128.72	0.069	143.80	0.082	133.51	0.071	121.40	0.062	115.21	0.057
7	123.12	0.134	143.80	0.195	129.05	0.148	113.60	0.061	106.23	0.058
8 ≥	118.51	0.165	143.80	0.266	125.32	0.176	107.26	0.111	99.03	0.075
Mean	143.80	0.102	143.80	0.102	143.80	0.102	143.80	0.102	143.80	0.102

Notes: Headcount ratios are calculated using the population weights of the survey.

[1] 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.

[2] estimates are based on the σ from the 10th percentile PCE.

[3] estimates are based on the σ from the aggregate households.

[4] estimates are based on the Malaysia's estimates of household economies of scale for housing (0.474).

Table 8. Poverty lines using 10th percentile PCE

Region / Area	Poverty line
Peninsular Malaysia Urban	142.33
Peninsular Malaysia Rural	145.95
Sabah Urban	150.65
Sabah Rural	121.38
Sarawak Urban	186.29
Sarawak Rural	166.40
Malaysia Urban	149.15
Malaysian Rural	144.84
Malaysia	143.80

Notes: Parentheses denotes the standard errors.
* significant at 1% level of significance. The ranking is from lowest to the highest: 1=the lowest poverty incidence and 6=the highest poverty incidence.
Source: Authors' calculations from the HES.

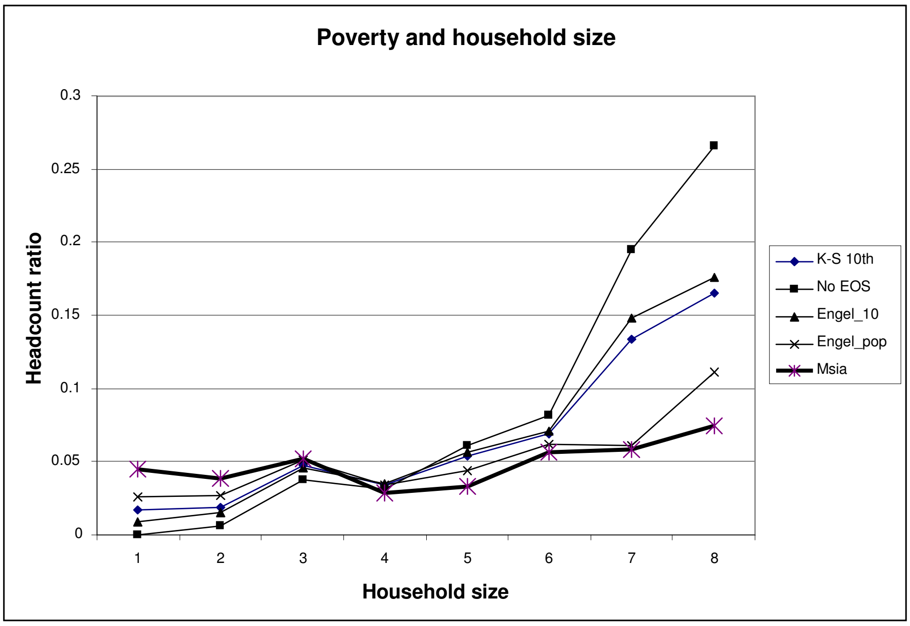

Figure 1: Poverty and household size