The Demand for Meats in Indonesia: A Censored Regression Approach

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Abstract

In this study, meat consumption and socio-demographic data from the 1990, 1993 and 1996 SUSENAS Household Food Expenditure and Consumption Surveys were employed to estimate the demand for meats in Indonesia. The provinces of DKI Jakarta and West Java were chosen as the areas of study because of the population, level of meat consumption and the availability and quality of information in these two provinces.

Several statistical and econometric procedures were performed. Firstly, a cluster analysis (Nicol, 1991) was used to aggregate the 16 meat types recorded in the SUSENAS into four Meat Groups (MG-1, 2, 3 and 4). Secondly, a double truncation procedure was used to estimate the linear approximation of the Almost Ideal Demand System (LA/AIDS) because of the large number of zero observations in the data as well as the fact that budget shares lie between zero and one. It is expected that the results of the study are more robust than previous censored regression approaches which only considered one-sided truncation at zero.

The estimated expenditure elasticities show that MG-1 (with the dominant meat, beef) and MG-3 (with the dominant meat, untrimmed bones) are income-inelastic, whereas MG-2 (with the dominant meat, commercial and native chicken) and MG-4 (with the dominant meat, beef liver) are income-elastic. The estimated uncompensated own-price elasticities are negative, as suggested by economic theory. The estimated own-price elasticity of MG-1 is -0.92, therefore, it is inelastic whereas MG-2, 3, and 4 have elastic estimated own price elasticities, -1.09, -1.16 and -1.03 respectively. The estimated uncompensated cross-price elasticities suggest that all the meat groups tend to be substitute goods as expected.

Keywords: censoring, cluster analysis, cross-sectional data, linearised AIDS.

I. Introduction

As a result of economic development during the last 25 years, Indonesia's food consumption patterns have changed considerably. Between 1976 and 1996, the prepared food share in total food expenditure increased by 11 per cent in urban areas and 8 per cent in rural areas. The share of cereals, on the other hand, decreased 13 per cent in urban areas and 16 per cent in rural areas. Since 1993, the prepared food share has been higher than the cereal share in the total food expenditure of urban consumers (CBS, 1998).

Over the last 25 years period, consumers food share in urban areas reduced faster than in rural areas. In 1970, both urban and rural consumers spent about 80 per cent of their total expenditure on food and non-food items. In 1996, only 48 per cent of the total expenditure of urban consumers was spent on food whereas their counterparts in rural areas spent more than 63 per cent. Incomes in Indonesia will increase in the years to come, and coupled with a population of more than 200 million with an annual growth rate of 1.6 per cent, the demand for meats in Indonesia will increase substantially in the near future (CBS, 1998).

Indonesian economic performance has been depressed during the recent Asian crisis, although the latest macroeconomic indicators show some promising results. Once the country recovers from the current recession, the economy will grow to a level that will induce greater consumption of goods and services. This is likely to cause a major transformation in Indonesian diets as consumers allocate an increasing proportion of their food expenditures to processed products and to livestock products such as meat, milk and eggs. This, in turn, will influence food and price policies as well as projections of demand for meats. In the first instance meat demand parameters are considered to be the most important. It is also expected that the results of this study can aid in the formulation of the next five year Development Plans which will start in the year 2000, particularly in the livestock/agricultural sectors.

In Australia, meat demand has been studied intensively (Main *et al*. 1976; Fisher 1979; Murray 1984; Chalfant and Alston 1986; Beggs 1988; Cashin 1991; Hutasuhut 1995). By contrast, interest in this field is relatively recent in Indonesia. The main constraint to such studies is the availability of data. With more refined methods of analysis and advances in computing facilities and expansion of data, it is expected that this area of study will make a more significant contribution to policy decision-making processes in the near future.

Therefore, the main concern of this study is to produce more reliable demand parameter estimates of meat in Indonesia for policy analysis and for future planning purposes. More precise income elasticities of various meat groups, for example, will predict better the amount of particular meat demanded in the next development stages.

The cross-sectional data available are from the National Socio-Economic Survey (*Survei Sosial Ekonomi Nasional)* or SUSENAS. It is a household survey conducted annually by the Central Board of Statistic (CBS). The food consumption and expenditure module of SUSENAS is conducted every three years. To overcome low price variations in the cross-sectional data, several SUSENAS surveys may need to be combined to estimate elasticities of meat demand in Indonesia. By doing so, it is expected that price variations will be more adequately captured over time. For the Indonesian case, only 1990, 1993 and 1996 SUSENAS data can be combined since they have similar data structures.

Then, because of the large number of zero observations in the SUSENAS data set, a double truncation procedure can be developed which ensures that the budget shares (dependent variables) of the linearised Almost Ideal Demand System lie between zero and one. It is expected that the results of the study will be more robust than previous censored regression approaches which only considered truncation at zero. As far as the authors are aware, this model has not been reported by others.

II. Specification and estimation of the demand function

A. LA/AIDS model, truncated both at zero and one

In the following section, a method is developed where the dependent variables are budget shares which implies that the dependent variables can only take values between 0 and 1. Many authors including Heien and Wessells (1990) have truncated from below. In other words, they censored the unobserved consumption into a zero value but did not make any attempt to take account of the fact that the maximum values of the dependent variables can not exceed one. Their method, is biased and inconsistent (Shonkwiler and Yen, 1999).

Let the empirical version of the LA/AIDS model be written as:

(1) $w_{it} = x_t\gamma_i + u_{it}$,

where $u_{it} \sim N(0, \sigma_i^2)$ and the other variables are defined as:

w_i is a vector of budget shares (independent variables);
x_t is a matrix of explanatory variables; and
γ_i is a vector of coefficients.

The mean and variance of equation (1) are:

(2) $E\{w_{it}\} = x_t\gamma_i$,

(3) $Var(w_{it}) = \sigma_i^2$.

The observed budget shares cannot take on negative values or be greater than unity, meaning the dependent variable is censored. Specifically, we observe:

(4) $$y_{it} = \begin{cases} 0 \text{ if } w_{it} < 0 \\ 1 \text{ if } w_{it} > 1 \\ w_{it} \text{ otherwise} \end{cases}$$

Let ϕ (z) and Φ (z) denote the probability density function (pdf) and cumulative distribution function (cdf) of a standard normal random variable, respectively. Then, Maddala (1983, p.366) shows that the expected value of X where the values of X less than the point a (or 0) and greater than the point b (or 1) are removed is:

(5) $$E\{X \mid a<X<b\} = \mu + \sigma \frac{\phi(a-\mu/\sigma) - \phi((b-\mu/\sigma)}{\Phi((b-\mu/\sigma) - \Phi((a-\mu/\sigma)}$$

In the present context:

(6) $$E\{y_{it} \mid 0<y_{it}<1\} = E\{w_{it} \mid 0<w_{it}<1\}$$

$$= x_t\gamma_i + \sigma_i \frac{\phi(-x_t\gamma_i/\sigma_i) - \phi((1-x_t\gamma_i)/\sigma_i)}{\Phi((1-x_t\gamma_i)/\sigma_i) - \Phi(-x_t\gamma_i/\sigma_i)} \quad \text{or}$$

(7) $$E(y_{it} \mid 0<y_{it}<1) = x_t\gamma_i + \sigma_i \frac{f_{it} - g_{it}}{G_{it} - F_{it}} \ ,$$

where the definitions of f_{it}, g_{it}, F_{it} and G_{it} are defined based on equation (6) as:

(8) $$f_{it} = \phi(-x_t\gamma_i/\sigma_i)$$

(9) $$g_i = \phi((1-x_t\gamma_i)/\sigma_i)$$

(10) $$F_{it} = \Phi(-x_t\gamma_i/\sigma_i)$$

(11) $$G_{it} = \Phi((1-x_t\gamma_i)/\sigma_i)$$

Moreover, the unconditional expectation of y_{it} is:

(12) $$E\{y_{it}\} = E\{y_{it} \mid y_{it} \le 0) P(y_{it} \le 0\} + E\{y_{it} \mid 0< y_{it}<1\} P\{0< y_{it}<1\} + E\{y_{it} \mid y_{it} \ge 1\} P\{y_{it} \ge 1\}$$

$$= E\{y_{it} \mid 0< y_{it}<1\} P\{0< y_{it}<1\} + P\{y_{it} \ge 1\},$$

$$= [x_t\gamma_i + \sigma_i \frac{f_{it} - g_{it}}{G_{it} - F_{it}}] (G_{it}-F_{it}) + (1-G_{it}), \quad \text{or}$$

(13) $$E\{y_{it}\} = (G_{it}-F_{it})\, x_t\gamma_i + \sigma_i(f_{it}-g_{it}) + (1-G_{it}) \,.$$

Equation (7) expresses the correct relationship between the mean of y_{it} and the explanatory variables when all the 0's and 1's are removed from the data set. Equation (13) expresses the correct relationship between the mean of y_{it} and the explanatory variables when all observations are used in the data set.

Equation (13) could not be directly estimated, thus a further mathematical manipulation is needed. Let us define $u_{it} = y_{it} - E(y_{it})$, first where it is assumed that the error term has a normal distribution. Then, the empirical version of the i^{th} equation is:

$$(14)\quad (y_{it}-1+G_{it}) = (G_{it}-F_{it}) [\, \alpha_i + \sum_{i=1}^{N} \gamma_{ij} \ln (p_{jt}) + \beta_i \ln (Y_t/P^*)] + \sigma_i (f_{it}-g_{it}) + u_{it}$$

or

$$(15)\quad (y_{it}-1+G_{it}) = \alpha_i (G_{it}-F_{it}) + \sum_{i=1}^{N} \gamma_{ij} (G_{it}-F_{it}) \ln (p_{jt}) + \beta_i (G_{it}-F_{it}) \ln (Y_t/P^*) + \sigma_i (f_{it}-g_{it}) + u_{it}$$

Summing both sides over *i*:

$$(16)\quad \sum_{i=1}^{N} (y_{it}-1+G_{it}) = \sum_{i=1}^{N} \alpha_i (G_{it}-F_{it}) + \sum_{j=1}^{N} \sum_{i=1}^{N} \gamma_{ij} (G_{it}-F_{it}) \ln (p_{jt}) + \sum_{i=1}^{N} \beta_i (G_{it}-F_{it}) \ln(Y_t/P^*) + \sum_{i=1}^{N} \sigma_i (f_{it}-g_{it}) + \sum_{i=1}^{N} u_{it}$$

or

$$(17)\quad \sum_{i=1}^{N} u_{it} = 1 - N + \sum_{i=1}^{N} G_{it} - \sum_{i=1}^{N} \alpha_i (G_{it}-F_{it}) - \sum_{j=1}^{N} \sum_{i=1}^{N} \gamma_{ij} (G_{it}-F_{it}) \ln (p_{jt}) - \sum_{i=1}^{N} \beta_i (G_{it}-F_{it}) \ln (Y_t/P^*) - \sum_{i=1}^{N} \sigma_i (f_{it}-g_{it})$$

Thus, the system of equations given by equation (14) are required to satisfy the adding-up condition. By implication, the variance-covariance matrix of the u_{it} should be non-singular. Further, if f_{it}, g_{it}, F_{it} and G_{it} were known, the equation (14) could be estimated by Generalised Least Square (GLS) within the usual SUR framework.

A two-stage estimation procedure was applied to equation (14):

Step 1: Estimate (1) using restricted SUR and calculate f_{it}, g_{it}, F_{it} and G_{it}.

Step 2: Estimate (14) using restricted SUR and estimated f_{it}, g_{it}, F_{it} and G_{it} from Step 1.

B. Demographic translating

The AIDS and LA/AIDS models as proposed by Deaton and Muellbauer (1980) do not consider demographic variables. However, there are basically two ways to incorporate demographic variables into a demand system - demographic scaling and translating (Pollak and Wales, 1981). Translation preserves the linearity of the system, whereas scaling is a highly non-linear specification. Heien and Pompelli (1988) applied the translation procedure to the LA/AIDS in estimating the demand for US beef. The socio-demographic effects are incorporated in the models by allowing the intercept in (14) to be a function of demographic variables. That is,

$$(18) \qquad \alpha_i = \rho_{io} + \sum_{j=1}^{S} \rho_{ij} \; d_j \qquad\qquad i = 1, ...N.$$

where d_j is the j^{th} demographic variable. Included in the demographic variables are years, provinces and location (rural and urban). With translation, the LA/AIDS model now becomes:

$$(19) \qquad (y_{it}\text{-}1\text{+}G_{it}) = \alpha_i^* \; (G_{it}\text{-}F_{it}) + \sum_{i=1}^{N} \gamma_{ij} \; (G_{it}\text{-}F_{it}) \ln (p_{jt}) + \beta_i \; (G_{it}\text{-}F_{it}) \ln (Y_t/P^*)$$
$$+ \sum_{j=1}^{S} \rho_{ij} \; (G_{it}\text{-}F_{it}) \; d_j + \sigma_i \; (f_{it}\text{-}g_{it}) + u_{it}$$

where $\alpha_i^* = \alpha_i + \rho_{io}$ and ρ_{io} is the intercept of demographic variables.

III. Data

A. Data aggregation

This section describes how the 16 individual meat types recorded in the SUSENAS data are grouped into a smaller and more manageable data set. The way in which the grouping is conducted is very important as Nicol (1991) noted that inappropriate aggregation of expenditures into a limited number of categories could influence subsequent demand estimation and test results. The “Stochastic Hicksian Aggregates” (SHA) technique which aggregates goods with relative prices constant up to a random element will be applied (Nicol, 1991).

Cluster analysis is used to find the grouping of goods which “best” reflect SHA. Since SHA requires that relative prices should be constant up to a random element then a distance measure for cluster analysis that will reflect the constancy of relative prices has to be chosen. The way in which the distance measure is computed is describe in Nicol (1991, p. 409). For illustrative purposes the description is repeated here.

Suppose p_j and p_k are relative prices of commodity j and k where $j \neq k = 1, ..., M$. Denote the relative price ratio at observation t as $\phi_{jkt} = p_{jt} / p_{kt}$. Constant ϕ_{jkt} is denoted by ϕ_{jk}. According to Nicol (1991), the variability of ϕ_{jkt} about their sample mean will depend on how relative prices vary in the population, therefore, constant ϕ_{jkt} are unlikely to be observed since these are realisations of a random variable.

Nicol (1991) proposed that the first step to test for statistically significant deviation from constancy of ϕ_{jkt} is to split observations (samples) in two parts and compute alternative estimates of the sample mean. A t statistic is used to test for significant differences in population means. For two commodities j and k where $\phi_{jk,1}$ and $\sigma^2_{jk,1}$ are the population means and variances respectively of the sub-samples, $l = 1, 2$, the t statistic can be computed as follow:

$$(24) \qquad t_{jk} = \frac{\left(\bar{\phi}_{jk,1} - \bar{\phi}_{jk,2}\right)}{\left(S_p^2/n_1 + S_p^2/n_2\right)^{0.5}} \quad \sim \quad t(n_1 + n_2 - 2)$$

where

$$\bar{\phi}_{jk,l} = (1/n_l)\sum_{t}^{nl} \phi_{jkt}$$

$$S_p^2 = \left\{(n_1 - 1)\cdot S_{jk,1}^2 + (n_2 - 1)\cdot S_{jk,2}^2\right\} / (n_1 + n_2 - 2)$$

$$S_{jk,l}^2 = 1/(n_l - 1)\sum_{t}^{nl}\left(\phi_{jkt} - \bar{\phi}_{jk,l}\right)^2$$

and l = 1, 2 are the two sub-sample sizes

The null hypothesis to be tested is $H_o : \phi_{jk,1} = \phi_{jk,2}$ which implies a constant relative price, ϕ_{jk}, for all $j \neq k$. The above t statistic is the standard test statistic for significant differences in population means. In this case, under H_o, the difference is zero when the population variances, $\sigma_{jk,l}^2$, $l = 1, 2$, are identical.

In theory the t_{jk} can be computed for any sample. Large positive and negative deviations of t_{jk} are viewed symmetrically as reflecting statistically significant deviations from constancy of ϕ_{jkt}. Therefore goods or commodities with relatively low t_{jk} will be grouped in the same category.

The 16 meat types are grouped by cluster analysis into more manageable commodity groups by using prices faced by households as the "cases". The first step is to find the distance matrix or t matrix by applying equation (24) to the sample data. The first problem that arises in this computation is that not all the pairs of commodities have enough observations to compute the t_{jk} values. In Table 1, is shown the number of observations in each pair of commodities. Some of the cells in the table consist of zero, one or a small number. These observations will not be enough to compute t_{jk} values with confidence. Previously, wherever the values in Table 1 are 0, 1 and 2, a high value was imputed into the t matrix to ensure that the two commodities with less chance to be consumed by a household at the same time will not be in a same group. However, it was realised that a small number in the intersection of two commodities in Table 1 does not mean that they have to be put in different categories. The problem is that there is not enough information to evaluate whether or not they have to be in the same or different meat group. Moreover, equation (20) can be directly applied when there is no missing observations in Table 1.

To avoid this complication another way to approximate the t values is proposed. Given that most observations were obtained from urban areas, relative prices of the 16 individual meat types in urban West Java and DKI Jakarta were used to compute price ratios in 1990 and 1996. First, price ratios of meat type j and k where $j \neq k = 1, ..., 16$ were computed for urban West Java in 1990. The same price ratios were also computed for the 16 meat types for the same year in DKI Jakarta. Then, average price ratios for 1990 in urban West Java and DKI Jakarta were obtained. The same procedure was used to obtain price ratios and its average for the same regions in 1996. These price ratios and their averages were then used to compute *t* values using equation (20) where $l = 1,2$ and $n_1 = n_2 = 2$. The *t* matrix (distance matrix) from this computation is shown in Table 2. It is then inputted into a computer software program MINITAB Release 12.0 (MINITAB, 1999) which uses the agglomerative hierarchical method for further clustering analysis. The cluster observation (CLUOBS) command with Euclidean and Ward linkage options of MINITAB were chosen to generate the end results.

The dendrogram for the 16 individual meat prices can be seen in Figure 1. Numbers along the horizontal axis are codes for disaggregate meat types and their definition can be seen in Table 4. Along the vertical axis are distance measures or similarity levels. Similarity is 100 when distance equals 0. When the distance between two commodities becomes larger, the similarity level will be smaller and *vice versa*. The final partition is obtained by placing a horizontal line across the graph at distance equal to 3.29. Nicol (1991, p. 410) argues that "the probability of observing fusion coefficients greater than 3.29 is approximately 0.001. This means that members of any cluster will be within about three standards deviation of one another when clustering ceases".

Another way to determine the final grouping of clusters is by observing the similarity and distance levels as listed in Table 3. The pattern of how these values change with the clustering steps can help analysts choose the final grouping. For example, if the similarity level changes by about the same magnitude for a series of steps, then changes by a noticeably different amount at the next step, this might be an indication that a final grouping consisting of the number of cluster at or near that step. In the case of the similarity levels in Table 3, it seems that there is no a clear clue when the final partition took place. After experimentation with several choices of distance measures and linkage methods, it was decided to cut the graph in Figure 1 at distance equal 3.29 to generate the final grouping. At the end, there are only four Meat Groupings (MG-1, 2, 3 and 4) from the initial 16 disaggregate meat types. Initial and final meat groupings can be seen in Table 4. Finally, after the aggregation process, the number of observations with the four meat groups that can be used for further estimation purposes are 8,168.

MG-1 comprises beef, buffalo meat and trimmings and accounts for 31 per cent of the total meat expenditure (Table 5). Beef is the dominant individual meat type. In Indonesia beef and buffalo meat, from a consumer point of view, is virtually the same, both in appearance and in the way the Indonesian people cook these two kinds of meats. Therefore, the results are consistent with prior expectations.

MG-2 comprises commercial and native chicken meats, goat/sheep meat, other fresh meat, dried meat, innards excluding liver and other offal. MG-2 accounts for the majority of total meat expenditure of the respondents, i.e. 65 per cent. The dominant meats are commercial and native chicken meats.

Table 1: Number of households (observations) which consumed the corresponding meat types

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	
2683	12	46	1416	350	5	11	40	221	38	20	355	91	361	91	20	**1**
	285	3	107	18	2	0	4	15	6	8	19	13	23	12	0	**2**
		266	80	42	1	1	7	15	4	0	26	10	19	13	2	**3**
			5043	105	3	10	62	331	53	25	502	174	645	145	37	**4**
				1396	3	5	15	101	10	6	131	42	107	38	4	**5**
					41	1	0	1	1	0	4	0	2	0	1	**6**
						41	0	1	1	2	3	3	3	0	2	**7**
							88	17	7	4	21	5	19	6	0	**8**
								560	22	6	125	38	93	25	7	**9**
									83	3	18	5	11	5	0	**10**
										46	11	2	7	2	1	**11**
											779	49	134	39	11	**12**
												282	35	15	3	**13**
													1182	76	5	**14**
														263	0	**15**
															61	**16**

Notes:

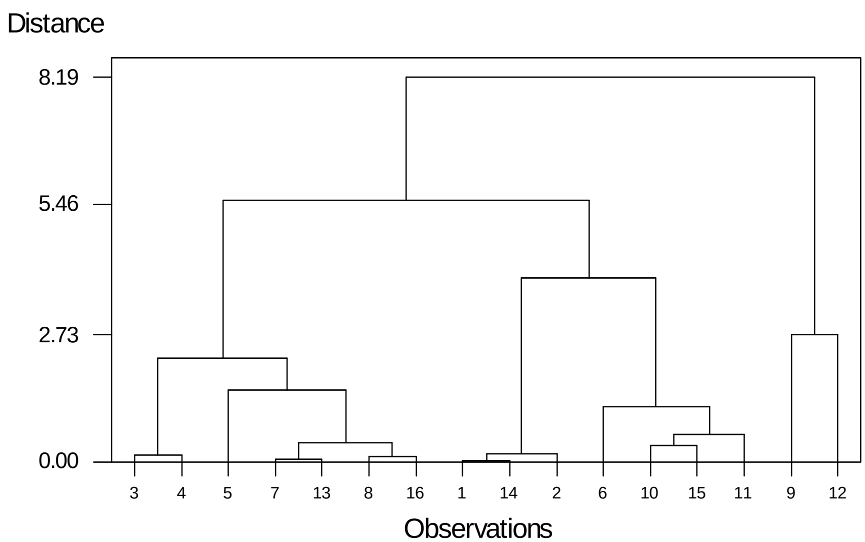
Number 1 to 16 along the first row and last column are codes for disaggregate meat types and their definition can be seen in Table 4.
Numbers along the diagonal (inside boxes) are the number of households that reported their consumption on that particular meat.

Table 2: Distance matrix (t-values) of average prices in DKI Jakarta and urban West Java between 1990 and 1996

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	0	0.140	4.261	2.053	1.809	2.097	0.202	2.596	6.294	0.968	0.971	5.536	2.486	0.020	1.372	0.902
2	0.140	0	1.835	0.796	0.837	2.215	0.265	1.612	4.275	0.977	1.001	2.815	2.439	0.134	2.230	0.786
3	4.261	1.835	0	0.146	2.095	3.099	0.370	1.393	4.675	0.987	1.021	3.185	1.376	1.065	2.413	0.566
4	2.053	0.796	0.146	0	0.687	2.668	0.352	1.901	5.963	0.981	0.999	9.229	0.818	1.121	1.616	0.602
5	1.809	0.837	2.095	0.687	0	3.124	0.308	1.542	4.269	0.978	0.997	3.259	1.502	0.806	2.130	0.750
6	2.097	2.215	3.099	2.668	3.124	0	0.529	1.765	2.558	0.885	0.759	2.316	1.968	2.703	1.150	4.204
7	0.202	0.265	0.370	0.352	0.308	0.529	0	0.133	0.982	0.953	0.904	0.481	0.040	0.348	0.670	0.515
8	2.596	1.612	1.393	1.901	1.542	1.765	0.133	0	9.051	1.008	1.070	2.869	0.245	1.605	2.175	0.110
9	6.294	4.275	4.675	5.963	4.269	2.558	0.982	9.051	0	1.073	1.249	2.719	7.613	3.762	6.645	1.092
10	0.968	0.977	0.987	0.981	0.978	0.885	0.953	1.008	1.073	0	0.589	1.415	1.343	0.504	0.337	0.699
11	0.971	1.001	1.021	0.999	0.997	0.759	0.904	1.070	1.249	0.589	0	1.845	1.807	0.705	0.470	0.920
12	5.536	2.815	3.185	9.229	3.259	2.316	0.481	2.869	2.719	1.415	1.845	0	1.180	3.850	2.935	0.364
13	2.486	2.439	1.376	0.818	1.502	1.968	0.040	0.245	7.613	1.343	1.807	1.180	0	1.198	2.860	0.052
14	0.020	0.134	1.065	1.121	0.806	2.703	0.348	1.605	3.762	0.504	0.705	3.850	1.198	0	1.458	1.315
15	1.372	2.230	2.413	1.616	2.130	1.150	0.670	2.175	6.645	0.337	0.470	2.935	2.860	1.458	0	2.030
16	0.902	0.786	0.566	0.602	0.750	4.204	0.515	0.110	1.092	0.699	0.920	0.364	0.052	1.315	2.030	0

Notes: Number 1 to 16 along the first row and column are codes for disaggregate meat types and their definition can be seen in Table 4.
The *t* matrix is now symmetric and all negative values have been converted to positive values (distance is always positive). Originally, the figures above the diagonal are not identical with the figures below the diagonal. Therefore one side of the data set was chosen to make up a symmetric *t* matrix.

Figure 1: Dendrogram for the meat price data



Notes: Number 1 to 16 are codes for disaggregate meat types and their definition can be seen in Table 4.

Table 3: The aggregation process of the 16 individual meat types into four meat groups

Step	Number of cluster	Similarity level	Distance level	Clusters joined	New cluster	Number of obs. in new cluster
1	15	99.78	0.020	1	14	2
2	14	99.57	0.040	7	13	2
3	13	98.81	0.110	8	16	2
4	12	98.42	0.146	3	4	2
5	11	98.09	0.176	1	2	3
6	10	96.35	0.337	10	15	2
7	9	95.69	0.398	7	8	4
8	8	93.57	0.594	10	11	3
9	7	87.38	1.164	6	10	4
10	6	83.41	1.531	5	7	5
11	5	76.11	2.205	3	5	7
12	4	70.54	2.719	9	12	2
13	3	57.69	3.905	1	6	7
14	2	39.53	5.581	1	3	14
15	1	11.23	8.193	1	9	16

Table 4: Disaggregate meat types and aggregate meat groups

Code	Initial	per cent	Code	Final	per cent
1	beef	32.60	MG-1	beef (1), buffalo (2) and trimmings (14)	49.42
2	buffalo	3.46			
3	goat/sheep meat	3.23			
4	commercial chicken	61.27	MG-2	goat/sheep meat (3), commercial chicken (4), native chicken (5), other fresh meat (7), dried meat (8), innards (13) and other offal (16)	87.20
5	native chicken	16.96			
6	other poultry meat	0.50			
7	other fresh meat	0.50			
8	dried meat	1.07			
9	shredded fried meat	6.80	MG-3	other poultry (6), canned (10), other processed (11), and bone (15)	5.27
10	canned meat	1.01			
11	other processed meat	0.56			
12	liver	9.46	MG-4	shredded fried (9) and liver (12)	16.26
13	innards excluding liver	3.43			
14	trimmings	14.36			
15	bone (untrimmed)	3.20			
16	other offal	0.74			

Notes: Percentage was calculated based on the number of households that reported consumption on particular meat type(s) divided by 8,231 observations.

Table 5: Definition of Meat Groups

No.	Individual meat types in each meat group	Average share
1	beef , buffalo meat and trimmings	0.307
2	commercial chicken, native chicken, goat/sheep meat , other fresh meat, dried meat, innards and other offal	0.649
3	other poultry, canned meat , other processed meat , untrimmed bone	0.021
4	shredded fried meat and beef liver	0.023

MG-3 comprises other poultry meat, canned meat, other processed meat and untrimmed bone with the dominant individual meat, other processed meat. MG-4 comprises shredded fried meat and beef liver with the dominant individual meat, beef liver. MG-3 and 4 account for a small percentage of the total meat expenditure, each accounting for slightly above 2 per cent. By and large, beef is the dominant constituent meat in MG-1, commercial and native chicken meats in MG-2, processed meats in MG-3 and offal in MG-4.

B. Estimation of missing prices

Because some respondents did not report their consumption on all meat groups during the week of the surveys, there were missing prices on some observations. Missing prices were estimated using four dummy variables and prices of the other meats. The estimated price equations are specified as:

(25) $P_i = \alpha_i + \sum_{j \neq i} \beta_j P_j + \sum_{k=1}^{4} \gamma_k D_k + \varepsilon_i$, *i = 1, ..., 4,*

where

P_i is the predicted price for meat group *i*; and

D_k is a dummy variable, representing years, provinces, and urban-rural regions.

IV. Results

A. Estimated results

In general, the estimated coefficients from the doubly truncated model are highly statistically significant at the 5 per cent level or better with only a few exceptions. As can be seen in Table 7, the exceptions are the coefficients of price for MG-1 in equations 1 and 2 (γ_{11} and γ_{21}) and the coefficient of price for MG-2 in equation 1 (γ_{12}). All the dummy variables are statistically significant, therefore, their presence in the model is important and omissions of these dummy variables will lead to misspecification errors. The significant results from the dummy variables mean that intertemporal (years) and locational (provinces and urban-rural regions) differences are important in this study. Likewise, the auxiliary variables (f-g) or instrument variables for all meat group equations are all highly statistically significant. Instrument variables were incorporated into the empirical model as a result of the doubly truncation procedure. Thus, omission of these variables in the empirical model might have caused misspecification errors.

The price coefficient, γ_{ij}, denotes the change in the i^{th} budget share with respect to a percentage change in j^{th} price with all other prices and meat expenditure held constant. It is expected that the own-price coefficient (γ_{ii}) is positive (Blanciforti *et al*., 1986). In this case, two of the own-price coefficients are negative where one of them are statistically insignificant, whereas the other two are positive and statistically significant. All the cross-price coefficients are highly statistically significant at the 1 per cent level, except on the cross-price coefficient of MG-1 with respect to price of MG-2 (or γ_{12}) and because of the symmetry condition γ_{21} is also statistically significant (Blanciforti *et al*., 1986). The expenditure coefficient, β_i , denotes the change in the i^{th} budget share with respect to a percentage change in real meat expenditure with all prices of meat groups held constant.

B. Estimated uncompensated elasticities computed at the sample mean values

The estimated elasticities are shown in Table A2 to A7 of Appendix 1 and definitions of the notation used in these tables can be seen in Table A1. In general, the estimated elasticities generated from this study conform with economic theory and their magnitudes are in plausible ranges. The results for MG-1 and MG-2 are very encouraging whereas the results for MG-3 and 4 should be interpreted with caution. Estimated elasticities for West Java province particularly from rural areas tend not to be as substantive as the results from DKI Jakarta. The small number of observations from rural and urban West Java and substantial deviation of the meat group prices from their mean values (outliers) had caused some estimated elasticities to have contradictory signs and statistically insignificant results from these regions.

Table 7: Coefficient estimates of the doubly truncated model

Coefficient	MG-1	MG-2	MG-3	MG-4
α_i	0.357	0.637	0.002	0.004
δ_{i1}	0.063	-0.066	-0.001	0.005
δ_{i2}	0.072	-0.073	0.001	0.001*
δ_{i3}	-0.110	0.116	-0.004	-0.002
δ_{i4}	-0.128	0.137	-0.003	-0.006
γ_{i1}	-0.002 ^{ns}	0.002 ^{ns}	0.003	-0.003
γ_{i2}	0.002 ^{ns}	0.007	-0.007	-0.003
γ_{i3}	0.003	-0.007	-0.001*	0.004
γ_{i4}	-0.003	-0.003	0.004	0.002
β_i	-0.091	0.097	-0.003	-0.003
σ_i	0.356	0.372	0.005	0.006

Notes:
- i meat group i $(i = 1,..,4)$
- α_i intercepts
- δ_{ij} dummy variable coefficients $(j = 1,..,4)$
- γ_{ij} price coefficients $(i = j = 1,..,4)$
- β_i real expenditure coefficients
- σ_i auxiliary (f-g) variable coefficients
- ns statistically insignificant at the 5 per cent level
- * statistically significant at the 5 per cent level

All other coefficients are statistically significant at the 1 per cent level

The estimated expenditure elasticities for all meat groups are positive which implies that meats are normal goods. The estimated expenditure elasticities for MG-1 and MG-3 are less than one (income-inelastic goods) whereas MG-2 and MG-4 are greater than unity (income-elastic goods). The smaller magnitudes of estimated expenditure elasticities of MG-1 compared to MG-2 are the result of higher prices of the former compared to the latter. Meat consumers tend to buy more of meat with lower prices, other things being equal. Except for MG-2, the estimated expenditure elasticities of MG-1, 3 and 4 vary across the data sets, where rural consumers tend to have smaller magnitudes of estimated expenditure elasticities.

The estimated own-price elasticities are negative as suggested by economic theory. The estimated own-price elasticity of MG-1 is inelastic whereas MG-2, 3, and 4 have elastic own price elasticities. An inelastic demand for MG-1 suggests that it has fewer close substitutes compared to MG-2, 3 and 4. However, a close examination of the estimated own-price elasticities of all meat groups reveals that they are near unitary elasticities. Unitary own-price elasticities means that a rise or fall in meat prices leaves quantity demanded of meat unaffected (from consumers' point of view) and total quantity supplied unchanged (from producers' point of view) (Lipsey and Chrystal 1995, p. 89).

The uncompensated cross-price elasticities estimated in this study suggest that all the meat groups tend to be substitute goods as expected. There are some negative estimated cross-price elasticities, however, their magnitudes are very small compared to the positive ones. A close examination of the estimated cross-price elasticities reveals that MG-1 and MG-2 tend to be substitute goods. The relationship of MG-1 and 2 with MG-3 and 4 tend to one of independence mainly because of the small portion of MG-3 and 4 in the total meat expenditure. Also, the small budget share of MG-3 and 4 in the total meat expenditure caused changes in their prices did not have a significant effect on the consumption of MG-1 and 2. Changes in the prices of MG-1 and 2, on the other hand, did have a significant effect on the consumption of MG-3 and 4.

While the results for estimated expenditure elasticities are clear, this is not always the case with estimated price elasticities. One explanation is that there is no regular pattern of meat prices between urban and rural regions or between the two provinces. The other explanation of the poor performance of the estimated own and cross-price elasticities, particularly for MG-3 and 4, is due to the small number of observations for these two meat groups. Because of the small number of observations for MG-3 and 4, predicted prices for these meats are not as good as for MG-1 and 2.

It should be emphasised here that estimating price elasticities is more difficult compared to income or expenditure elasticities particularly when using cross-sectional data. The difficulties are more apparent when estimating cross-price elasticities. Even when a long time series of price data are available, it is hard to find sensible cross-price elasticities for food (Deaton and Muellbauer 1980b, p. 78-82; Deaton 1987). Therefore, the estimated price elasticities, particularly the cross-price elasticity from this study, should be interpreted with caution.

V. Conclusion

The main conclusions of this study are: (ii) the cluster analysis conducted in this study to obtain more manageable set of meat groups from highly disaggregated meat types recorded in the SUSENAS data has shown a new insight into the way in which meat commodities are partitioned in meat demand studies in Indonesia; (ii) intertemporal (years) and locational (provinces and urban-rural regions) variations are important in this study, thus omission of these variables will lead to misspecification errors; and (iii) the correct specification of the doubly truncated version of the linear approximation the of Almost Ideal Demand System (LA/AIDS) has produced better and more reliable parameter estimates.

Appendix 1

Table A1: Notation

MG-1	beef , buffalo meat and trimmings
MG-2	goat/sheep meat, commercial chicken, native chicken, other fresh meat, dried meat, innards excluding liver and other offal
MG-3	other poultry, canned meat, other processed meat, untrimmed bone
MG-4	shredded fried meat and beef liver
Data set 1	Data from urban West Java in 1990
Data set 2	Data from DKI Jakarta in 1990
Data set 3	Data from rural West Java in 1993
Data set 4	Data from urban West Java in 1993
Data set 5	Data from DKI Jakarta in 1993
Data set 6	Data from rural West Java in 1996
Data set 7	Data from urban West Java in 1996
Data set 8	Data from DKI Jakarta in 1996
η_i	expenditure elasticity of demand for good *i* (*i* = 1, 2, 3, 4 for MG-1, 2, 3, 4)
ε_{ij}	uncompensated price elasticity of demand for good *i* with respect to price of good *j* (*i*, *j* = 1, 2, 3, 4 for MG-1, 2, 3, 4)
*	denotes statistically significant at the 5 per cent level
ns	means statistically insignificant at the 5 per cent level

Table A2: Uncompensated expenditure elasticities computed at the mean values across years, provinces and urban-rural regions

No.	Data set	MG-1 (η_1)	MG-2 (η_2)	MG-3 (η_3)	MG-4 (η_4)
1	1990, W. Java, Urban	0.70	1.14	-2.72 ns	0.46
		(0.002)	(0.001)	(1.426)	(0.041)
2	1990, DKI Jakarta	0.78	1.17	0.39	0.58
		(0.002)	(0.001)	(0.037)	(0.027)
3	1993, W. Java, Rural	0.51	1.12	16.29 ns	1.87
		(0.005)	(0.001)	(25.909)	(0.112)
4	1993, W. Java, Urban	0.71	1.14	-0.04 ns	-0.47 ns
		(0.002)	(0.001)	(0.679)	(0.239)
5	1993, DKI Jakarta	0.79	1.17	0.57	0.15 ns
		(0.002)	(0.001)	(0.017)	(0.082)
6	1996, W. Java, Rural	0.21	1.11	3.92	1.74
		(0.009)	(0.001)	(1.020)	(0.059)
7	1996, W. Java, Urban	0.63	1.13	-0.45 *	-1.10
		(0.003)	(0.001)	(0.226)	(0.296)
8	1996, DKI Jakarta	0.74	1.15	0.51	-0.02 ns
		(0.002)	(0.001)	(0.027)	(0.062)

Table A3: Uncompensated own-price elasticities computed at the mean values across years, provinces and urban-rural regions

No.	Data set	MG-1 (ε_{11})	MG-2 (ε_{22})	MG-3 (ε_{33})	MG-4 (ε_{44})
1	1990, W. Java, Urban	-0.92	-1.09	-1.88	-0.73
		(0.004)	(0.003)	(0.661)	(0.073)
2	1990, DKI Jakarta	-0.91	-1.08	-1.14	-0.78
		(0.003)	(0.003)	(0.070)	(0.056)
3	1993, W. Java, Rural	-0.92	-1.09	2.63 ns	-1.43
		(0.006)	(0.002)	(5.664)	(0.068)
4	1993, W. Java, Urban	-0.92	-1.09	-1.24	-0.25 ns
		(0.004)	(0.003)	(0.114)	(0.254)
5	1993, DKI Jakarta	-0.91	-1.08	-1.10	-0.57
		(0.003)	(0.003)	(0.045)	(0.124)
6	1996, W. Java, Rural	-0.93	-1.09	-0.30 ns	-1.37
		(0.010)	(0.002)	(0.396)	(0.078)
7	1996, W. Java, Urban	-0.92	-1.09	-1.34	0.06 ns
		(0.005)	(0.002)	(0.143)	(0.260)
8	1996, DKI Jakarta	-0.92	-1.09	-1.11	-0.48
		(0.003)	(0.003)	(0.049)	(0.116)

Notes: Figures inside the brackets are the standard errors. Unless otherwise marked with ns and * all the other estimated elasticities are statistically significant at the 1 per cent level.

Table A4: Uncompensated cross-price elasticities of MG-1 computed at the mean values across years, provinces and urban-rural regions

No.	Data set	With respect to the price of MG-2 (ε_{12})	MG-3 (ε_{13})	MG-4 (ε_{14})
1	1990, W. Java, Urban	0.21 (0.005)	0.01 (0.001)	-0.01 (0.001)
2	1990, DKI Jakarta	0.13 (0.003)	0.01 (0.001)	-0.01 (0.001)
3	1993, W. Java, Rural	0.41 (0.008)	0.02 (0.001)	-0.02 (0.002)
4	1993, W. Java, Urban	0.20 (0.004)	0.01 (0.001)	-0.01 (0.001)
5	1993, DKI Jakarta	0.13 (0.003)	0.01 (0.001)	-0.01 (0.001)
6	1996, W. Java, Rural	0.73 (0.014)	0.03 (0.002)	-0.03 (0.003)
7	1996, W. Java, Urban	0.29 (0.005)	0.01 (0.001)	-0.01 (0.001)
8	1996, DKI Jakarta	0.17 (0.004)	0.01 (0.001)	-0.01 (0.001)

Table A5: Uncompensated cross-price elasticities of MG-2 computed at the mean values across years, provinces and urban-rural regions

No.	Data set	With respect to the price of MG-1 (ε_{21})	MG-3 (ε_{23})	MG-4 (ε_{24})
1	1990, W. Java, Urban	-0.04 (0.002)	-0.01 (0.001)	-0.01 (0.001)
2	1990, DKI Jakarta	-0.07 (0.002)	-0.01 (0.001)	-0.01 (0.001)
3	1993, W. Java, Rural	-0.02 (0.002)	-0.01 (0.001)	-0.003 (0.001)
4	1993, W. Java, Urban	-0.04 (0.002)	-0.01 (0.001)	-0.004 (0.001)
5	1993, DKI Jakarta	-0.07 (0.002)	-0.01 (0.001)	-0.01 (0.001)
6	1996, W. Java, Rural	-0.01 (0.001)	-0.01 (0.001)	-0.003 (0.001)
7	1996, W. Java, Urban	-0.03 (0.002)	-0.01 (0.001)	-0.004 (0.001)
8	1996, DKI Jakarta	-0.05 (0.002)	-0.01 (0.001)	-0.01 (0.001)

Notes: Figures inside the brackets are the standard errors. Unless otherwise marked with ns and * all the other estimated elasticities are statistically significant at the 1 per cent level.

Table A6: Uncompensated cross-price elasticities of MG-3 computed at the mean values across years, provinces and urban-rural regions

No.	Data set	With respect to the price of MG-1 (ε_{31})	MG-2 (ε_{32})	MG-4 (ε_{34})
1	1990, W. Java, Urban	5.20	-5.97	5.37
		(1.853)	(1.946)	(2.136)
2	1990, DKI Jakarta	0.93	-1.06	0.89
		(0.051)	(0.054)	(0.086)
3	1993, W. Java, Rural	-19.56 ns	22.57 ns	-21.93 ns
		(33.924)	(39.620)	(37.099)
4	1993, W. Java, Urban	1.46	-1.67	1.49
		(0.125)	(0.145)	(0.153)
5	1993, DKI Jakarta	0.65	-0.74	0.62
		(0.037)	(0.053)	(0.047)
6	1996, W. Java, Rural	-3.53	4.10 *	-4.19 *
		(1.300)	(1.674)	(1.653)
7	1996, W. Java, Urban	1.94	-2.24	2.10
		(0.341)	(0.347)	(0.217)
8	1996, DKI Jakarta	0.71	-0.81	0.70
		(0.060)	(0.069)	(0.029)

Table A7: Uncompensated cross-price elasticities of MG-4 computed at the mean values across years, provinces and urban-rural regions

No.	Data set	With respect to the price of MG-1 (ε_{41})	MG-2 (ε_{42})	MG-3 (ε_{43})
1	1990, W. Java, Urban	-0.32	-0.06 ns	0.65
		(0.067)	(0.067)	(0.028)
2	1990, DKI Jakarta	-0.21	-0.10 ns	0.51
		(0.050)	(0.053)	(0.021)
3	1993, W. Java, Rural	0.62	-0.02 ns	-1.04
		(0.092)	(0.109)	(0.198)
4	1993, W. Java, Urban	-0.87	-0.18 ns	1.77
		(0.229)	(0.185)	(0.217)
5	1993, DKI Jakarta	-0.41	-0.20 ns	1.03
		(0.104)	(0.107)	(0.066)
6	1996, W. Java, Rural	0.58	-0.07 ns	-0.89
		(0.073)	(0.091)	(0.114)
7	1996, W. Java, Urban	-1.39	-0.10 ns	2.52
		(0.294)	(0.263)	(0.373)
8	1996, DKI Jakarta	-0.56	-0.17 ns	1.24
		(0.113)	(0.128)	(0.098)

Notes: Figures inside the brackets are the standard errors. Unless otherwise marked with ns and * all the other estimated elasticities are statistically significant at the 1 per cent level.

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