Unit Value Biases in Meat Demand in Indonesia

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Contributed Paper presented to the 47th Annual Conference

Of the Australian Agricultural and Resource Economics Society

At

Fremantle,

February 12-14, 2003

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Abstract

Indonesia is an emerging market for beef and cattle exports so estimates of income and price elasticities may help analysts predict future demands. In contrast to developed countries, where meat demand studies often use aggregate data, Indonesian studies rely on household surveys, with unit values (ratios of expenditures to quantities) used instead of market prices. Elasticities estimated from unit values can be subject to various quality and measurement error biases. In this paper, data from 29,000 households on Java are used to estimate a demand system for beef, chicken and other meat groups, and the extent of bias from commonly used estimation strategies is evaluated.

JEL: D12, Q11

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I. Introduction

Indonesia is an emerging market for beef and cattle exports so estimates of income and price elasticities may help analysts predict future demands. In contrast to developed countries, where meat demand studies often use aggregate data, Indonesian studies rely on household surveys, with unit values (ratios of expenditures to quantities) used instead of market prices. Unlike market prices, unit values reflect household's quality choices, are affected by reporting errors, and are unavailable for non-purchasing households. The quality effects matter because household surveys typically aggregate different varieties, so even if consumers faced the same prices, as the mix of varieties changes with variations in household income and other characteristics, the unit values change. In fact, unit values will tend to vary less than prices if consumers react to high prices by choosing lower quality, and this is likely to create a systematic overstatement in the absolute value of estimated price elasticities (Deaton, 1988). Reporting errors in either expenditures or quantities will also matter because they are reflected in unit values, and these errors are likely to cause spurious correlations with the demands that are being 'explained' by the unit values, causing estimated price elasticities to be biased.

Although methods for correcting the biases in demand elasticity estimates from unit value data have been developed, most notably by Deaton (1987, 1988, 1990), researchers rarely apply them. To see whether such corrections have any practical impact, this paper estimates demand systems for beef, chicken and other meat groups, using data from 29,000 households on the island of Java in Indonesia. We compare price elasticities of meat demand calculated from procedures which attempt to correct for the various biases caused by unit values with the results from simpler procedures which do not make these corrections.

The results suggest that estimated meat demand elasticities are sensitive to the choice of procedure for dealing with unit values. The simplest procedures make beef demand appear much more own-price elastic than do the more sophisticated estimation methods. While the estimated own-price elasticity of demand for chicken also varies according to the method used to deal with unit values, the variation in the price elasticities is less severe than for beef. One consequence of these results is that pricing strategies for beef producers, which are based on estimated demand elasticities from Indonesia, may prove to be inappropriate if the wrong method for dealing with unit value biases is used.

II. Previous Meat Demand Studies in Indonesia

Meat demand has been studied intensively in the United States (e.g. Hahn, 1994; Alston and Chalfant, 1993; Eales and Unnevehr, 1993; Yong and Hayes, 1993; Eales and Wessels, 1999). By contrast, interest in this field is relatively recent in Indonesia although there are many estimates of demand parameters for food crops in either Indonesia or Java. The emphasis on food crops and neglect of meat demand studies reflects the structure of consumption and is also partly due to the fact that Indonesia has a history of intervening in the supply, pricing and trade of key staple food crops, and especially rice, in order to maintain food security. It is therefore not surprising that food crop consumption analyses have been done more often than meat demand analyses. Most of these demand studies in Indonesia use unit values (expenditures divided by quantities) as proxies for 'prices' due to the unavailability of market prices in the household survey data.

Examples of previous studies of income and price elasticities of food demand include Timmer and Alderman (1979) and Dixon (1982) both of whom estimated food crop (rice, corn, cassava) elasticities. A broader set of foods were included by Chernichovsky and Meesok (1984). Unlike most studies, Chernichovsky and Meesok's (1984) estimated demand elasticities for both Java and off-Java regions. They found that the income elasticity of demand for meat (1.68) was the 3rd highest of the 12 foods they studied, while the own price elasticity (-1.86) was the fifth highest for Java. Income elasticity of meat demand for Outer Islands residents was the 2nd highest of the 12 foods they studied. They also found that the own-price elasticity of demand for meat is higher in the Outer Islands than in Java, where a 10 percent increase in the price of meat brought a 23 percent decline in the quantities consumed by the households in the Outer Islands, but only an 18 percent decline for households in Java. All three of these studies used data from SUSENAS and used unit values as measure of prices. While Deaton (1990) also uses unit values, he reports a lower estimate of the own price elasticity for meat (-1.09 for rural Java), due to the impact of his correction method on unit values (see below for details).

More recent, and also more disaggregated meat demand analysis in Indonesia comes from a study by Hutasuhut (2000) who utilised the data from the 1990, 1993 and 1996 SUSENAS to estimate the demand for meats in Jakarta and West Java. A double truncated Linear Approximate version of the Almost Ideal Demand System (LA/AIDS) model was used to account for the fact that budget shares lie between zero and one. In terms of data aggregation, Hutasuhut (2000) applied the 'Stochastic Hicksian Aggregates' technique (where goods which are highly correlated in prices are put together in one group) and formed 4 meat groups (MG1-4) from the 16 disaggregated meat types.[2] MG-1 consists of beef, buffalo meat and trimmings and accounts for 32 of the total meat expenditure. Beef is the dominant individual meat type in MG-1. MG-2 consists of commercial and native chicken meats, goat/sheep meat, other fresh meat, dried meat, innards excluding liver and other offal (65 percent of meat budget share) in which commercial and native chicken are the dominant meats in this group. MG-3 comprises of other poultry meat, canned meat, other processed meat and untrimmed bone, while MG-4 made up of shredded fried meat and beef liver. As with previous studies, Hutasuhut (2000) used unit values as implicit prices in his analysis.

On average, the estimated expenditure elasticities for MG-1 and MG-3 were less than unity while those for MG-2 and MG-4 were slightly greater than unity. With regards to the estimated own-price elasticities, Hutasuhut (2000) reports that the own-price elasticity for MG-1 is inelastic (ranges from -0.91 to -0.93) whereas MG-2, 3, and 4 have elastic own price elasticities. (for example, the own price elasticity for MG-2 range from -1.08 to -1.09). A point to note is that the estimated own-price elasticities of all meat groups for Jakarta and West Java reveals that they are near unitary elasticities. To make comparisons with previous meat demand studies, Hutasuhut (2000) reports estimates done by Kesavan et al. (1992) who used data from 1987 SUSENAS. Kesavan et al. reported that the estimated own-price elasticties for the demand for beef and poultry meat are -0.515 and -0.647 respectively while another study by Puslibangnak (1992) found that expenditure elasticities for beef and preserved meat ranges from 0.64 for Yogya to 1.15 for Jakarta. The own price elasticity ranges from –0.69 for Yogya and –1.69 for Central Java while it was 0.30 for Jakarta. In addition, the expenditure elasticity for poultry ranges from 0.88 for East Java to 1.04 for Central Java. In other words, Puslibangnak's results confirm that on average beef is a more luxury than chicken. The estimated own-price elasticitiy for chicken range from -0.25 for East Java to - 2.16 for Jakarta.

[2] There are initially 17 meat types in the SUSENAS data set. However, Hutasuhut (2000) discarded households with pork consumption from the data set because the majority of respondents in the chosen study areas do not consume pork due to religious reasons.

Hutasuhut (2000) points out that one of the limitations in his study is that the quality of individual meat commodities is assumed to be homogenous, and if the ignored quality effect is substantial, the estimates might give biased results because they rely on unit values rather than prices.

III. Econometric Problems Created by Using Unit Values

The problems that may occur when unit values are used as proxies for market prices have been discussed previously in the literature by Cox and Wohlgenant (1986) and Deaton (1988, 1990, 1997). However, these problems remain widely ignored so in this section we summarize some of the potential biases that can occur from the use of unit values. In some cases, the direction of the bias depends on the particular demand specification used, so the discussion considers the *double log* and the *share-log* specifications. These two specifications are the ones used by Deaton (1987, 1990) in his unit value correction procedures, and the share-log is the one used in the empirical section of this paper.[3]

The models, written in terms of an arbitrary good *i* (but not indexing the individual household) are:

$$\ln Q_i = \alpha_i + \beta_i \ln x + \gamma_{ii} \ln p_i + \sum_j \gamma_{ij} \ln p_j + \sum_k \theta_{ik} z_k + u_i \tag{1}$$

$$w_i = \alpha_i + \beta_i \ln x + \gamma_{ii} \ln p_i + \sum_j \gamma_{ij} \ln p_j + \sum_k \theta_{ik} z_k + u_i \tag{2}$$

where Q_i is the quantity of food *i*, w_i is the budget share of food *i*, *x* is household total expenditure, p_i is the own-price, the p_j are cross-prices ($i \neq j$), the z_k are other relevant household characteristics, and the u_i is a random error. The use of unit values involves replacing $\ln p_i$ and $\ln p_j$ with $\ln v_i \equiv \ln E_i - \ln Q_i$, and $\ln v_j \equiv \ln E_j - \ln Q_j$. In the double log model, the own-price elasticity of quantity demand is directly estimated as γ_{ii}. In the share-log model, the elasticity is $(\gamma_{ii} / w_i) - 1$. The nature of the elasticity formulas, as it turns out, is important in evaluating the direction of bias.

Bias due to quality variation

[3] The share-log model is also closely related to the linear approximate Almost Ideal Demand System, with budget shares treated as a linear function of log income and log food prices.

The first problem that arises from using unit values as proxies for prices is quality variation. In markets in which prices are high, consumers may react by choosing goods that are lower quality. In contrast, in markets in which prices are low, consumers may choose to consume items that are higher quality (Deaton, 1988). Hence, unit values, which reflect both price and quality, will tend to vary by less than prices, i.e., $(\partial \ln v_i \,/\, \partial \ln p_i) < 1$. As a result, the absolute value of the $\tilde{a}_{ii}$ coefficient in (1) and (2) will be bigger when unit values are used than when market prices are used because the same movement in the left-hand side variables is attributed to smaller movements in the right-hand side variable.

The direction of the bias depends on the sign of the $\tilde{a}_{ii}$ coefficient. In model (1) $\tilde{a}_{ii}$ normally would be expected to be negative, so the bias makes demand appear more elastic, overstating the response of quantity to price (that is, the elasticity will tend to be further from zero--Deaton, 1988). In model (2), if the demand for food is own-price inelastic, then $\tilde{a}_{ii} > 0$, and the exaggerated size of $\tilde{a}_{ii}$ will make it appear as if the commodity demand is even more inelastic (that is, the elasticity will tend to be closer to zero). Conversely, if the demand is own-price elastic, then $\tilde{a}_{ii} < 0$, and the use of unit values will make it appear that demand is even more price elastic than it truly is. Hence, for budget share models, when unit values are used, the effect of bias due to quality variation always moves estimates of the own-price elasticity away from minus one (-1).

Bias due to measurement errors

Two types of measurement error bias are relevant. The first is “attenuation bias” due to the fact that unit values are noisy measures of prices. Attenuation bias is expected to force the estimated $\tilde{a}_{ii}$ toward zero in both models (1) and (2). As a consequence, the elasticities are biased toward 0 and -1, respectively. Thus, attenuation bias due to random measurement error generally operates in the opposite direction to the bias due to quality variation in the unit values.

The second type of bias is due to “correlated errors” in expenditures and/or quantities that appear on both the left-hand and right-hand sides of equations (1) and (2). For example, consumers may not correctly recall the quantity of food consumed, Q_i, and instead over- or under-estimate it as $Q_i \pm \mathring{a}_Q$. In this case, the denominator of the unit value expression contains an error. The error, however, is not simply passed to the random error term of the regression (as it would if quantity only appeared on the left hand side of a demand regression). Instead, because the unit value can be written as $\ln v_i \equiv \ln E_i - \ln Q_i$ there is a common component on the left-hand ($\mathring{a}_Q$), and right-hand side ($-\mathring{a}_Q$) of equation (1). Thus, no matter what the true relationship between price and quantity, the estimated relationship will be more negative, due to the spurious negative correlation between quantity and unit value. Thus, correlated errors bias potentially counteracts the effect of the attenuation bias due to random errors and causes the response of quantity to price to be overstated.

For budget share models like equation (2), the effect of correlated measurement errors depends on whether households report expenditures independently of quantities.[4] If the errors are only in expenditures, there will be a spurious positive relationship between w_i and v_i. Thus, for foods that are own-price inelastic ($\tilde{a}_{ii} > 0$), the correlated errors bias will cause the estimated elasticity to be closer to 0 and further from -1 (in the opposite direction to the attenuation bias). But if the errors are in quantities, and if either enumerators or respondents use quantities to help construct reported expenditures, there will be a spurious negative relationship between w_i and v_i.[5]

IV. Specification of the Demand Models

To illustrate the possible biases from the uncritical use of unit values as proxies for market prices, we compare meat demand elasticities calculated from procedures which attempt to correct for the various biases with the results from simpler procedures which do not make these corrections. Ideally, we would have elasticities estimated from market prices to use as our reference point, but such estimates are unavailable because there is not sufficiently disaggregated market price information available to match with the SUSENAS household survey data.[6] The procedure that we take as a reference point is the one developed by Deaton (1990), which was also illustrated using data from rural Java. Although this is the most

[4] See Deaton (1997) for a more detailed treatment of this effect.

[5] For example, if the respondent first remembers the quantity purchased and then uses the unit price in order to construct the expenditure estimate that is requested by the enumerator.

[6] The Indonesia Family Life Survey (IFLS) collects data on community-level prices, but there is insufficient overlap of the commodities with the SUSENAS budget items, and the survey was also carried out in a different year.

sophisticated econometric procedure for dealing with the biases caused by unit values, it has rarely been applied.[7] The other unit value procedures that we use are:

(i) replacing *missing* unit values with the mean unit value calculated across other households in the same *province.*

(ii) replacing *missing* unit values with the mean unit value calculated across other households in the same *district*. This procedure, and the replacement with provincial means are similar to what Minot (1998) has used, noting that there is no seasonal variation in SUSENAS because all households are observed in the same month.

(iii) replacing *missing* unit values with the *cluster mean* of the unit value (Sahn, 1988);

(iv) replacing *missing* unit values with the *predictions* from a regression of observed unit values on regional dummies and household total expenditures (Jensen and Manrique, 1998; Heien and Pompelli, 1989);[8]

(v) using *cluster mean unit values*, in place of both household-specific and missing unit values (Case, 1991; Rae, 1999).

The Deaton Procedure

The procedure starts with a two-equation system of budget shares (w_{Gic}) and unit values (v_{Gic}) that are both functions of the *unobserved* prices, (p_{Hc}):

$$w_{Gic} = a_G^0 = b_G^0 \ln x_{ic} + g_G^0 \cdot z_{ic} + \sum_{H=1}^{N} q_{GH} \ln p_{Hc} + (f_{Gc} + u_{Gic}^0) \quad (3)$$

$$\ln v_{Gic} = a_G^1 = b_G^1 \ln x_{ic} + g_G^1 \cdot z_{ic} + \sum_{H=1}^{N} y_{GH} \ln p_{Hc} + u_{Gic}^1 \quad (4)$$

the G indicates goods, i indicates households and the c indexes clusters. Amongst the explanatory variables, x_i is total expenditure of household i, p_H are the unobserved prices, $\mathbf{z}_i$ is a vector of other household characteristics, f_{Gc} is a cluster fixed-effect in the budget share for good G and u_{Gic}^0 and u_{Gic}^1 are idiosyncratic errors. The two equations allow consumers to choose both quantity and quality, so that expenditure on good G is the product of price,

[7] Gracia and Albisu (1998) are one of the few examples in the agricultural economics literature.

[8] A related procedure is to regress the deviation of household-specific unit values from the mean for each region in each quarter on a set of household characteristics and use this equation to predict adjusted unit values for the non-consuming households (Cox and Wohlgenant, 1986).

quantity, *and* quality. Thus, if the logarithm of the budget share is differentiated with respect to ln x and ln p_H the results are not the usual expenditure and price elasticities, but rather:

$$\partial \ln w_G / \partial \ln x = b_G^0 / w_G = e_G + b_G^1 - 1 \tag{5a}$$

$$\partial \ln w_G / \partial \ln p_H = q_{GH} / w_G = e_{GH} + y_{GH} \tag{5b}$$

where e_G is the elasticity of quantity demanded with respect to total expenditure, e_{GH} is the elasticity of quantity demanded with respect to the price of *H*, b_G^1 is the elasticity of the unit value with respect to total expenditure (henceforth, called the *quality elasticity*) and y_{GH} is the *elasticity of the unit value with respect to the price* of *H*. It is only in the special case when the y matrix is an identity matrix (implying that prices and unit values move perfectly together) that the simple expedient used in most previous analyses of SUSENAS of using unit values in place of prices gives accurate estimates of the log price derivative, q_{GH}.

In the first stage, the procedure removes the household-specific effects of income and other demographic characteristics from the budget shares and unit values. To do so, equations (3) and (4) are estimated using OLS with dummy variables for each cluster in place of the unobserved price (a 'within' estimator). In addition to x_i and $\boldsymbol{z_i}$, this specification also controls for all cluster fixed effects, including those of unobserved prices, so the b_G^0, g_G^0, b_G^1, and g_G^1 parameters can be estimated consistently, even in the absence of market price data. These four parameters are used to create *adjusted* budget shares and unit values that have the quality effects due to income and other factors removed. The first stage regressions also produce residuals needed in the second stage for estimating the covariances that are used to correct for the effect of any measurement error in unit values and budget shares. The error terms, e_{Gic}^0 and e_{Gic}^1, from equations (3) and (4) contain all the variability in w_{Gc} and v_{Gc} that are not explained by x, $\boldsymbol{z}$, or the cluster fixed effects. Under the assumption that there is a single price per cluster, the unexplained variation around the cluster mean can indicate measurement error.

In the second stage, the adjusted budget shares ($\hat{y}_{Gc}^0$) and unit values ($\hat{y}_{Gc}^1$) are averaged by cluster:

$$\hat{y}_{Gc}^{0} = \frac{1}{n_c} \sum_{i \in c} \left(w_{Gic} - \tilde{b}_{G}^{0} \ln x_{ic} - \tilde{g}_{G}^{0} \cdot z_{ic} \right) \tag{6a}$$

$$\hat{y}_{Gc}^{1} = \frac{1}{n_{Gc}^{+}} \sum_{i \in c} \left(\ln v_{Gic} - \tilde{b}_{G}^{1} \ln x_{ic} - \tilde{g}_{G}^{1} \cdot z_{ic} \right) \tag{6b}$$

where n_c is the number of households in cluster c, n_{Gc}^{+} is the number reporting a unit value and tildes indicate estimates from the first stage (implying n_c n_{Gc}^{+} for all c). These cluster averages are then used to compute a 'between-cluster, errors-in-variables' regression:

$$\tilde{B} = \left(\tilde{S} - \tilde{\Omega} \tilde{N}_{+}^{-1} \right)^{-1} \left(\tilde{R} - \tilde{\Gamma} \tilde{N}^{-1} \right) \tag{7}$$

where the elements of $\tilde{S}$ and $\tilde{R}$ are the covariances of the cluster averages of the adjusted budget shares ($\hat{y}_{Gc}^{0}$) and unit values ($\hat{y}_{Gc}^{1}$), $\tilde{s}_{GH} = \operatorname{cov}(\hat{y}_{Gc}^{1}, \hat{y}_{Hc}^{1})$ and $\tilde{r}_{GH} = \operatorname{cov}(\hat{y}_{Gc}^{1}, \hat{y}_{Hc}^{0})$; $\tilde{\Omega}$ and $\tilde{\Gamma}$ are covariances of the errors from the first stage within-cluster residuals (e_{Gic}^{0}, e_{Gic}^{1}); and $\tilde{N}$ and $\tilde{N}_{+}$ are formed from the mean cluster size variables n_c and n_{Gc}^{+}.

After this second operation, Deaton's procedure has purged the unit values of the quality effects of income and demographics (the first stage) and measurement error (the second stage), but the adjusted shares and unit values are still contaminated by the cluster-wide influence of price on quality and are not yet able to produce the required parameters for calculating elasticities. This can be seen from Deaton's (1990) result that, as the number of clusters, c, tends to infinity, holding fixed the number of households in each cluster, the probability limit of equation (7) is:

$$\operatorname*{plim}_{C \to \infty} \tilde{B} = \left(\Psi' \right)^{-1} \Theta' \tag{8}$$

In other words, at the limit, $\tilde{B}$, the estimated relationship from the second stage between-cluster regression of adjusted budget shares on adjusted unit values, is not the log price derivative, q_{GH} (what we want) but rather the 'mixed' matrix $\left(\Psi' \right)^{-1} \Theta'$. The disentangling of the price and quality effects in equation (7) takes place at the third stage and relies on a separability assumption. This final step assumes that the effect of unobserved price on quality can be treated like an income effect, which allows the log price derivative, q_{GH} to be identified, and this provides the remaining information needed to calculate the price elasticities (see Deaton, 1990, equation 20).

V. Data

The data used in this paper come from the detailed consumption module of the 1999 SUSENAS. The survey covered a random sample of 65,664 households, residing in 1,864 rural and urban communities. Data for the present study were limited to 28,964 households located on Java. This island consists of the capital, Jakarta, and other fast growing cities including Surabaya (East Java), Bandung (West Java), Semarang (Central Java) and Yogyakarta. More than 60 percent of the Indonesian population in 1999 lived on Java, and economic activity is also concentrated there. The households in our sample were the ones for whom it was possible to merge the consumption module (used only every third year) with the core questionnaire, which is administered to a larger sample. It is the core questionnaire (used every year) that provides the information on the demographic characteristics and economic activity of the household. The survey's sampling procedure involved two-stage selection. At the first stage, sub districts are selected from Java's provinces, districts and sectors (urban and rural); and at the second stage 16 households are selected per cluster. This spatial clustering encourages the assumption that households within each cluster face the same prices.

The consumption module includes 17 disaggregated meat items and for each of these, households were asked to recall the quantity and value of each of these meat items purchased from the market during the last week, or given to them as gifts or consumed out of own production. The latter quantities are valued by local interviewers using the imputed prices. The survey also collects non-food expenditure over the past month but expenditure on durables are excluded from the aggregate of household consumption. From this detail we formed 3 meat groups, which consist of beef, chicken, and other meat groups.

An important feature of the survey is that it does not collect market prices. Also no other survey gives sufficiently disaggregated prices to match with the spatial distribution of the clusters in our sample. Therefore, we used unit values (expenditures divided by quantities) as proxies for market prices. These were constructed by first converting all purchase quantities into kilograms, and then the unit values for each of the 17 meat items were aggregated, using a weighted geometric index, to give a unit value index for each of the 3 meat groups. The weights used are the average budget shares for each component meat in the group, calculated over all households in the survey. For example, for household j the unit value index for meat group k, $\ln V_{jk}$ depends on the unit values, v_{ij}, and weights for the i individual meat types that make up group k:

$$\ln V_{jk} = \sum_{i=1}^{I} \overline{w}_i \ln v_{ij} \ .$$ [9]

The characteristics of the unit values for all Java, and for urban and rural Java are presented in Tables 1a-1c. Overall, chicken (consists of purebred and free-range chicken) is the main type of meat consumed by the Javanese households. Means of the unit values are also shown in the tables. These are computed from those households who make market purchases of the commodity under consideration. In general, beef prices are higher compared to other meat types, especially in urban areas. On average, consumers paid Rp. 22,157 (A$4.14) per kilo for beef and Rp. 12,390 (A$2.32) per kilo for chicken.

The coefficient of variation (the standard deviation divided by the mean) can be used to indicate the degree of heterogeneity within each group, which is greatest for the other meat category, which consists of 14 different types of meat. Column (d) of the tables shows how many clusters record at least one household making a purchase for each of the meat categories. Overall, the number of clusters with unit values is the largest for chicken, followed by other meat and beef. It is also apparent that a substantial number of clusters have only one household that provides the unit values information, which in many procedures will provide the 'price' information used for all of the households in the cluster.

The shares of expenditures on each meat category are shown in the last columns of Tables 1a, 1b and 1c. A point to note is that these budget shares are not the ratios of aggregate consumption of each food to aggregate total consumption (so called 'plutocratic budget), but the average of the budget shares for each household. These meat items contribute almost 2 percent of the average budget, ranging from chicken at 1.04 percent to other meat at 0.27 percent. As can be seen from the tables, the urban population spends relatively more of their consumption budget on meat (especially for beef) than does the rural population, an indication of the relative affluence of the urban dwellers.

[9] Although the same weights are applied for all households, they are rescaled in each case to account for goods not purchased to ensure that the weights add to one for each household (Deaton, 1997).

VI. Empirical Results of the Elasticity Estimation

Deaton Procedure

Tables 2a-2c contain results from the first stage (within-cluster) estimation of the budget share and unit value equations. The first stage estimates explain much of the variation in unit values (between 51 to 68 percent for all Java), but somewhat less of the variation in budget shares. All of the expenditure effects on budget shares are statistically significant, as are all of those on unit values except for chicken and other meat in rural Java. The other (unreported) variables used at the first stage include (log) household size, a set of demographic variables (the number of household members in each of thirteen age and sex categories as a ratio of household size), and nine educational dummies. These variables are based on those used by Deaton (1990).

The positively signed b^0 coefficients in Tables 2a-2c indicate goods whose budget shares rise as household expenditures rise (i.e. luxury goods with expenditure elasticities greater than one) and this is the case for all three meat groups considered in the study. On average, beef has the highest expenditure elasticity compared to other meat types. Tables 3a-3c also show that rural households tend to have larger expenditure elasticities than urban households, indicating that meat is even more of a luxury good in rural areas of Java. For instance, rural households have expenditure elasticities of 3.44 and 2.73 for beef and chicken compared with urban households whose expenditure elasticities are 2.17 and 1.67. These results contradict Hutasuhut (2000), who found that the estimated expenditure elasticity is greater for urban households.

The quality elasticities, b^1 show the rate at which unit values rise as households become better off, reflecting the purchase of higher quality meats within a group. In general, the quality components of expenditure elasticities are the highest for the other meat category (ranging from 12 percent for Java to 14 for rural Java), suggesting that this group is fairly heterogeneous in quality. It is apparent from Tables 2a-2c that the quality elasticity for beef is almost twice the size of the quality elasticity for chicken (the difference is even larger for rural Java). The fact that unit values vary systematically with household income cautions against treating unit values as if they were prices. When prices rise, households are effectively made poorer, so they will downgrade the quality of their purchases and the reported unit value will not rise by as much as the (unreported) price level. Hence, price elasticities calculated as the percentage decrease in quantity divided by the percentage increase in unit value will tend to be too big, and this effect may be especially apparent for beef compared with chicken.

Tables 3a-3c contain the estimated own- and cross-price elasticities for Java, as calculated by the Deaton procedure. In addition to the three meat groups, there is an extra row and column for "all other goods", the estimates for which are obtained from the homogeneity and adding-up restrictions. The elasticities are conditional not only on household size and the dummy variables for household characteristics mentioned above, but also on a set of province and urban dummy variables. These dummy variables are used at the second stage (between-clusters) to control for any longer-term interregional price differences.[10] In addition to the price elasticities, the tables also include bootstrapped estimates of "standard errors". To calculate these standard errors, 1000 random draws are taken from the second stage data (i.e., the cluster average budget shares and unit values, after the effect of household total expenditures and other characteristics have been controlled for). For each of these random draws, all of the elasticities are recalculated. The length of the interval around the mean of each bootstrapped elasticity that contains 63.8 percent of the bootstrap replications is calculated and one-half of this interval is used as the estimate of the standard error. The rationale is that if the distribution of the elasticity estimates was normal, 0.638 is the fraction of a normal random variable within two standard deviations of the mean (Deaton, 1997).

All of the own price elasticities of demand are negative (except for the other meat category), as would be expected. Overall, the consumption of beef is more sensitive to changes in its own price than is the consumption of chicken. For example, a 10 percent increase in the price of beef (chicken) would reduce the amount consumed by 5.6 percent (2.5 percent). Demand for beef is considerably more price elastic in rural areas than in urban areas, possibly reflecting the lower incomes of the rural population. However, even with this greater elasticity, the results in Table 3c are considerably less elastic than almost all estimates in the literature either for Java or Indonesia, many of which also use SUSENAS data (see for example Chernichovsky and Meesok, 1984; Hutasuhut, 2000). However, Deaton (1990) points out that when unit values from SUSENAS are used as proxies for market prices and no correction is made for quality and measurement error effects, the expected bias is towards making elasticities too large in absolute terms.[11]

To check whether the results of interest, for beef and chicken are being affected by the unexpectedly positive own-price elasticity for other meats, we also estimated a system where other meats are included with the non-meat aggregate. This forces the elasticities for other meats (along with for other, non-meat consumption) to be obtained from the homogeneity and adding up restrictions. The results for this new, two-meat system are reported in Tables 3d-3f, and it is apparent that there are similar patterns to those found previously. Specifically, the demand for beef is more price elastic than is the demand for chicken (with the exception for urban Java) when other meats are excluded from the analysis. However, the exclusion of other meat as a separately specified item in the demand system does change the point estimates of the own-price elasticities for chicken (from -0.251 to -0.421 for all Java), making the distinction between the own-price elasticity of demand for beef and chicken less apparent. It is also apparent from Tables 3e and 3f that the demand for chicken in urban Java is more own-price elastic than it is in rural Java, which is the opposite to the pattern for beef. This could be due to many rural households in Java raising chicken for their own consumption.

Non-Deaton Procedure

Table 4 contains the estimated own-price and cross-price elasticities using five different unit values procedures which do not make the corrections for quality biases and measurement errors that the Deaton procedure makes. According to these simpler procedures, and in contrast to the Deaton method results in Tables 3d-3f, beef demand is much more own-price elastic than is the demand for chicken. The own-price elasticity of demand for beef appears largest when missing unit values are replaced with province-specific mean unit values. While this procedure also inflates the own-price elasticity for chicken, the effect on the beef elasticity is much larger. Thus, when province mean unit values are used for those households without a unit value, the demand for beef appears five-times as own-price elastic as is the demand for

[10] It is not possible to add them at the first (within-cluster) stage because the cluster fixed effects obliterate them.

[11] Deaton (1990) used SUSENAS data to estimate price elasticity for meat. He does not however disaggregate the meat category. So we cannot make comparison.

chicken, whereas when the Deaton method is used there is almost no difference in the beef and chicken own-price elasticities (based on the results for all Java).

Replacing missing unit values with either the district mean unit value or with the predicted unit value from a regression on regional dummy variables and household total expenditures causes some small improvement in the estimated own-price elasticities – in the sense of bringing them closer to the estimates from the Deaton procedure. However, there is still no overlap with the confidence interval for the beef own-price elasticity that comes from applying the Deaton procedure (Figure 1). The fact that the own-price elasticities are especially large for beef when estimation methods make no correction for unit value biases is not surprising. Uncorrected quality variation is expected to make own-price elasticities larger in absolute value (Deaton, 1988). Thus, the fact that the quality elasticity for beef is twice the size of the quality elasticity for chicken (see Table 2) suggests that the neglect of quality effects will exaggerate own-price elasticities more for beef than for chicken.

The methods of either replacing missing unit values with cluster mean unit values or using cluster mean unit values in place of both household–specific and missing unit values have a closer correspondence of point estimates and a high overlap of confidence intervals with the elasticities from the Deaton method.[12] The similarities of these two methods may reflect the fact that in the sample there are a large proportion of clusters that only have one consumer, so replacing missing values with the cluster mean is effectively the same as using the cluster mean for all households. Because of this feature of the current sample, these two methods may not agree as closely on other samples where there are more households with unit values in each cluster.

VI. Conclusions

In Indonesia, as in many developing countries, demand studies often rely on household surveys, with unit values used instead of market prices. Because Indonesia is an emerging market for beef and cattle exports, accurate estimates of the price responsiveness of beef and competing product demand may be useful to producers (Hutasuhut, et al., 2001). In this paper

[12] Some of the previous food demand elasticities calculated from SUSENAS data have in fact used the method of replacing household-specific unit values with cluster means (Case, 1991; Rae, 1999), so the results here may provide some support for this procedure.

we attempt to assess the possible role that unit value biases may play in interfering with the accurate estimation of meat demand elasticities. Specifically, meat demand elasticities calculated from procedures which attempt to correct for the various biases that may result from the use of unit values are compared with the elasticities that result from simpler procedures which do not make these corrections.

The results suggest that estimated meat demand elasticities are sensitive to the choice of procedure for dealing with unit values. The simplest procedures make demand appear more own-price elastic than do the more sophisticated estimation methods, with this effect especially apparent for beef. Hence, any pricing strategies for beef producers that are based on estimated demand elasticities may prove to be inappropriate if the wrong method for dealing with unit value biases is used.

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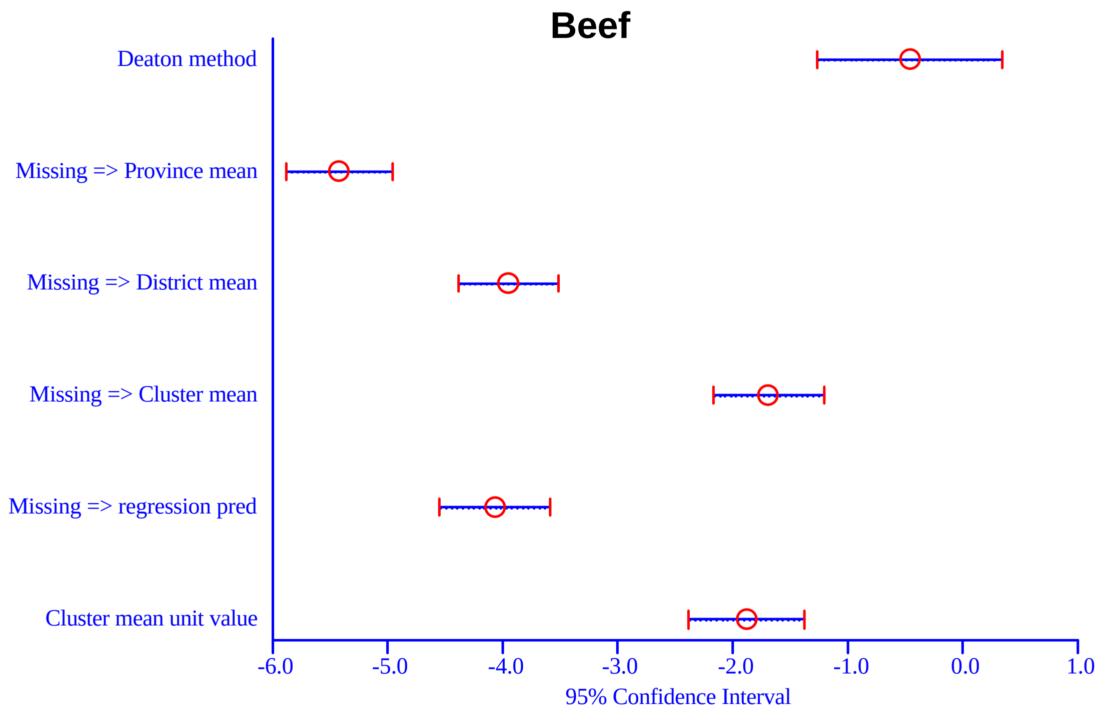
Figure 1: Comparison of Own-Price Elasticities from Different Methods of Using Unit Values



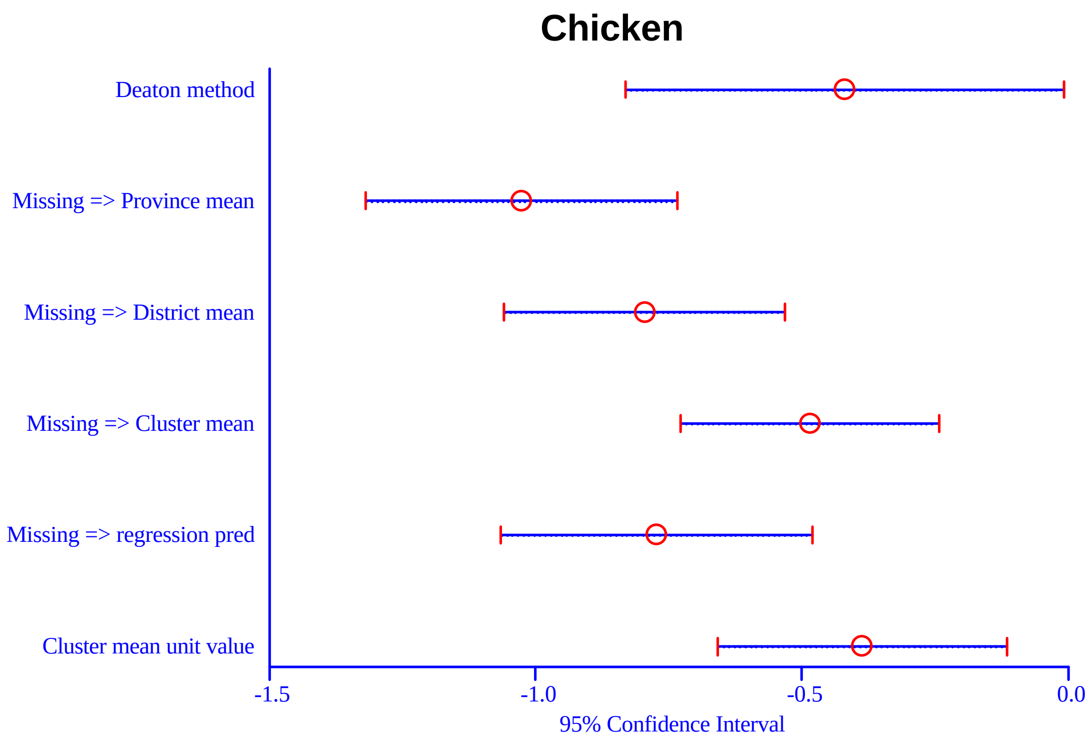


Table 1a. Commodities, Sample Sizes and Budget Shares for Java, 1999

Commodities	Number of households with unit values (a)	Mean unit value (b)	Coefficient of variation of unit value (c)	Number of clusters with unit values (d)	Number of clusters with only one consumer (e)	Percentage shares of total expenditure (f)
Beef	2,695	22,157.27	0.185	908	345	0.39
Chicken	5,984	12,390.80	0.187	1,388	312	1.04
Other Meat	2,714	12,847.76	0.444	943	361	0.27

Note: (a) is the number of households with a well-defined unit value, which equals the number of purchasing households minus those who report in irregular units

(b) in Rupiah per kg

Table 1b. Commodities, Sample Sizes and Budget Shares for Urban Java, 1999

Commodities	Number of households with unit values (a)	Mean unit value (b)	Coefficient of variation of unit value (c)	Number of clusters with unit values (d)	Number of clusters with only one consumer (e)	Percentage shares of total expenditure (f)
Beef	1,904	22,706.32	0.181	550	163	0.54
Chicken	4,140	12,460.94	0.186	767	89	1.24
Other Meat	1,969	12,844.45	0.442	578	164	0.36

Note: (a) is the number of households with a well-defined unit value, which equals the number of purchasing households minus those who report in irregular units

(b) in Rupiah per kg

Table 1c. Commodities, Sample Sizes and Budget Shares for Rural Java, 1999

Commodities	Number of households with unit values (a)	Mean unit value (b)	Coefficient of variation of unit value (c)	Number of clusters with unit values (d)	Number of clusters with only one consumer (e)	Percentage shares of total expenditure (f)
Beef	791	20,835.67	0.179	358	182	0.26
Chicken	1,844	12,233.34	0.188	621	238	0.87
Other Meat	745	12,856.51	0.450	365	197	0.20

Note: (a) is the number of households with a well-defined unit value, which equals the number of purchasing households minus those who report in irregular units.

(b) in Rupiah per kg.

Table 2a. First Stage Estimates: Effect of Total Expenditures on Quantity and Quality for Java

	Budget Share Equation			Unit Value Equation			
Commodities	b^o	$t(b^o)$	R^2	b^1	$t(b^1)$	R^2	e
Beef	0.007	24.14	0.22	0.048	4.61	0.68	2.66
Chicken	0.012	25.81	0.22	0.024	3.44	0.57	2.11
Other Meat	0.003	15.36	0.17	0.121	3.38	0.51	2.08

Note: b^o is the derivative of the budget share with respect to log total expenditures, b^1 is the derivative of the (log) unit value with respect to log total expenditures (a.k.a. the 'quality elasticity'), R^2 is for the budget share and unit value regressions, and e is the expenditure elasticity of quantity.

Table 2b. First Stage Estimates: Effect of Total Expenditures on Quantity and Quality for Urban Java

	Budget Share Equation			Unit Value Equation			
Commodities	b^o	$t(b^o)$	R^2	b^1	$t(b^1)$	R^2	e
Beef	0.007	16.22	0.23	0.041	3.52	0.65	2.17
Chicken	0.009	15.16	0.22	0.027	3.33	0.53	1.67
Other Meat	0.003	8.65	0.18	0.122	3.12	0.44	1.58

Note: b^o is the derivative of the budget share with respect to log total expenditures, b^1 is the derivative of the (log) unit value with respect to log total expenditures (a.k.a. the 'quality elasticity'), R^2 is for the budget share and unit value regressions, and e is the expenditure elasticity of quantity.

Table 2c. First Stage Estimates: Effect of Total Expenditures on Quantity and Quality for Rural Java

	Budget Share Equation			Unit Value Equation			
Commodities	b^o	$t(b^o)$	R^2	b^1	$t(b^1)$	R^2	e
Beef	0.007	17.72	0.18	0.076	3.20	0.71	3.44
Chicken	0.015	21.67	0.22	0.018	1.36	0.67	2.73
Other Meat	0.004	13.11	0.16	0.140	1.47	0.67	2.86

Note: b^o is the derivative of the budget share with respect to log total expenditures, b^1 is the derivative of the (log) unit value with respect to log total expenditures (a.k.a. the 'quality elasticity'), R^2 is for the budget share and unit value regressions, and e is the expenditure elasticity of quantity.

Table 3a. Unconstrained Estimates of Own and Cross Price Elasticities for Java, 1999

	Beef	Chicken	Other Meat	Other cons
Beef	**-0.560**	-0.115	0.359	-2.386
	(0.43)	(0.41)	(0.29)	(0.54)
Chicken	-0.165	**-0.251**	-0.225	-1.473
	(0.29)	(0.26)	(0.19)	(0.30)
Other Meat	0.044	-1.619	**1.061**	-1.684
	(0.46)	(0.60)	(0.51)	(0.61)
Other cons	0.000	0.001	0.001	**-0.270**
	(0.00)	(0.00)	(0.00)	(0.00)

Note: Standard error in ( ); Results for "Other cons" derived from homogeneity and adding up restriction

Table 3b. Unconstrained Estimates of Own and Cross Price Elasticities for Urban Java, 1999

	Beef	Chicken	Other Meat	Other cons
Beef	**-0.351**	0.013	-0.007	-1.867
	(0.48)	(0.58)	(0.45)	(0.63)
Chicken	0.197	**-0.277**	-0.343	-1.258
	(0.33)	(0.36)	(0.39)	(0.37)
Other Meat	0.158	-1.958	**0.376**	-0.279
	(0.49)	(0.88)	(0.68)	(0.65)
Other cons	0.002	0.001	0.000	**-0.270**
	(0.00)	(0.00)	(0.00)	(0.00)

Note: Standard error in ( ); Results for "Other cons" derived from homogeneity and adding up restriction

Table 3c. Unconstrained Estimates of Own and Cross Price Elasticities for Rural Java, 1999

	Beef	Chicken	Other Meat	Other cons
Beef	**-0.897**	-0.198	1.130	-3.552
	(0.98)	(0.74)	(0.59)	(1.19)
Chicken	-0.582	**-0.012**	-0.214	-1.913
	(0.60)	(0.45)	(0.31)	(0.62)
Other Meat	0.479	-0.415	**2.174**	-5.242
	(1.20)	(1.04)	(1.56)	(1.87)
Other cons	-0.001	0.002	0.002	**-0.272**
	(0.00)	(0.00)	(0.00)	(0.00)

Note: Standard error in ( ); Results for "Other cons" derived from homogeneity and adding up restriction

Table 3d. Unconstrained Estimates of Own and Cross Price Elasticities for Java, 1999

	Beef	Chicken	Other cons
Beef	**-0.458**	0.078	-2.330
	(0.43)	(0.37)	(0.53)
Chicken	-0.179	**-0.420**	-1.506
	(0.28)	(0.22)	(0.30)
Other cons	0.000	0.002	**-0.267**
	(0.00)	(0.00)	(0.00)

Note: Standard error in ( ); Results for "Other cons" derived from homogeneity and adding up restriction

Table 3e. Unconstrained Estimates of Own and Cross Price Elasticities for Urban Java, 1999

	Beef	Chicken	Other cons
Beef	**-0.352**	0.008	-1.867
	(0.46)	(0.39)	(0.61)
Chicken	0.125	**-0.528**	-1.278
	(0.31)	(0.21)	(0.36)
Other cons	0.001	0.002	**-0.268**
	(0.00)	(0.00)	(0.00)

Note: Standard error in ( ); Results for "Other cons" derived from homogeneity and adding up restriction

Table 3f. Unconstrained Estimates of Own and Cross Price Elasticities for Rural Java, 1999

	Beef	Chicken	Other cons
Beef	**-1.129**	0.157	-2.545
	(0.89)	(0.60)	(0.97)
Chicken	-0.538	**-0.080**	-2.104
	(0.56)	(0.41)	(0.59)
Other cons	-0.001	0.002	**-0.267**
	(0.00)	(0.00)	(0.00)

Note: Standard error in ( ); Results for "Other cons" derived from homogeneity and adding up restriction

Table 4. Comparisons of Price Estimates Using Different Unit Values Procedures[13]

a) Replacing missing unit values with province-specific mean

	Pooled		Urban Java		Rural Java	
	Beef	Chicken	Beef	Chicken	Beef	Chicken
Beef	**-5.420**	0.194	**-3.277**	0.060	**-10.444**	1.007
	(0.248)	(0.248)	(0.246)	(0.233)	(0.564)	(0.599)
Chicken	-0.617	**-1.026**	-0.304	**-0.988**	-0.345	**-1.047**
	(0.156)	(0.156)	(0.150)	(0.142)	(0.330)	(0.351)

b) Replacing missing unit values with district-specific mean

	Pooled		Urban Java		Rural Java	
	Beef	Chicken	Beef	Chicken	Beef	Chicken
Beef	**-3.947**	0.398	**-2.621**	-0.009	**-6.466**	1.897
	(0.232)	(0.225)	(0.247)	(0.221)	(0.479)	(0.502)
Chicken	-0.481	**-0.795**	-0.402	**-0.919**	0.072	**-0.383**
	(0.146)	(0.141)	(0.150)	(0.134)	(0.280)	(0.293)

c) Replacing missing unit values with the cluster mean of the unit values

	Pooled		Urban Java		Rural Java	
	Beef	Chicken	Beef	Chicken	Beef	Chicken
Beef	**-1.687**	-0.334	**-1.424**	-0.155	**-1.666**	-0.599
	(0.256)	(0.284)	(0.225)	(0.237)	(0.660)	(0.786)
Chicken	-0.129	**-0.485**	-0.138	**-0.731**	0.052	**0.121**
	(0.117)	(0.130)	(0.112)	(0.118)	(0.269)	(0.320)

d) Replacing missing unit values with the predictions from a regression of observed unit values on regional dummies and household total expenditures

	Pooled		Urban Java		Rural Java	
	Beef	Chicken	Beef	Chicken	Beef	Chicken
Beef	**-4.065**	0.162	**-1.984**	0.071	**-8.860**	0.828
	(0.256)	(0.248)	(0.256)	(0.234)	(0.574)	(0.601)
Chicken	-0.633	**-0.773**	-2.837	**-0.811**	-0.457	**-0.673**
	(0.161)	(0.156)	(0.156)	(0.142)	(0.336)	(0.352)

e) Replacing missing and non-missing unit values with the cluster mean unit values

	Pooled		Urban Java		Rural Java	
	Beef	Chicken	Beef	Chicken	Beef	Chicken
Beef	**-1.884**	-0.529	**-1.557**	-0.377	**-2.001**	-0.462
	(0.269)	(0.316)	(0.240)	(0.271)	(0.680)	(0.834)
Chicken	-0.164	**-0.387**	-0.163	**-0.677**	0.030	**0.256**
	(0.123)	(0.145)	(0.120)	(0.135)	(0.339)	(0.277)

[13] The estimated own-price elasticities using unadjusted unit values on the subset of households recording consumption of each good do not confirm with the economic theory as it gives positive own-price elasticity for

beef and chicken (with the exception of own-price elasticity for chicken in urban Java). The elasticity matrices using unadjusted unit values are available from the authors.