December 2006

Evaluating the Use of Unit Values and Community Prices in Demand and Food Policy Analysis

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Abstract

Agricultural economists sometimes have a choice of using either unit values or community prices when analysing food price policy. Unit values (ratios of household expenditure on a food to the quantity purchased), and community prices, which are enumerated from vendors in local markets, are both proxies for market prices. While it is believed that biases may result from the use of unit values, due especially to measurement error and quality effects, evidence on this issue is lacking. Even less is known about community prices. This paper provides empirical evidence that suggests that economists should exercise caution when using unit values as proxies for market prices. Community prices in our two case studies have a number of properties that make them more reliable in our two case study countries—Vietnam and Papua New Guinea. Price elasticities calculated from unit values provide poor approximations to those calculated with community prices. If the unit value-based (or community price-based) elasticities are biased, they may distort food policy analysis. In our study, the use of unit values (if wrong) could lead policy makers to decide to liberalize rice exports which could generate unexpected adverse nutritional consequences because price elasticities were understated.

JEL: C81, D12

Keywords: Food demand, Quality, Measurement error, Prices, Unit values

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EVALUATING THE USE OF UNIT VALUES AND COMMUNITY PRICES IN DEMAND AND FOOD POLICY ANALYSIS: TWO CASE STUDIES IN ASIA

Food policy analysis links nutrition objectives to economic policies and relies crucially on estimated price elasticities of demand (Timmer and Alderman, 1979). Price elasticities are also needed to better understand the effects of trade policies on households (Winters et al., 2004) especially because first-order approximations that ignore consumer substitutions can greatly overstate welfare losses (Friedman and Levinsohn, 2002). Many countries, however, lack the detailed price data needed for estimating elasticities. As a result, analysts frequently use *unit values* (expenditures/quantities) from household budget surveys as proxies for unobserved prices. Unfortunately, unit values have different properties than prices and their use can bias estimated demand elasticities in two ways (Niimi, 2005; Deaton, 1988). One problem with unit values is quality variation. If consumers respond to higher prices by reducing quality, then unit values will understate the increase in market prices, biasing elasticities. The other problem with unit values is that they reflect reporting errors in expenditures and/or quantities, potentially causing either attenuation bias or bias due to spurious correlation between demands and the unit values.

Warnings about the hazards of using unit values, however, are often ignored; many studies treat them as close substitutes for market prices. Some authors simply note that "prices paid by households were derived by dividing expenditures by quantities" (Han, *et.al.*, 2001, p. 180). Others mislabel unit values as "prices" (Minot and Goletti, 1998, p.740). Although sometimes unit values may be used because they are the only measure that is available, even when there is or could be other measures of market prices, continued reliance on unit values may have been encouraged because the bias from such procedures has never been empirically demonstrated. In fact, there has never been a 'crucial experiment' in which the elasticities calculated from market price data are compared with the elasticities from unit values (Deaton, 1990).

While use of unit values often reflects the unavailability of market prices, their use also may reflect the perception that prices collected by enumerators from vendors in local markets (henceforth, *community prices*) also can be unreliable proxies for market prices. It is possible that community prices are gathered from the wrong market, for goods with a different specification from that consumed by the household and are reported at prices that are not the prices actually paid by local residents (Deaton and Grosh, 2000). But, the fact is that we do not know how the quality of community price data compares to that of unit values since there has been almost no research on the nature of community price surveys (Frankenberg, 2000).

In this paper we use household survey data to compare price elasticities estimated with community prices to those estimated with unit values. Our case studies contribute in two ways to the literature on using unit values from cross-sectional data to estimate price elasticities. First, by comparing price elasticities based on community prices with those based on unit values, we illustrate the magnitude of the differences that can arise using common methods of estimating unit value-based and community price-based elasticities. We find this differences to be large and statistically significant, although we note that the interpretation of this difference depends on the assumption that community prices are an appropriate reference standard, an assumption which is relaxed at the end of the paper. Second, we examine the source of the differences between unit value-based elasticities from community price-based elasticities. Our findings on the use of unit values are consistent with those of Deaton (1997) which shows that quality effects are relatively minor. Beyond previous studies, we also show that differences between the community price- and unit value-based elasticity estimates may be due mainly to errors in the expenditures reported by households rather than errors in quantities. We also discuss steps that might be taken by analysts if they are not sure whether unit values or community prices is the best approach.

To illustrate the practical effect of relying on elasticity estimates that use unit values, we expand on a recent study by Minot and Goletti (2000). In their study, Minot and Goletti use data from the World Bank's 1993 Vietnam Living Standards Measurement Survey (VLSS) to estimate a 14-food demand system to simulate the impact that liberalizing the nation's rice market has on income, nutrition, and poverty. In our paper we use a second round of the VLSS data to reappraise the findings of Minot and Goletti. We show how the results vary if either unit values are used exclusively for all 14 foods or community prices are used exclusively. The key estimated policy parameter, the elasticity of calories with respect to rice prices, is quite sensitive to way price is measured. The fact that the choice of the measure of prices matters means that analysts should begin to take seriously the problems of measurement error when they are engaged in food policy analysis. We also use a data set that we collected from Papua New Guinea (PNG) to show that the sensitivity to using unit values or community prices applies more generally.

The rest of the paper is organized as follows. In the next section, we discuss the biases that can result when unit values are used in demand studies. Section 3 describes the household surveys and Section 4 uses the data to explore the reliability of the unit value and community price series. Section 5 contains the results of the econometric estimation of the 14-food demand system and examines the results of the food policy analysis based on the elasticites estimated using unit values and those using community prices. We also estimate a demand system for individual foods and introduce a wider set of unit value estimation methods. The final section concludes.

The Hazards of Unit Values and Community Prices

Although Deaton (1988, 1990, 1997) and others have discussed the shortcomings of using unit values as proxies for market prices, many analysts ignore these warnings.[1] 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. The two models that we use in this paper, the *double log* and the *share-log* (or budget share), are the models used by Deaton (1987, 1990) in his unit value correction procedures.[2]

The models, written in terms of an arbitrary good *i* (with no index for households) 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 (or log-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 elasticity formulas are important in evaluating the direction of bias.

Bias due to quality variation

The first problem that arises from using unit values as proxies for prices is quality variation. In local 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 γ_{ii} coefficient in (1) and (2) will be larger 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 in the elasticity parameter depends on the sign of the $\bullet_{ii}$ coefficient. In model (1) $\bullet_{ii}$ 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 $\bullet_{ii} > 0$, and the exaggerated size of $\bullet_{ii}$ will make it appear as if the commodity demand is even more inelastic. In this case, the elasticity will tend to be closer to zero. Conversely, if the demand is own-price elastic, then $\bullet_{ii} < 0$, 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 (a RHS variable) are noisy measures of market prices. In the case of attenuation bias, the error that affects the unit values is not correlated with the dependent variable. Hence, in the case of the budget share model (equation (2)), attenuation bias occurs when expenditures are measured with little error while quantities are. In this case, by construction, unit values also are measured with error. The bias would be in the opposite direction to that caused by quality variation.[3] Attenuation bias in this case is expected to force the estimated $\bullet_{ii}$ toward zero and the estimated price elasticity towards –1. In the case of the log-log model, attenuation bias occurs when quantities are measured with little error and expenditures (and unit values) are measured with relatively serious error. In this case, since the dependent variable is not measured with error, but the right hand side variable is, the estimate of the elasticities (which is $\bullet_{ii}$) is biased toward 0. Thus, attenuation bias due to random measurement error (that is, not correlated errors) 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*, or errors in measuring expenditures and/or quantities that appear on both the left-hand and right-hand sides of equations (1) and (2).[4] Correlated errors become a problem in the case of equation (1) when quantities are measured with error. For example, consumers may not correctly recall the quantity of food consumed, Q_i, and instead mis-estimate it as $Q_i \pm \bullet_Q$. In this case the LHS of equation (1) is measured with error. The problem with this type of error, however, is that it 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 quantity also appears in the unit value (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 ($\bullet_Q$), and right-hand side ($-\bullet_Q$) of equation (1). Thus, no matter what the true relationship between price and quantity, the estimated relationship will be more negative because of the spurious negative correlation between quantity and unit value. Thus, correlated errors bias operates in the opposite direction to attenuation bias, causing the response of quantity to price to be overstated (move away from zero). The effect of correlated errors in equation (1) acts to reinforce the error due to quality effects.

In the case of budget share models the problem of correlated errors is different.[5] If quantities are measured with little error, but expenditures are measured with error, both the LHS and RHe variables contain a common error term. In this case, however, since the error components are in the numerator of both variables, the estimated relationship will be more positive because of the positive correlation between the budget share and the unit value. Thus, for foods that are own-price inelastic ($\bullet_{ii} > 0$), the correlated errors bias will cause the estimated elasticity to be closer to 0 and further from –1. Thus, correlated errors bias the elasticities from the budget share model in the opposite direction to the attenuation bias and in the same direction as bias due to quality variation.

From this discussion biases due to the use of unit values in demand studies are potentially pervasive and complex. Moreover, it is difficult ex ante to predict which variable will be subject to more serious measurement problems. The specific commodity, the type of household and the environment within which households are operating all affect the nature of the measurement error. The different potential biases are summarized in Table 1. Because it is difficult to give an *a priori* indication of the overall direction of the bias, an empirical analysis is needed. In particular, comparisons of the elasticities calculated from unit values with those calculated from community prices would be one strategy to assess the nature of the biases that arise when using unit values. The strategy, of course, depends on the assumption that community prices are good measures of true market prices. There is no guarantee of this, however. Without a benchmark against which unit value prices can be reliably compared, the key finding of the analysis would be that two estimates of price elasticities vary (or be similar, in which case there either set of estimate could be used). If there are great differences between unit value-based and community price-based elasticities, and there is no apriori reason for believing one series of prices are measured with less error, then the food policy analysts needs to consider the range of possible estimates and assess what the consequences would be of choosing to put more analytical faith in one over the other.

Measuring Prices with Community Surveys

While during part of the paper (results section below), we assume that the information from a community price questionnaire can be used to create measures of the true prices households face when making their consumption decisions, we also recognize that it is possible that there are several sources of errors in collecting community prices which are more serious than those that affect unit values. For example, prices collected in community surveys may not reflect the actual prices that are faced by consumers. Hence, while community prices (unlike unit values) are desirably free of household-level variation associated with endogenous purchasing decisions, it is possible that community prices do not reflect all of the differences across communities and across households in the exogenous purchasing opportunities that they face. The question becomes an empirical one: How serious is the measurement error from the sources?

Data and Econometric Issues

The data for the primary analysis come from the 1997-98 Vietnam Living Standards Survey (VLSS). The VLSS is based on a nationally representative sample of 6000 households scattered across 194 rural and urban communes.[6] The fieldwork for this survey took place between December 1997 and December 1998, with an equal number of households surveyed in each quarter of the year. Over three-quarters of the sampled households were also included in the 1992-93 VLSS that is used by Minot and Goletti (2000). This fact, plus the similarity of survey methods in the two years, suggests that our findings should be relevant for interpreting any biases in the demand estimates used by Minot and Goletti in their food policy simulations.

The VLSS is an integrated household survey that collects information on income, expenditure, demographics and related topics. The food expenditure block of the survey asks respondents to recall four details for each of 45 foods: the number of months they purchased the item over the past year; the number of times per month they purchased the item; the usual quantity of each purchase; and the value of this quantity. A similar set of questions is asked about own-production and other non-purchases (such as gifts received). Using these data, an estimate of annual consumption expenditure on each food can be constructed.[7]

The most important food item in the survey is rice, a commodity that constitutes 40 percent of household food expenditures (including self-produced and gifted items). With an average food budget share of 50 percent, rice comprises 1/5th of the total household budget. Other key foods are pork, fish, fruits and vegetables (Table 2, column 1). The consumption budget shares reported here are based on the 14 food groups used by Minot and Goletti (2000). The food expenditure block of the questionnaire contains all of the information that is needed for calculating unit values. The survey allows respondents to report quantities in several different units. To ensure a higher degree of consistency, we formed unit values only from quantities that were reported in units deemed more reliable for the particular food (usually kilograms). The unit values were calculated only from the market purchases of households. To further guard against the possibility of outliers affecting the results, we removed any unit values that were more than four standard deviations from the mean for each food, following Cox and Wohlgenant (1986).[8] The unit values for each of the 45 foods were aggregated, using a weighted geometric index, to give a unit value index for each of the 14 food groups. The weights used are the average budget shares for each component food in the group, calculated over the survey households.

An important feature of the VLSS is that enumerators also executed a market price survey in rural and urban communities. In the survey, 3 observations were made on food prices in local markets for 36 food items. We calculate weighted geometric price indices from these community prices, use the aggregated community prices when estimating price elasticities and assess how community price-based demand elasticities compare to those estimated from unit values.

In addition to the data from Vietnam, we supplement our study with data from PNG, which were collected by the authors in 1996. The survey covered a random sample of 1200 households, residing in 120 rural and urban clusters. Respondents provided information on the value and quantity of food purchases, gifts, and own-production. Enumerators also collected community prices in each cluster using two different surveys. The community prices of food items purchased from commercial retail outlets (e.g., rice, sugar, tinned fish, beer) were collected from the two main trade stores or supermarkets used by the households in each cluster. The survey team also collected prices of locally produced and marketed foods from the nearest local outdoor market. Enumerators recorded the price and weight of up to six different lots of each commodity. The community price survey was carried out on two different days, providing us with prices on up to 12 lots of each food item for each cluster.[9]

Unit Values Versus Community Prices

Our data from Vietnam and PNG demonstrate the differences between community prices and unit value series (the important point) and there is some supporting evidence that community prices may more accurately measure the market price faced by consumers. Above all, comparisons of community prices and unit values from the VLSS using only households that *both* made purchases of goods during the year *and* for which there were prices recorded in the local market are not consistent with the implicit assumption of many demand analysts that unit values are close substitutes for community prices (Table 3, rows 1 to 7, column 5). The average correlation between the two measures of price is less than 0.40 across the 7 foods.[10] Even for major foods, such as rice and pork, the correlations are only 0.436 and 0.604. These correlations are not atypically low; the correlations between community prices and unit values for the major foods in PNG are equally low (rows 8 to 10).

Equally important, we also find that community prices are less variable than unit values. For the seven foods where Minot and Goletti use unit values, the coefficient of variation of the unit value series ranges from 26 to 250 percent higher than those of the community price series (Table 3, rows 1 to 7, columns 2 and 4).[11] In the case of the three goods from the PNG survey, the coefficients of variation also are higher for unit values (rows 8 to 10). Even when the data are collapsed to cluster-level averages, which should remove idiosyncratic error, there is a low correlation between (log) unit values and (log) community prices (Table 2, column 6).

The correlation among individual price records *within clusters* in the Vietnam study also is higher for community prices than for unit values. For example, in the case of rice, the average correlation amongst the unit values within a commune was only 0.42. Knowing that part of the variation among households is due to quality effects, we can remove the effect of quality using the first stage of the Deaton method (see next section for the model). Even after doing so, the average intra-cluster correlation of unit values is still only 0.53. In contrast, the average intra-cluster correlation of community price observations for rice (that is, the correlation of the reported prices from the three vendors that were interviewed) is more than 0.90.

The above exercises show that community prices are less variable than unit values (even when quality effects are removed); one interpretation of this is that community prices are more reliably measured. There are also other criticisms of community prices although our data suggest that some of these are unfounded. For example, if the method used by enumerators to elicit price data from vendors in local markets was flawed in not taking into account the propensity of buyers and sellers to bargain (as opposed to merely inquiring about the price without bargaining), we would expect community prices to be substantially higher than unit values that are reported by households after bargaining. While the community prices of four of the items from the VLSS (rice, pork, sugar and cooking oil) are above the unit values, others are below (Table 3, columns 1 and 3). Moreover, with the exception of pork, the gap ranged only from 1 to 3 percent.[12]

Our data sources also suggest that measurement errors due to the propensity for consumers to shop for food outside the local market and/or buy in quantities for which they receive a bulk discounts are not serious. If the shopping habits of consumers did earn them substantial savings, like the case of bargaining, we would expect unit values from households to be lower than community prices. The narrow gap between unit values and community prices reported in Table 3, however, also serves to counter these arguments. The same patterns were found in the data collected in PNG's rural areas.

One final factor which may distort the comparison of unit values and market prices is that the unit values refer to purchases made over the last 12 months, and so should not vary by season, whereas the community prices may reflect current seasonal conditions. An examination of rice unit values and community prices, however, suggests that community prices and unit values have a similar temporal pattern across the months of the survey (Figure 1).[13] While such a finding should concern users of community prices since this means that the price recorded by the enumerator on any given survey visit is not going to be representative of the price faced by the household over the rest of the year, the method used by the VLSS to overcome this problem for the collection of unit values (i.e., asking about consumption quantities and expenditures for the whole year) does not appear to overcome this problem. Surprisingly, the unit value series has a similar seasonal trend to the community price series.[14]

In summary, according to our analysis of the behavior of community prices and unit values, we believe community prices are somewhat better proxies of the true market prices that consumers face than are unit values. There appears to be less variation in community prices, the correlations amongst observations within a cluster are higher and they are more closely correlated with alternative measures of market prices. While based on these criteria, community prices arguably are better measures of market prices than unit values, we do not want to in anyway attempt to argue that community prices are perfect. In fact, we have raised and discussed a number of sources of errors. At least in the Vietnam and PNG samples, we are not able to find evidence that the problems with the community prices are any worse than the shortcomings of unit values. However, we also do recognize that both prices series could be measured with error and if so it would be useful information to know if estimates of price elasticities that are needed to food policy analysis are the same or not. If the elasticity estimates are different, and if there is no ex ante way of being sure which estimate is more distorted due to measurement error, the careful analyst will want to consider the policy implications on relying on both of the estimates.

Price Elasticity Estimates, Unit Values, Community Prices and Food Policy

In this section, we explore the implications of using alternative proxies for market prices on estimated price elasticities. We also decompose the differences in price elasticities that result when demand analysts use unit values and community prices. Although we present some results for the log-log model (equation 1), we rely mainly on the budget share model (equation 2). In the first part we estimate price elasticities for 14 food *groups*, while the second part is based on individual foods, for whom quality bias due to aggregation should be less severe. The estimation of the 14 food group model is repeated three times: once with community prices used for all groups, once with unit values for all; and finally with unit values for seven of the food groups and community prices used for the other foods, following Minot and Goletti. The control variables, also following Minot and Goletti, include: the logarithm of household size, the proportion of young children in the household, the proportion of adults, dummy variables for farm households and female-headed households, and seven regional dummy variables. The budget share regressions range in explanatory power from an R^2 of 0.79 for rice to only 0.16 for 'other grains.' Since with three 14×14 matrices of elasticities there is too much detail to report, the comparisons concentrate on the own-price elasticities.[15] Policy-wise, our objective is to explore the consequences for policy making of using unit values versus community prices. Following the discussion above, we conduct our analysis under the assumption that community prices are better measures of market price and examine what impact using unit values has on the simulated nutritional impact of liberalized rice prices in Vietnam. This assumption is relaxed in the discussion in the next section.

Elasticity Results for Food Groups

Our initial reappraisal of the results of Minot and Goletti (2000) comes from the model that is estimated using unit values for rice, maize, cassava, sweet potato, pork, oil, and sugar, and price indexes for the other foods (these results are contained in the column headed "Mixture" in Table 4, column 2). According to the model, the own-price elasticity of demand for rice in Vietnam in 1997-98 is -0.24, which is exactly the same as the price elasticity reported by Minot and Goletti (2000, p. xii), at the mean income level in 1992-93.[16] The own-price elasticities for the other foods in Table 4 also obey a similar pattern to that found by Minot and Goletti. The correlation between the two sets of elasticity estimates is 0.89.[17]

However, the elasticities differ when market prices are used for all of the food groups (Table 4, column 4). The own-price elasticity of demand for rice is -0.58, which is more than twice the size (in absolute value terms) of that which is estimated from the use of unit values. The small standard errors on each of the elasticity estimates also demonstrate that the differences are statistical significant; the 95 percent confidence intervals are far from overlapping. It is also notable that the particular combination of prices and unit values used by Minot and Goletti makes the demand for rice appear even more inelastic (-0.24—column 2) than if unit values had been used exclusively (-0.32—column 3).[18]

The differences in the elasticity estimates when using unit values and community prices are not limited to rice. There also are large discrepancies in the elasticities for maize, cassava, sweet potato, sugar and cooking oil. To summarize these discrepancies across all 14 food groups, we use the concept of the sum of squared deviations.[19] Let $\bullet$ be the vector of elasticities calculated from the community price series and $\hat{\bullet}$ the corresponding elasticity vector from either unit values alone or from the mixture of community prices and unit values. The sum of squared deviations is calculated as $(\hat{\bullet} - \bullet)'(\hat{\bullet} - \bullet)$, for both the own-price elasticities alone and for the full system of own- and cross-price elasticities. The sum of squared deviations reported at the bottom of Table 4 show that the results using the mixture of prices and unit values are somewhat closer to the vector of market price elasticities than are the results that just use unit values. Nevertheless, the discrepancy is still large; on average, each elasticity in the "mixture" column is at least 0.4 points above or below the corresponding elasticities calculated with community prices.

The results suggest that using unit values as a proxy for market prices causes the own-price elasticity of demand for rice to be biased upwards (that is, towards zero). The discussion of theoretical biases that are summarized in Table 1, row 2 suggests that in a budget share model (with inelastic demand) uncontrolled quality variation in unit values would cause such a bias (column 1). Correlated errors between the rice budget shares and rice unit values induced by errors in reporting expenditures could also cause the own-price elasticity for rice to be biased towards zero (column 3). Errors in reporting expenditures are also consistent with the pattern of shifts in the elasticity estimates when the log-log rice demand model is used with unit values:[20]

$$\ln Q_r = 3.92 - \underset{(0.06)}{0.28}\ln V_r + \underset{(0.27)}{0.41}\ln x - \underset{(0.01)}{0.03}[\ln x]^2 + \underset{(0.03)}{0.92}\ln n + regional \;\; dummies$$

where Q_r is the quantity of rice consumed, V_r is the unit value for rice, and n and x are household size and total expenditure (with standard errors reported). When rice prices, P_r are used:

$$\ln Q_r = 4.39 - \underset{(0.08)}{0.44}\ln P_r + \underset{(0.27)}{0.35}\ln x - \underset{(0.01)}{0.03}[\ln x]^2 + \underset{(0.03)}{0.94}\ln n + regional \;\; dummies$$

Using unit values with a double-log model causes the estimated own-price elasticity of demand for rice to be biased *toward* from zero, which is the same direction of bias as observed in the budget share model. This pattern is what would be expected if the major source of bias is due to errors in measuring expenditures, which would cause attenuation bias in a log-log model (Table 1, row 1, column 3). It is reasonable that in the case of rice, which in Vietnam is largely a home-produced cereal crop, consumption expenditure is measured with more error than quantities.

It seems apparent from the above results that the use of unit values can cause bias in estimated price elasticities of demand (or at least cause them to be different than community price-based estimates). To explore how the differences might affect food policy analysis, we calculated the elasticity of caloric intake with respect to rice price, ε_{cr}:

$$\varepsilon_{cr} = \sum_{i=1}^{I} \varepsilon_{ir} c_i , \tag{3}$$

where ε_{ir} is the elasticity of demand for food i with respect to the price (or unit value) of rice and c_i is the contribution of food i to total caloric intake. This calculation follows a similar one made by Minot and Goletti, which resulted in an estimate of the calorie elasticity with respect to rice prices of -0.21. When the calorie elasticity is calculated from the demand system with the mixture of prices and unit values that Minot and Goletti use, there appears to be only a small negative response of caloric intake to higher rice prices (-0.27±0.07). But the measured response is twice as large (-0.54±0.05) when using the elasticities from the demand system that exclusively uses community prices. Hence, using community prices shows a sharper tradeoff between food security and export revenue objectives, following the relaxation of Vietnam's rice export quota.

From this analysis it should be clear that it is important to understand the magnitude of the differences in elasticities that can arise from different proxies for prices. If the community price-based estimates were right, then any harmful effect on nutritional status in Vietnam from rice price liberalization measures is largely disguised when unit values are used to calculate the elasticities. However, we do not know that. In contrast, if the unit price-based estimates were actually correct, but analysts used the community price-based estimates, policy makers that are worried about the poverty effects may decide not to liberalize rice prices.

Elasticity Results for Individual Foods

For a number of reasons, our analysis in the preceding section may have unfairly characterized the problems in demand modeling approaches that rely on unit values. In this section, we seek to show that our findings are robust to several modeling choices. In particular, we show that the differences (which we can call biases for now) from using unit values is largely the same even when the food groupings change and even when the estimation approaches change. We also examine the elasticity estimates when using the methods suggested by Deaton (1990) and Cox and Wohlgenant (1986), approaches that were developed to adjust for some biases that are inherent in using unit values. As before, we also seek to identify whether quality variation or measurement error (or both) is responsible for the bias that occurs when using unit values.

The main substantive change in this section is to re-run our analysis using individual foods rather than broader food groups. The potential problem with the broader food groups is that because they are less homogeneous, they may give more biased estimates of price elasticities due to the larger within-group quality variation. Hence, we only consider the seven individual foods (rice, cassava, maize, sweet potato, pork, sugar, and cooking oil) that Minot and Goletti (2000, p. 48) identify as being more homogeneous and more suitable candidates for using unit values.

Another change is that there is no replacement of either missing commune-level mean unit values or community prices with their regional means. Many more communes lack a unit value than lack market prices (*n*=75 across the seven foods), so the previous procedure often compared regional unit values with commune-level prices. Hence, it is perhaps unsurprising that the unit values provided poor approximations. In this section, communes in which no household purchases a particular food are excluded from the analysis because there is no way to estimate a unit value for them. It is possible that in some settings, and with some survey designs, all clusters of households would have at least one unit value available so we wish to study the performance of unit values under these conditions.

Another advantage of dropping communes with no unit values available is that it enables use of the econometric procedure specifically developed by Deaton (1990) to correct for bias that unit values introduce into price elasticity estimates.[21] This approach relies on a budget share equation (equation 2 with the addition of fixed effects) and on an equation that explains the variation in unit values. Intra-commune variation in budget shares and unit values identifies the effect of income and other household characteristics on both the quantity and quality demanded. The effect of income on the unit value is shown by a *quality elasticity* which also indicates how important quality variation is to any bias in the price elasticity estimates. Any residual variation in unit values (and covariance with the budget share residuals) is assumed to reflect measurement error. The effect of this measurement error is accounted for in a between-communes, errors-in-variables, regression applied to budget shares and unit values that have previously been purged of the effect of household characteristics. The effect of price on quantity is then untangled from any commune-wide quality effects, using a separability theory of quality (Deaton 1988).

The combination of using individual foods and no replacement of commune-level missing values does pose one problem. There are 107 communes where no households purchase either maize or cassava. Thus, including these two foods in the demand system could potentially reduce the sample to just 2600 households (in 83 communes). This small sample may not be an adequate testing ground for the Deaton correction procedure, which depends on a large number of clusters for its consistency (Deaton, 1990). Therefore, maize and cassava are excluded from the demand system and for the remaining five foods (rice, sweet potato, pork, sugar and cooking oil) there are 149 communes (containing 4638 households) with both prices and unit values available.

The results of estimating the budget share model for each of the five foods using the community prices are reported in Appendix Table 1. Using these results, the next step generates a matrix of own- and cross-price elasticities, which produces our baseline set of elasticities (Appendix Table 2). The own-price elasticities estimated from the community prices for the individual foods are close to the results for the same foods that were estimated on the full sample of communes.[22] For example, the own-price elasticity of demand for rice is estimated as -0.50 ± 0.04, compared with the estimate from the 14-food system on the full-sample of -0.58 ± 0.05. Hence, the switch to a smaller sample and modeling individual food demands should not affect our comparisons of unit value-based and community price-based elasticities.

In comparison with the own-price elasticities estimated from community prices, the elasticities estimated from unit values are almost all significantly less elastic, regardless of the procedure used to correct for unit value quality biases (Table 5, column 2 to 5). This consistent shift in the elasticities when unit values are used is suggestive of the importance of errors in measuring food expenditures, which would bias the γ_{ii} coefficients from equation 2 upwards, making demand appear less own-price elastic. While quality variation in unit values typically also makes elasticities from budget share models more inelastic, this source of error can be ruled out for two reasons. First, quality variation should move the elasticity for sweet potato in the opposite direction to that for the other foods because sweet potato is an own-price elastic good (that is, $\gamma_{ii} < 0$) when community prices are used. But in fact the unit value-based own-price elasticities for sweet potato are all significantly closer to zero, which is inconsistent with the effect of quality variation. Second, the quality elasticities calculated from the Deaton procedure are universally small, ranging from 0.02 to 0.12, with the most important foods (rice and pork) having quality elasticities of 0.06 and 0.08 (Appendix Table 3, column 4). Thus a doubling of household expenditures would raise the unit value of rice by only six percent, suggesting that quality effects are small.

In addition to providing information on the likely source of measurement error bias, the elasticities reported in Table 5 also allow us to assess the performance of some procedures that have been suggested for dealing with unit value biases. The Deaton procedure, which has been described above, performs rather poorly on this sample (Table 5, column 2). The elasticities have the largest sum of squared deviations from the community price elasticities and two of the own-price elasticities from the Deaton procedure are positive (albeit with wide standard errors). Thus, it may be that even with 150 clusters, the Deaton procedure is not able to provide consistent estimates, despite its sophisticated econometric content. Interestingly, comparing the results with those using the Deaton method in an analysis of price elasticities for PNG rural consumers, we find similar poor performance of the Deaton estimator (Gibson and Rozelle, 2005).

The Cox and Wohlgenant procedure (Column 3) is based on a regression of unit value deviations from regional and quarterly means on a set of household characteristics. This regression is designed to provide a set of quality-adjusted unit values for both the consuming and non-consuming households. While giving the smallest sum of squared deviations from the community price elasticities, it fails to reproduce the pattern of elasticities that are estimated from the community prices. The food that is the least own-price elastic according to community prices (sugar) becomes the most elastic, while the food that is the most elastic with community prices (sweet potato) becomes the second least elastic. This reversal of the patterns is shown by the negative correlation coefficient for the two sets of own-price elasticities (Table 5, col. 3, row 8).

The last two procedures reported in Table 5 use cluster averages (either means or medians) of the unit values, in place of both missing and household-specific unit values. The advantage of averaging is that it can improve consistency of the estimator (Deaton, 1997) because measurement error variance falls as cluster size increases (VLSS clusters contain approximately 30 households), while medians have the further advantage of being robust to outliers. However, like the previous results, using commune means of the unit values produces own-price elasticity estimates that are substantially less elastic than the estimates from the community prices (Table 5, column 4). When commune medians of the unit values are used, the sum of squared deviations from the community price elasticities is smaller than it is for the commune mean unit values, but the correlation with the community price-based elasticities is even lower (rows 6 to 8).[23]

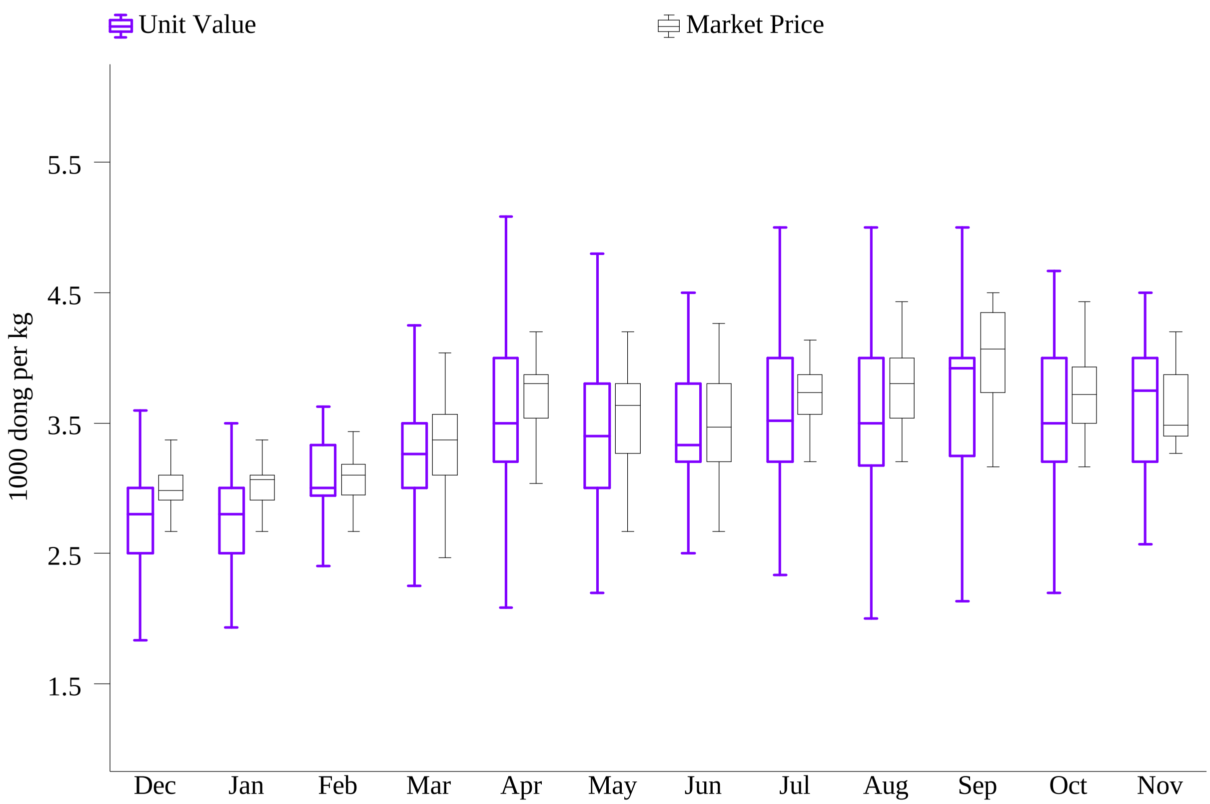
Summary and Conclusion

Agricultural economists sometimes have a choice of using either unit values or community prices when estimating price elasticities of demand for food policy analysis. Both are proxies for the actual market prices that influence household demand. The results reported in this paper suggest that analysts should exercise caution when using unit values as proxies for market prices. In comparison with the community prices in our two case study countries, unit values have a number of unfavourable properties, including a lower statistical reliability – in the sense of having lower correlations amongst reports on what should be the same local price. This greater reliability of the community price data matters because price elasticities calculated from unit values provide poor approximations to those calculated with community prices. We infer from this that the unit value-based price elasticities may be biased, causing possible distortions to food policy analysis. In the example studied here, using unit values may have caused any adverse nutritional consequences of liberalising rice exports from Vietnam to be understated. The possible dependence of policy recommendations on the type of price data used for the elasticity estimates also underlines the need for sensitivity analysis, especially in cases where analysts are forced to rely on unit values as the only available proxy for market prices.

While for the reasons stated above (and for reasons that are found in Gibson and Rozelle, 2005), there is some reason to believe that community prices are better measures of market prices than unit values, we also understand that it is too heroic to really believe the community prices in all situations (including our own case studies) are not measured with substantial error also. If so, the nature of our conclusion changes. Instead of putting the emphasis on collecting better community prices and ignoring unit values, our results can be interpreted as being a challenge to try to untangle the effects of unavoidable measurement error. According to this interpretation, the analyst assumes that both unit value-based and community price-based estimates of price elasticities are biased. There are several responses. First, as we do in Gibson and Rozelle (2005), the research team at the time of data collection may put effort into collecting a third set of market price data. Whether picture data or diaries or whatever, given the importance of having good proxies for market prices, there should be effort into collecting data with as little error as possible.

Alternatively, analysts may want to assume that there will be error and take steps to adjust for it or use analytical methods to understand the serious of the problem. If an instrument could be collected, an IV approach could be used to correct for the measurement error with either (or both) of the unit values or community prices. If there are no good instruments available, food policy analysts may want to follow the procedures of Black et al. (2000) that generate a set of bounds within which the true estimates of the parameters may lie. With this information, the costs and consequences of using alternative estimates of the price elasticities can be compared and conditional food policy recommendations can be presented to policy makers.

If community price measures do a respectable job of proxying for market prices, our analysis also found that the major source of the discrepancy between unit value-based and community price-based elasticities appears to be measurement error in food expenditures. When unit values are used as a proxy for price, this type of error causes attenuation bias in models with log quantity as the dependent variable and correlated errors bias (in a positive direction) in budget share models. The quality effects in unit values, and the contribution of these effects to bias in the price elasticities, is relatively minor. Thus, the emphasis on quality effects in unit values (Deaton 1988) and on the calculation of quality-adjusted prices (Cox and Wohlegenant, 1986), may be somewhat misplaced. Instead, the main need according to our findings is to develop data sources and estimation methods that minimise the effect of errors in reporting food expenditures.



Note: See footnote 14 for interpretation of the graph symbols

Figure 1: Distribution of Rice Market Prices and Rice Purchase Unit Values by Month in the Vietnam Living Standards Survey

Table 1. The Nature of Biases in Estimates of Own Price Elasticities from Demand Equations from Various Sources of Measurement Error Using Unit Value Data.

	Errors in Unit Value-based Demand Equations due to:		
Functional Form[a]	Quality variations	Quantities (and unit values) being measured with error, but not expenditures	Expenditures (and unit values) being measured with error, but not quantities
Log-log	More elastic (Further from 0)	Correlated errors problem (negatively correlated errors) More elastic (Further from 0)	Attenuation bias More inelastic (Closer to 0)
Budget share (when inelastic price relationship)[b]	More inelastic (Closer to 0)	Attenuation bias More elastic (Further from 0)	Correlated errors problem (positively correlated errors) More inelastic (Closer to 0)
Budget share (when elastic price relationship)[b]	More elastic (Further away from -1; larger in absolute value terms)	Attenuation bias More inelastic (Closer to –1; smaller in absolute value terms)	Correlated errors problem (positively correlated errors) More inelastic (Closer to 0; smaller in absolute value terms)

[a] The functional forms are being imposed on standard demand equations. In the log-log equation, the log of the quantity demanded is on the LHS and log of the unit value is on the RHS. In the budget share equation, the expenditure share is on the LHS and the log of the unit value is on the RHS.

[b] In the budget share model, an inelastic relationship is one in which the gamma parameter in equation (2) is greater than 0 (or $\bullet_{ii} > 0$); an elastic relationship is one in which $\bullet_{ii} < 0$.

Table 2: Descriptive Statistics for Unit Values and Market Prices of 14 Major Food Groups and Correlations between Unit Values and Market Prices in Vietnam, 1997-98.

	Mean Budget Share	Unit Values		Market Prices		Correlation between unit values, prices
		Mean	Std. deviation	Mean	Std. deviation	
Rice	0.204	1.24	0.10	1.25	0.14	0.55
Maize	0.002	0.94	0.20	0.84	0.25	0.16
Other grains	0.001	2.01	0.20	2.53	0.14	0.11
Cassava	0.002	0.28	0.30	-0.07	0.50	0.42
Sweet potato	0.014	0.67	0.39	0.28	0.40	0.41
Legumes	0.005	1.92	0.17	2.05	0.14	0.30
Fruits and vegetables	0.042	0.88	0.27	0.93	0.20	0.42
Pork	0.062	2.91	0.19	3.04	0.20	0.74
Other meat	0.029	2.91	0.18	2.99	0.15	0.46
Fish	0.050	2.29	0.26	2.60	0.26	0.38
Sugar	0.008	1.92	0.06	1.95	0.08	0.26
Cooking oil	0.013	2.38	0.15	2.66	0.08	-0.11
Other food	0.050	1.90	0.17	1.72	0.12	0.02
Beverages	0.020	2.42	0.36	2.35	0.21	0.34

Source Author's calculations from 1997-98 Vietnam Living Standards Survey data.

Note: Summary statistics are calculated from commune averages (n=190) of the price and unit value indexes. The units are 1000 dong/kg, in logarithmic terms. The indexes are formed from data on 5935 households, with unit values more than four standard deviations from the mean being trimmed and missing values being replaced by regional averages.

Table 3. Means, Coefficients of Variation, and Correlations of Unit Values and Community Prices of Seven Food Commodities for Vietnam Rural Households, 1997-98.

	Unit Values		Community Prices		Correlation between prices and unit values
	Mean (std. dev)	Coefficient of variation	Mean (std. dev)	Coefficient of variation	
Vietnam					
Rice[a]	3.464 (0.77)	0.22	3.551 (0.53)	0.15	0.436
Corn/maize	3.350 (3.29)	0.98	2.275 (0.70)	0.31	0.104
Cassava	1.656 (1.15)	0.69	1.244 (0.50)	0.40	0.320
Sweet potato	2.499 (1.59)	0.64	1.514 (0.49)	0.33	0.272
Pork	18.878 (4.59)	0.24	21.336 (4.12)	0.19	0.604
Sugar	6.917 (1.06)	0.15	7.053 (0.52)	0.07	0.120
Cooking oil	13.837 (2.92)	0.21	13.998 (0.886)	0.06	0.103
Papua New Guinea					
Sweet Potato	61.07 (39.43)	0.65	48.45 (29.02)	0.60	0.593
Banana	79.62 (51.49)	0.65	60.76 (32.23)	0.53	0.375
Rice	105.95 (26.14)	0.25	112.04 (20.45)	0.18	0.588

Note: All prices in rows 1 to 7 are in 1,000 dong per kg, except cooking oil, which is per liter. The exchange rate in Vietnam is 13,000 dong equals 1 US dollar. All prices in rows 8 to 10 are in toya per kg, except cooking oil, which is per liter. The exchange rate in PNG is 130 toea equals 1 US dollar. The unit values used in the calculations are only those specified in terms of grams and kilograms (or liters for oil). Summary statistics only are calculated over those households with *both* a unit value and a community price available.

[a] Excludes glutinous and fragrant rice.

Table 4: Symmetry-Constrained Elasticity Estimates for Vietnam From Demand Systems Using a Mixture of Market Prices and Unit Values, 1997-98.

		Own-Price Elasticities of Demand		
	Mean Calorie Share	Using Mixture of Market Prices and Unit Values	Using Unit Values	Using Market Prices
Rice	0.740	-0.24[a]	-0.32	-0.58
		(0.07)	(0.08)	(0.05)
Maize	0.009	-3.03[a]	-4.73	-1.68
		(1.07)	(1.53)	(0.66)
Other grains	0.018	-1.35	-0.54	-1.13
		(0.23)	(0.14)	(0.24)
Cassava	0.008	-1.81[a]	-9.38	-2.38
		(4.19)	(6.17)	(0.54)
Sweet potato	0.007	-0.10[a]	-0.42	-1.97
		(0.64)	(0.65)	(0.25)
Legumes	0.014	-1.26	-1.34	-1.32
		(0.32)	(0.19)	(0.44)
Fruits and vegetables	0.034	-0.90	-0.61	-0.90
		(0.08)	(0.06)	(0.08)
Pork	0.031	-0.71[a]	-0.81	-0.97
		(0.09)	(0.11)	(0.12)
Other meat	0.014	-1.00	-0.75	-1.06
		(0.16)	(0.17)	(0.17)
Fish	0.014	-0.87	-1.06	-0.90
		(0.08)	(0.09)	(0.08)
Sugar	0.022	-0.38[a]	-0.55	-0.18
		(0.41)	(0.46)	(0.32)
Cooking oil	0.046	0.05[a]	-0.00	-0.67
		(0.24)	(0.20)	(0.31)
Other food	0.024	-0.71	-1.56	-0.66
		(0.09)	(0.08)	(0.09)
Beverages	0.018	-0.69	-1.17	-0.78
		(0.09)	(0.08)	(0.10)
Sum of squared deviations between own-price elasticities and elasticities from market prices[b]		6.44	62.85	n.a.
Sum of squared deviations between own- and cross-price elasticities and elasticities from market prices[b]		375.48	814.45	n.a.
Elasticity of calories with respect to rice price		-0.27	-0.22	-0.54
		(0.07)	(0.08)	(0.05)

Note: Standard errors in ( ).
[a] Unit values used as a proxy for market prices.
[b] Based on the squared differences between the elasticities calculated with market prices and those calculated from each of the unit value procedures.

Table 5: The Effect of Different Data Sources and Estimation Methods on Estimated Own-Price Elasticities of Demand for Individual Foods in Vietnam, 1997-98.

	Results Based on Market Prices	Results Based on Unit Values			
		Deaton Procedure	Cox and Wohlgenant	Commune Means	Commune Medians
Rice	-0.50	-0.09	-0.37	-0.21	-0.23
	(0.04)	(0.11)	(0.04)	(0.05)	(0.05)
Sweet potato	-1.57	-0.45	-0.49	-0.50	-0.61
	(0.16)	(0.41)	(0.13)	(0.12)	(0.11)
Pork	-0.85	-0.74	-0.60	-0.70	-0.71
	(0.11)	(0.19)	(0.05)	(0.09)	(0.08)
Sugar	-0.46	0.01	-0.66	-0.25	-0.86
	(0.23)	(1.27)	(0.12)	(0.24)	(0.18)
Cooking oil	-0.88	0.24	-0.33	0.19	-0.07
	(0.18)	(0.33)	(0.05)	(0.15)	(0.12)
Sum of squared deviations[a]					
Own-price elasticities		2.91	1.58	2.44	1.83
Own- and cross-price elasticities		18.95	6.87	16.65	13.51
Correlation with own-price elasticities estimated from market prices		0.40	-0.11	0.30	0.03

Source: Calculated from 4638 households in 149 communes in the 1997/98 Vietnam Living Standards Survey. Standard errors in ( ).

[a] Based on the squared differences between the elasticities calculated with market prices and those calculated from each of the unit value procedures.

Appendix Table 1: Budget Share Equations from Vietnam Living Standards Survey for 5 Major Foods, 1997-98

	Mean (std. dev)	Rice	Sweet potato	Pork	Sugar	Cooking Oil
ln price of:						
Rice	1.243	0.090	0.002	-0.004	-0.002	-0.003
	(0.14)	(11.99)**	(4.44)**	(0.99)	(2.19)*	(1.84)+
Sweet potato	0.319	-0.0002	-0.001	-0.001	-0.0001	0.003
	(0.39)	(0.08)	(3.47)**	(0.57)	(0.54)	(5.10)**
Pork	3.064	0.025	0.0001	0.009	-0.008	0.0004
	(0.18)	(2.70)**	(0.15)	(1.38)	(7.05)**	(0.23)
Sugar	1.953	-0.003	-0.001	-0.024	0.004	-0.011
	(0.07)	(0.20)	(0.78)	(2.54)*	(2.36)*	(4.20)**
Cooking oil	2.654	0.013	0.0007	-0.009	0.008	0.002
	(0.08)	(1.07)	(0.70)	(1.00)	(3.22)**	(0.68)
ln tot expenditure	9.444	-0.135	-0.002	-0.0001	-0.002	-0.005
	(0.67)	(56.94)**	(10.01)**	(0.05)	(9.84)**	(14.40)**
ln household size	1.462	0.132	0.001	-0.014	-0.001	0.001
	(0.47)	(44.44)**	(5.92)**	(8.67)**	(3.72)**	(2.93)**
% < 5 yrs	0.090	-0.059	0.0004	0.018	0.001	-0.000
	(0.13)	(7.94)**	(0.50)	(3.74)**	(1.49)	(0.05)
% >15 yrs	0.694	-0.006	-0.001	0.001	0.001	-0.002
	(0.23)	(1.49)	(2.11)*	(0.33)	(1.73)+	(2.62)**
Female head	0.277	-0.003	-0.000	0.001	-0.0003	0.0002
	(0.45)	(1.66)	(0.54)	(0.49)	(1.52)	(0.67)
Farm household	0.525	0.025	0.000	-0.0001	0.001	0.001
	(0.50)	(12.61)**	(2.20)**	(0.07)	(3.77)**	(1.90)+
Constant		1.20	0.011	0.125	0.031	0.075
		(27.96)**	(2.63)**	(4.36)**	(6.40)**	(8.09)**
R^2		0.70	0.10	0.11	0.21	0.11

Note: Estimated by Seemingly Unrelated Regression, using data from 4638 households in the 1997/8 Vietnam Living Standards Survey. Each equation also includes six regional dummies. The likelihood ratio test for the explanatory power of the variables in the system is 7868, with 100 degrees of freedom (p<0.00).

Absolute value of heteroscedastically-robust *t* statistics in ( ); + significant at 10%; * significant at 5%; ** significant at 1%

Appendix Table 2: Expenditure and Unconstrained Food Price Elasticities for 5 Major Foods in Vietnam, 1997-98.

		Elasticity with respect to the price of:				
	Expenditure Elasticity	Rice	Sweet potato	Pork	Sugar	Cooking oil
Rice	0.25	-0.50	0.001	-0.14	-0.02	0.07
	(0.01)	(0.04)	(0.02)	(0.05)	(0.08)	(0.07)
Sweet potato	0.29	1.18	-1.57	0.06	-0.50	0.36
	(0.07)	(0.27)	(0.16)	(0.16)	(0.63)	(0.51)
Pork	1.00	-0.07	-0.02	-0.85	-0.40	-0.14
	(0.02)	(0.08)	(0.03)	(0.11)	(0.16)	(0.14)
Sugar	0.76	-0.29	-0.02	-0.92	-0.46	0.96
	(0.02)	(0.13)	(0.04)	(0.13)	(0.23)	(0.30)
Cooking oil	0.63	-0.20	0.23	0.03	-0.88	-0.88
	(0.03)	(0.11)	(0.05)	(0.14)	(0.21)	(0.18)

Note: Estimated from the regression parameters in Table 3, and evaluated at mean budget shares. Symmetry not applied. Elasticities for "all other goods" can be derived from the homogeneity and adding-up restrictions. Heteroscedastically robust standard errors in ( ).

Appendix Table 3. First Stage Estimates for Deaton Method: Effect of Total Expenditures on Quantity and Quality

	Budget Share Equation			Unit Value Equation			
Commodities	b^o	$t(b^o)$	R^2	b^1	$t(b^1)$	R^2	e
Rice	-0.129	64.28	0.75	0.064	12.54	0.63	0.22
Sweet potato	-0.001	6.34	0.24	0.092	4.71	0.70	0.38
Pork	0.001	0.71	0.24	0.084	14.08	0.60	0.93
Sugar	-0.002	9.12	0.34	0.020	5.46	0.34	0.73
Cooking oil	-0.005	16.51	0.28	0.116	13.96	0.39	0.45

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.

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Endnotes

[1] Just in the *American Journal of Agricultural Economics* we have found more than 20 papers that use unit values, often making either no correction or only partial correction for the likely biases. In recent years, for example, see Ramezani et al. (1995); Park and Holcomb (1996); Gao et al. (1996); Park and Capps (1997); and Minot and Goletti (1998).

[2] 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.

[3] We are assuming that in our survey design, enumerators are asking respondents to provide information on expenditures and quantities and that unit values are created by division. If it were possible for households to provide directly information on their unit values, it is possible that a survey form could be designed whereby expenditures and unit values were elicited by questionnaire and quantities were derived by construction. In such a case, if expenditures were measured with little error and unit values had considerable error, then quantities would have an offsetting error and an AIDS model-based estimate of a price elasticity would be biased towards –1.

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

[5] The effect of correlated measurement errors in the AIDS model of equation (2) also depends on whether households report expenditures independently of quantities. We are assuming that expenditures are reported separately. However, in many cases, households produce a large fraction of the goods that they consumer. In this case, the measure of household expenditure for a commodity could contain two parts: one, the expenditure on goods purchased in the market (which would presumably be reported directly in value terms); and two, the implicit expenditure of goods consumed that was produced by the household (which would be valued as the quantity produced times some price metric). In this case, if the quantity of the home produced commodity were measured with error, it would create a correlated errors problem.

[6] Missing prices in four communes make the maximum sample 5935 households in 190 communes.

[7] Further details on the procedures followed can be found in Appendix E of *Vietnam Living Standards Survey (VLSS), 1997-98 Basic Information*, Poverty and Human Resources Division, World Bank, April 2001.

[8] This procedure removed 0.8 percent of the unit values, with the highest trimming rate for maize (1.3 percent) and the lowest rate for pork (0.2 percent).

[9] Our decision to include the additional case study of PNG was made in an attempt to demonstrate that our results (that is, that estimates of unit value-based elasticities are much different than estimates of community price-based ones) arise in more than the case study country. The comparisons of the Vietnam results (which are at the heart of the analysis in this) to results from PNG (which end up demonstrating the relationship between unit value-based and community price-based elasticity estimates are similar) also provides some additional support for our assumption that community prices actually provide more accurate estimates of the true market prices. In another paper that use only data from PNG, we use a third measure of market prices (pictures of prices of goods from local markets that all respondents provide price information on) and argue that the close relationship between community prices and picture prices supports the assertion that community prices are better proxies of market prices than unit values (Gibson and Rozelle, 2005). While it does not follow absolutely that the same result would apply in Vietnam, it does provide a rationale for our assumption, which is then relaxed.

[10] Deaton and Grosh (2000) report a similarly low correlation, of 0.34 for the median food, using the 1992-93 VLSS.

[11] We call these homogeneous since they were called so by Minot and Goletti. Based on this selection criteria they used unit values for these goods in their demand system, a point that is examined below.

[12] The pork specification used for the community price survey was “pork butt”, which sells at a premium compared with other types of pork.

[13] The horizontal bar in the box plot shows the median rice price per month and the ends of the box extend from the 25th percentile to the 75th percentile of prices. The lines emerging from the box show the dispersion in the remainder of the data outside this inter-quartile range.

[14] The problem with using current price to model demand is an issue only when consumption is measured on a yearly basis (e.g., the Vietnam study). In most studies, including the PNG study, consumption is measured on a two week basis, so the correct price is the price at the time the consumption decision is occurring.

[15] The full elasticity matrices are available from the authors.

[16] However, they also report a national average estimate of -0.29 (Table 41), with no discussion for why the two estimates differ.

[17] The elasticities that Minot and Goletti report for North and South are averaged, to give national-level elasticities for this correlation.

[18] In general, the results using the mixture of prices and unit values are not just some convex combination of the market price and unit value elasticities that are reported in the last two columns of Table 4. For 9 of the 14 food groups, the own-price elasticity from the model with a mixture of unit values and prices is outside of the range set when either unit values or market prices are used exclusively. This sensitivity of the elasticities to the choice of data suggests that it is important to check how robust policy recommendations are with respect to the elasticities. In this regard, Minot and Goletti do provide some sensitivity analysis on the price elasticity of rice demand.

[19] It should be emphasized again that the use of the sum of squared errors criteria implicitly is using the assumption that the elasticities that use community prices are correct and then create of measure of the bias that arises when using unit values. An alternative interpretation is that large sum of square errors means that the two sets of elasticities (one set estimated with community prices; one set estimated with unit values) differ significantly.

[20] The sample is the 3637 households with a unit available from their recorded rice purchases (only for those recorded in kilograms). Hence, the elasticities are not comparable with those from the budget share model, which is estimated on the full sample of 5935 households. The comparison between the own-price elasticities when unit values are used with those when community prices are used is robust to the specification of the income term in the double-log equation.

[21]We could not use the Deaton procedure previously because it basically seeks to remove within-cluster variability in unit values. No such variability is allowed when all households in the same cluster are given the same unit value (i.e., the regional mean in cases where no cluster level unit value was available). Nicita (2004) is a recent application.

[22] To see this, compare column 4 of Table 4 with column 1 of Table 5. The correlation between the two sets of estimated own-price elasticities is 0.96.

[23] The own-price elasticity for sugar is sensitive to the choice of cluster means or cluster medians and this appears to be due partly to a single commune. If this commune is dropped from the sample, the own-price elasticity for sugar rises to -0.45.