Growing Demand for Animal-Protein-Source Products in Indonesia: Trade Implications[1]

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Abstract

New elasticities were estimated from Indonesia's 1996, 1999, and 2002 National Socio-Economic Survey, or SUSENAS, data using a double-hurdle demand specification. The estimates suggest that major changes in Indonesian household diets are expected in the coming years, as income growth is sustained and as urbanization proceeds at a fast pace. The consumption "trading-up" pattern for animal-protein source products observed in many countries may also occur in Indonesia. In this particular case, households will shift from fish to dairy and meat products. The trade impacts of this emerging consumption pattern will be determined by the cost of adjustment in Indonesia's domestic productive capacity and the influence of the country's predominantly Islamic tradition.

Keywords: demand, household consumption, trade.

GROWING DEMAND FOR ANIMAL-PROTEIN-SOURCE PRODUCTS IN INDONESIA: TRADE IMPLICATIONS

Introduction

Despite differences in preferences, consumers seem to follow general phases in the evolution of their consumption behavior. This is described in a well-established law in economics called the Engel curve, which reflects that as household income rises, the proportion of income spent on food declines, suggesting relatively low income elasticity for food. A more detailed examination of consumption data usually gives further refinement of the pattern stated by Engel. That is, even with a declining share of food expenditure, absolute food expenditure actually increases as consumers "trade up" to higher-valued products, suggesting differential income elasticity of various food groups within the consumption basket. This pattern has been repeated in international consumer trends reported by various studies (Cranfield et al. 1998; Pingali 2004; Gehlhar and Coyle 2001; Regmi and Dyck 2001; Seale, Regmi, and Bernstein 2003; and Haley 2001) showing that as income grows, consumers in lower income countries shift their food consumption away from carbohydrate-rich staple foods toward more expensive sources of calories, such as meat and dairy products.

From an examination of 114 countries, Table 1, reported by Seale, Regmi, and Bernstein (2003), shows that low-income countries allocated more than half—52.58%—of their income to food, with the largest share, 26.97%, going to bread and cereals. Indonesia, a low-income country, shows this particular pattern. In contrast, high-income countries spent only 16.97% of income on food, with 11.83% spent on cereals and bread. There are several factors that generate this pattern, but the main drivers have been the responsiveness of consumers to changes in income at different phases of a country's economic development and the large movements of the population into bigger cities (i.e., urbanization). In the same study, low-income countries (see Table 2) are shown to be more responsive to changes in income, both in the total food aggregate as

well as in specific food groups when compared with high-income countries. In particular, animal-protein sources such as meat and diary have generally higher responsiveness than do bread and cereals. Hence, the share of expenditure allocated to animal-protein source food groups increases faster than the share for other food groups when consumer income rises.

In the case of Indonesia, except for the Asian crisis period in the late 1990s, it posted a reasonable economic growth, at 5.77% in the 1980s, 7.82% in the 1990s, and 4.28% in the 2000s.[1] Moreover, like many other countries in Asia, urbanization has proceeded at a fast pace in Indonesia. In 1980, only one-fifth—22%—of the Indonesian population lived in urban areas. In just two decades, this proportion has almost doubled to 42%, and by 2010, the Food and Agriculture Organization of the United Nations projects that more than half (53%) of the population will be in urban areas. The sustained income growth and fast urbanization will have significant impacts on the diets of Indonesian consumers in the future. With the expected "trading up" of consumer diets toward animal-protein sourced products, this paper aims to examine the consumption of animal-source protein products among Indonesian households, focusing on the current responsiveness of households to income and price changes as well as on the changes in location of households from rural to urban areas. This measure of responsiveness will suggest the shape and form of the consumption pattern that will emerge in Indonesia in the next decade. Finally, this emerging consumption pattern will have strong implications for the adjustments that will be necessary in the supply of these food products, both from domestic production and from trade.

In the next section, the current consumption pattern of dairy and meat products in Indonesia is described. Then, the structure of production of these products is briefly presented, followed by a report of new elasticity estimates based on a double-hurdle demand specification estimated using three sets of SUSENAS data. The SUSENAS (Survei Social Ekonomi Nasional, or National Socio-Economic Survey) data are collected by Indonesia's Central Bureau of Statistics. Next, the evolution of policy impacting the markets of these products is reviewed. Finally, the major sources of imports and the destination of exports (if any) are traced.

Consumption

The evolution of Indonesia's consumption pattern is a classic case of the Westernization of household diets (Huang and David 1993; Pingali 2004). Of the key characteristics of this change, three stand out: the very clear slowing of per capita consumption of Indonesia's main staple—rice; increased consumption of wheat and wheat-based products; and a rise in high protein-diets sourced from animal products. Of these three characteristics, the last one is the least obvious yet it is expected to be the major change in household diets in Indonesia in the immediate future.

Table 3 shows the major sources of animal protein consumption in Indonesia. It is basically a fish-based consumption bundle, with poultry and dairy products gaining increasing importance and with beef and pork making a small contribution. Fish ranks as the most common source of animal protein, as shown by the high proportion of households reporting positive consumption of fish in the three SUSENAS survey at 85% to 87%. A distant second is poultry products, with 18% to 32% of households reporting positive consumption. Milk products follow with 21% to 29%, followed by beef products at 9.9% to 14%. The last is pork products, with 2.7% to 3.6% households reporting positive consumption. In terms of magnitude of per capita consumption, fish consumption again ranks first, with 1.14 to 1.53 kilograms per person per month. This is followed by dairy products at 0.42 to 0.74 kilograms, then poultry at 0.15 to 0.30 kilograms. Beef and pork consumption are the smallest at 0.05 to 0.06 kilograms and 0.02 to 0.03 kilograms, respectively.

Dairy

Table 4 shows that the per capita consumption of milk products in Indonesia is very low compared with the consumption level of selected neighboring countries. Japan has the highest fluid milk consumption in this group at 39.21 kilograms per person, followed by India and South Korea. Per capita consumption in Indonesia is only 1.40 kilograms, which is higher than that of the Philippines—a country with a comparable per capita income level before the crisis but which has been recently overtaken by its richer Islamic neighbor, Malaysia. Consumption is even lower in all milk products. For example, per capita consumption of butter is lowest in Indonesia at 0.04 kilograms per person, which is much lower than that of the Philippines and Malaysia, with average consumption of 0.12

and 0.43 kilograms, respectively. India and South Korea rank highest, with butter per capita butter consumption at 2.18 and 1.20 kilograms, respectively. Indonesia also has the lowest per capita consumption of cheese at 0.03 compared to 1.86 in Japan, 0.21 in the Philippines, and 0.24 in Malaysia. Indonesia's nonfat dry (NFD) milk and whole milk powder (WMP) per capita consumption of 0.30 kilograms is still among the lowest compared with 2.54 and 2.73 kilograms per person, respectively, in Malaysia. Clearly, there is substantial room for growth in dairy product consumption in Indonesia.

The SUSENAS survey data are used to examine the specific dairy products that are consumed by households. Table 5 lists the major dairy product categories consumed by Indonesian households.[2] In terms of the proportion of households reporting positive consumption of dairy products, sweet canned liquid milk ranks the highest at 10.8% to 15.6%, followed by canned powdered milk at 4.5% to 6.0% and ice cream at 4.2% to 4.7%. Only 1.3% to 1.7% of households reported consumption of fresh or preserved milk. In terms of magnitude of consumption in milk equivalent, canned powdered milk consumption contributed the highest, with a share of 45% to 55% of the dairy product consumption basket; this is followed by baby formula powdered milk at 22% to 35%, and sweet canned milk at 14% to 16%. Reconstitution of powdered milk is a common practice among Indonesian households where access to refrigeration facilities may be limited.

In terms of spatial distribution of milk use, it is reported that 70% of dairy products are only available and consumed in urban areas of Java. All dairy plants in Indonesia are located on the island of Java, making distribution of products outside of this island difficult because of poor infrastructure such as lack of refrigeration, transportation, and roads. The distribution of the remaining 30% of dairy products available on the market (for rural areas outside Java) are limited, and the high costs associated with distribution drive up consumer prices, making it too expensive for low-income consumers to afford.

With limited fresh milk consumption, it is reported that roughly 80% of fresh milk produced in Indonesia is utilized by the dairy processing industry. About 10% is used by small-scale industry, while 5% is consumed directly and another 5% goes into other uses (including for young calves).

Meat

A similar comparison of per capita consumption of meat products from selected countries is given in Table 6. Indonesia's per capita meat consumption ranks low compared with its Asian neighbors including countries with comparable incomes and countries with similar Islamic traditions. With very high incomes, Japan and South Korea have the highest per capita beef consumption in Asia. In contrast, Indonesia ranks at the bottom, higher only than India and Malaysia, but lower than the Philippines. On the other hand, Malaysia has the highest per capita consumption of poultry in Asia at 37.32 kilograms. Indonesia's 1.48 kilograms ranks it, together with India, as among the lowest. The Philippines' consumption is much higher than Indonesia's at 7.61 kilograms.

Of the three meats, chicken meat has the largest share in the Indonesian meat consumption basket. The more popular product preparations are chicken and noodles, chicken porridge, chicken soup, chicken satay, and fried and roasted chicken. As in many other countries, the poultry sector has been successful in increasing the variety of value-added products that are presented to consumers in the market.

In 1999, 50% of the total broiler production was sold as live birds and the other half was marketed as dressed. For integrated producers, 30% is sold through modern processing and slaughter houses, and the other 70% goes to traditional outlets. Of the 30%, 75% is marketed to restaurants and supermarkets and the other 25% goes to food processing. In contrast, 100% of the production of independent producers goes directly to the wet market.

Production

Supply, from either domestic or foreign sources, needs to adjust to meet the changing consumption pattern in Indonesia. Domestic production is a large component in the supply of most of the major sources of animal protein. Fish, the primary source in terms of the proportion of households with positive consumption and in terms of the level of consumption, is produced domestically. For dairy, only 30% of raw milk is produced domestically. The remaining 70% is imported in powder form. In beef, very little is imported, but 18% of slaughter cattle is imported as feeder calves from Australia. Most of the poultry and pork products are produced domestically.

Dairy

Domestic dairy production in Indonesia contributes only 30% of total supply. The rest of the country's dairy product requirements are imported in powder form. The reason often cited for the deficit in dairy production is that milk production is generally dominated by small producers with only two to three cows per farm. Moreover, production is very concentrated—restricted to the island of Java. East Java accounts for 45% of total production, West Java has a 35% share, and Central Java has 15%.

The small dairy producers are organized into cooperatives, numbering approximately 120, which consist of nearly 100,000 dairy farmers. The dairy cow numbers in 2004 were 370,000 cows. Yield per cow is only 1,425 kilograms. Although higher than the productivity in Malaysia and India, it is much lower when compared with the 9,205 yield per cow in South Korea (see Table 7). The primary reason cited for the low productivity is that small producers lack access to improved genetics and feeds, and resources for improving herds are limited. Compounding these factors are unfavorable weather and relatively high feed costs.

With milk production in the hands of widely dispersed small producers, assembling the milk presents logistical problems, which may lead to compromised product quality. Fresh milk is collected from small farmers and delivered to the local cooperative. Some cooperatives sell the milk to the milk processors or retailers, while some that have small processing facilities process it for themselves. The local cooperatives are members of the Indonesian Milk Cooperative's Association.

Fresh milk is processed by the local processors into such products as powdered milk, sweetened condensed milk, liquid milk, and other milk products (yogurt, butter, etc.). Local processors only produce milk powder in the form of WMP. Most imported dairy products are in the form of NFD milk powder, which is cheaper, easier to process, and has a longer shelf life than WMP. The milk products in Indonesia are generally produced by blending fresh milk with imported NFD. NFD is used mainly in the manufacture of ready-to-drink milks and is also sold in retail packs. Full fat or WMP, on the other hand is mainly utilized for infant formulas.

The Indonesian dairy product processing industry is dominated by seven dairy manufacturers. Table 8 shows that Nestlé Indonesia's production accounts for almost

half of the market at 49%, followed by Friesche Vlag Indonesia at 21.9%, then Indomilk at 14.3%. Sari Husada, Ultra Jaya, Foremost Indonesia, and Inolakto share the rest of the market.

Meat

Most of Indonesia's cattle also serve for draft purposes. Hence, productivity is low (0.18 of the calf crop in Indonesia versus 0.90 in the United States) and so is the slaughter rate (0.15 in Indonesia versus 0.38 in the United States). Instead of importing beef, to supplement domestic production, Indonesia imports live cattle from Australia. Before the crisis in the late 1990s, live cattle imports represented 25% to 27% of total annual slaughter. The most recent data show this to be 15% to 18%. The share of beef production from imported cattle will be higher than these shares that are based on cattle numbers because imported cattle are generally heavier than domestic cattle by 50 kilograms per animal at slaughter. Final slaughter weight is around 400 to 450 kilograms.

Live cattle imports are a combination of breeding cows and feeder calves. The Government of Indonesia (GOI) encourages this import by not imposing any import duties and by requiring importers to allocate 10% to 20% of their cattle imports as female cows for breeding. Moreover, importers are encouraged to sell 10% to 20% of their feeder calf imports to local small farmers for fattening to utilize farm by-products as well as to promote farm employment. Despite these regulations, however, it is reported that some slaughter-ready cattle are imported to quickly recover their costs. The cattle fattening industry is concentrated in Lampung, in southern Sumatra, and in the eastern and western parts of Java.

The preference for live cattle imports versus meat imports may also be driven both by economic considerations as well as Indonesia's long Islamic tradition. Domestic fattening makes good use of available farm by-products and surplus labor. Moreover, the strict slaughter requirements for "halal" certification favors live cattle imports for domestic slaughter.

In the poultry sector, broiler meat accounts for an estimated 60% of total production, followed by native chicken at 29%, and spent layer and duck meat at 8% and 3%, respectively.

The broiler sector is highly concentrated, with just a few companies controlling production to final distribution, including Charoen Phokpand, Japfa, Anwar Sierad, Cimanggis, Cipendawa, Wonokoyo, and Cibadak. These large poultry integrators own poultry farms and feed production facilities. Most of the poultry production is still undertaken through these large integrators' contracts with poultry farmers. They supply day-old chicks, feed, and other necessary inputs, while the farmers provide housing and labor.

Policy

Prior to the liberalization that followed the macroeconomic crisis in the late 1990s, the food and fiber sector in Indonesia was heavily controlled by the GOI through the BULOG, a state trading company. BULOG had control over the importation, domestic processing, and distribution of major food and feed products. Prices of controlled products were administered. Major changes in policy followed the macroeconomic crisis, as the GOI committed in its letter of intent as a condition of International Monetary Fund assistance to liberalize the food and fiber sector. Now, private sector participation in all these activities in most of the commodities is allowed.

Dairy

With limited domestic production, dairy producers do not receive significant and consistent support from the GOI. The most common support extended in the past is in the form of low-interest loans given to members of the cooperatives. This type of loan is charged a subsidized interest rate, which is 4 to 9 percentage points below commercial rates.

From 1982 to 1998, the GOI required milk processing firms to purchase 2.4 liters of milk produced by domestic ranches for every liter of basic milk material they import. Under the Uruguay Round Agreement on Agriculture (URAA), Indonesia's commitment for the dairy sector was very restrictive. It had a tariff rate quota (TRQ) of 414 tmt in milk equivalent at a 40% in-quota rate. The out-quota rate was very prohibitive at 210%. The implementation of this TRQ was through the local content scheme, where the quotas were allocated using milk absorption certificates based on the amount of domestically produced milk used in processed products (FAO 2003). This rule was abolished after 1998. The current policy regime imposes no government restrictions on imports of dairy

products. Dairy imports are governed by a "tariff-only" regime. Moreover, the actual duty applied is much lower than the bound in-quota rate despite import levels in excess of the TRQ. For example, the import duty for nonfat dairy milk and full fat dairy milk is only 5%. In fact, the tariff is waived if the imported milk product is to be used as a raw material by the food and beverage industries. Only a 10% value added tax (VAT) is imposed on all dairy product imports.

There is no guarantee that the current low applied tariff rates will remain. A GOI assembled tariff team proposed imposing the URAA bound rate of 40% import duty applied on all finished dairy products. But so far, the GOI has chosen a more liberalized import regime for dairy. Table 9 compares the domestic and world price of milk powder and shows that the domestic retail price in Indonesia is 61% to 105% higher than the wholesale price in the United States. The large price wedge despite the low tariff may be due to transportation costs (both international and domestic transportation cost) which are excluded in this comparison. Quality issues were also not considered.

Meat

Unlike the dairy sector, protection of the local industry through control of imports has been a policy of the GOI for the meat sector. This is accomplished through a number of means. A common instrument is to impose strict inspection requirements. Prior to 1999, only licensed importers were allowed to import meat products. This was changed to allow general importers to import broiler provided the requirement of a written prior approval process is met. In this process, each importer is required to submit the type of commodity to be imported, processing plant number, "halal" certification, proposed date of import, country of origin, quantity, and port of entry. It is common knowledge that such requirements can be trade restrictive, especially since approval or denial can be arbitrary. In 2000, the GOI imposed an import control policy with the ban of imported chicken parts.

Tables 10 and 11 give the bound and applied tariff for poultry and beef. They also compare the domestic price to the comparable world price and report the implied nominal rate of protection. Poultry has benefited from liberalization in the import of feed ingredients, with the domestic poultry price converging to the world price, despite the current ban on chicken parts. On the other hand, the domestic beef price remains significantly

higher than the comparable world price, although at a much lower magnitude compared with the period prior to liberalization.

A 10% VAT was supposed to have been implemented on all imported products (except for six basic food ingredients such as rice, unhusked rice, corn, sago, soybeans, and iodized/noniodized salt, and strategic commodities such as animal feed/or raw material for animal feed, seeds, and breeding stock). However, application of the tax is not yet consistent and enforcement has been lax. All imports are also subject to a sales tax of 2.5%.

Sources of Imports and Destination of Exports

The trade impacts of the consumption pattern emerging in Indonesia have been influenced by the domestic production potential of the affected sector and the policy regime adopted by the GOI. Of the animal-source protein products, only dairy products are traded in significant amounts. This liberal policy of the GOI may be because there is very limited production potential for dairy in Indonesia. Moreover, developing the dairy sector is costly and will have a long gestation period.

Indonesia imports all dairy products, including butter, cheese, NFD, and skim milk powder (SMP). The largest import volume is in NFD, at 87 tmt in 2004. This is followed by SMP, at 20 tmt. Butter and cheese imports were 10 and 8 tmt, respectively. Table 12 shows that the main sources of NFD imports are New Zealand, Australia, the United States, and the European Union. Because of their proximity to Indonesia, Australia and New Zealand are the main suppliers of NFD. It is reported that in 2001, half of the NFD imported from the United States was attributed to USDA's grant for food aid and community building programs in Indonesia.

Some of the NFD imports are re-exported. Table 13 shows that Iraq used to be the main destination, accounting for 89% of volume shipped out of the country. In 2003, Singapore, East Timor, the United Arab Emirates, and Zambia are the main destinations. Similarly, Indonesia imports WMP and re-exports some of it to other countries. Table 14 shows the sources of WMP imports, including New Zealand, Australia, and the Philippines. The United States increased its export share in 2003, likely as a result of the government-sponsored aid program. Again, Iraq used to be a major destination of Indonesia's WMP exports. In 2003, major destinations are Malaysia and Taiwan (see Table 15).

In contrast to the diary sector, trade in meat products is not significant. This restrictive policy is due to a number of factors. In the poultry sector, technology transfer is easy and developing the domestic production potential is quicker. Moreover, the practice of large integrators of contracting production with local farmers is consistent with the GOI's policy to promote employment, especially in rural areas. Hence, there is an incentive for the GOI to protect the domestic industry. In the case of beef, a strict slaughter requirement for "halal" certification has created the need for trade in live cattle rather than in meat. Moreover, the duty-free importation of live cattle has encouraged this practice. Australia is the main supplier of live cattle because of the availability of Australian breeds that are adapted to conditions in Indonesia and its proximity, requiring only five days of shipping from northern Australia to ports in Indonesia. For the limited beef imports, Australia and New Zealand (see Table 16) are the major suppliers. Trade in pork is mostly non-existent because of the long Islamic tradition of the country. In 2000, Indonesia imported poultry mostly from the United States (83.8% market share), and with Brazil and Thailand accounting for 8% each. Poultry trade has been limited since the ban on the import of chicken parts. The U.S. share in 2002 dropped to 8.9%, resulting in an up-tick in the share for Australia (see Table 17). With the growing demand for poultry, such a ban has encouraged domestic production, with most of the inputs, including feed ingredients such as corn and soymeal, being imported.

Double-Hurdle Demand Model

In this paper, demand for dairy products, beef, pork, poultry, and fish are estimated using a double-hurdle model of the sample selection type developed by Heckman (1979). As shown in Tables 3 and 5, which illustrate specific consumption, even the most popular product of a particular food group had a significant number of households reporting no consumption. In the double-hurdle model, the consumption decision of households is represented as a two-step process. First, households decide whether or not to consume. This is interchangeably referred to as the censoring rule or participation decision. After a consumption decision is arrived at, households then decide how much to consume. The standard sample selection model is used, since the observed consumption level in the data is not a random sample but systematically chosen from the entire population. Several

studies have used this specification, including Blaylock and Blisard 1992; Haines, Guilkey, and Popkin 1988; Jones 1989; Jones and Yen 2000; Newman, Henchion, and Matters 2001; Yen 1993, 1994; Yen and Huang 1996; Yen and Jensen 1995; and Yen, Jensen, and Wang 1996. This specification is necessary to adequately address the many zero observations (Amemiya 1973 and Maddala 1983). The model has a censoring rule, equation (1a), that determines participation in the market and a regression, equation (1c), that estimates the level of consumption:

$$z_i^* = w_i'\gamma + \upsilon_i \tag{1a}$$

$$z_i = \begin{cases} 1 & if \quad z_i^* > 0 \\ 0 & if \quad z_i^* \le 0 \end{cases} \tag{1b}$$

$$y_i = x_i'\beta + \varepsilon_i \quad if \quad z_i = 1 \tag{1c}$$

where the error terms are independently (across observations) and jointly normally distributed, that is,

$$\begin{pmatrix} \upsilon \\ \varepsilon \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho\sigma_\varepsilon \\ \rho\sigma_\varepsilon & \sigma_\varepsilon \end{pmatrix}\right]. \tag{1d}$$

In this paper, the vector *w* has the same elements as the vector *x*. Since the variance of the censoring equation (1a) is not identified, it is normalized to unity in (1d). Equation (1a) represents the first stage of the consumption decision. The variable *z* with asterisks is unobserved, with an indicator variable *z* related to it in equation (1b). When *z* =1, that is, a decision to consume is arrived at, equation (1c) represents the second stage, in which the level of consumption is determined. From this specification we derive two important equations. The first is the probability for a positive consumption, which can be determined in (2):

$$\Pr(z = 1) = \Pr(w_i'\gamma + \upsilon_i > 0) = \Pr(\upsilon_i > -w_i'\gamma) = 1 - \Phi(-w_i'\gamma) = \Phi(w_i'\gamma)\,. \tag{2}$$

The second equation is the conditional mean given in (3):

$$E(y_i \mid z_i^* > 0) = x_i'\beta + \rho\sigma_\varepsilon \frac{\phi(w_i'\gamma)}{\Phi(w_i'\gamma)}. \tag{3}$$

The main difference in the sample selection model with the uncensored demand models is the additional term in the conditional mean equation. There are three types of elasticities that can be derived from the model to examine the responsiveness of consumers to changes in some continuous exogenous variables (e.g., income), namely, the elasticity of participation from (2); the elasticity of the conditional mean from (3) (i.e., for those with positive consumption); and the elasticity of the unconditional mean, which accounts for both.[3] The elasticity of participation is

$$e^p = \frac{\partial\Phi(w_i\gamma)}{\partial x_i}\frac{x_i}{\Phi} = \phi\gamma_i \frac{x_i}{\Phi}, \tag{4}$$

and the elasticity of the conditional mean is

$$e^c = \frac{\partial E(y_i \mid z_i = 1)}{\partial x_i}\frac{x_i}{E(y_i \mid z_i = 1)} \tag{5}$$

$$e^c = \left[\beta_i - \gamma_i\rho\sigma_\varepsilon\left(\frac{\phi}{\Phi}\right)\left\{\left(\frac{\phi}{\Phi}\right) - w_i\gamma\right\}\right]\left[\frac{x_i}{\beta_i x + \rho\sigma_\varepsilon\left(\frac{\phi}{\Phi}\right)}\right].$$

The elasticity of the unconditional mean accounts for both (4) and (5):

$$e^u = \frac{\partial E(y_i)}{\partial x_i}\frac{x_i}{E(y_i)} \tag{6}$$

$$e^u = \left[\Phi\left\{\beta_i - \gamma_i\rho\sigma_\varepsilon\left(\frac{\phi}{\Phi}\right)\left\{\left(\frac{\phi}{\Phi}\right) - w_i\gamma\right\}\right\} + \left\{\beta_i x + \rho\sigma_\varepsilon\left(\frac{\phi}{\Phi}\right)\right\}\gamma_i\phi\right]\left[\frac{x_i}{\left\{\beta_i x + \rho\sigma_\varepsilon\left(\frac{\phi}{\Phi}\right)\right\}\Phi}\right].$$

It is common knowledge that an estimation of the model using only equation (1c) presents several serious statistical problems, the root of which is the exclusion of the

additional term in the conditional mean when $\rho \neq 0$, which then becomes a part of the new disturbance term. The first problem is that the intercept is biased because the expected value of the excluded term is not necessarily zero. Second, the slopes will also be biased because it is likely that the regressors in the estimated equation will now be correlated to the new disturbance, which has the excluded term. The size of the bias will depend on the magnitude of the correlation, the relative variance of the disturbance, and the severity of the truncation from the censoring rule. Third, the excluded term may induce heteroskedasticity in the new disturbance term, so that the ordinary least squares estimates are not efficient.

To avoid these problems, the literature has proposed two acceptable alternative methods of estimating the sample selection model (1a) to (1d). The preferred one is the maximum likelihood estimator. The likelihood function of this model can be constructed by accumulating the contribution of each observation from the entire sample. The first term in (7) accounts for the contribution to the likelihood function of all the observations with no actual consumption. This is just the marginal probability that the censoring rule equation is less than or equal to zero. The second term accounts for the contribution of all the observations with positive consumption. This probability is equal to the density function at the level of observed consumption multiplied by the conditional probability distribution from the censoring rule given that an actual positive consumption was observed.

$$LLF = \sum\nolimits_{i\in\{z_i=0\}} \ln\left[1-\Phi(w_i\gamma)\right] + \tag{7}$$

$$\sum_{i\in\{z_i=1\}} \left\{ \ln\phi\left(\frac{y_i - x_i\beta}{\sigma_\varepsilon}\right) - \ln\sigma + \ln\Phi\left(\frac{w_i\gamma + \rho\dfrac{y_i - x_i\beta}{\sigma_\varepsilon}}{\sqrt{1-\rho^2}}\right)\right\}.$$

Maximization of the likelihood function in (7) will give consistent and efficient parameter estimates, assuming that the uncensored disturbances are normal and homoskedastic.[4] The model can also be estimated using a two-step procedure proposed by Heckman (1979), where a probit model is estimated first for the censoring rule, and then the consumption level regression is augmented by an estimated mill's ratio. The parameters in this estimation procedure are consistent but not efficient. Moreover, the

standard errors need to be corrected because of the estimation error introduced with the use of an estimated mill's ratio. Also, there is no opportunity to impose the restriction that $|\rho|<1$, which can be violated in an estimation.

The elasticity of the unconditional mean can be disaggregated into two effects (similar to Cragg 1971). This is accomplished by dividing both sides of equation (6) by the left-hand side, normalizing it to unity. The resulting first term in the right-hand side of equation (6) is the effect of a change in any (continuous) independent variable on the level of consumption for those that already have a positive consumption, weighted by the probability to consume. The second term is the effect on the probability to consume weighted by the conditional mean.

Data from the SUSENAS surveys for 1996, 1999, and 2002 are used in the estimation of the double-hurdle model using SAS version 9.0. The data have 60,675–60,406 households in the sample. The explanatory variables in both equations are the same, which included total expenditure, own price, prices of substitute products, urban-rural dummy, number of children in the household, and provincial dummy. The estimate using the three datasets (see Table 18) gave very significant ρ values ranging from -0.322 to -0.489 in dairy, -0.215 to -0.423 in beef, -0.003 to -0.044 in pork, -0.360 to -0.248 in poultry, and -0.091 to -0.160 in fish, suggesting the appropriateness of the double-hurdle model in all commodities except for pork. That is, in the population, there are unmeasured influences on selection that are related to the unmeasured influences on the level of consumption. Specifically, since ρ is negative, the levels of consumption in the selected group are likely to be smaller than those in the unselected group. Tables 19a to 19e give the elasticity estimates for the participation and the unconditional level of consumption decisions for the major sources of animal protein. All the own-price and income elasticities are of the expected sign and significant, with a negative own-price elasticity and positive income elasticity (with the exception of fish in the probability-of-consumption equation only) in both the participation and unconditional consumption equations. Based on the sign of the cross-price effects, meat is a substitute for dairy, poultry and pork are substitutes for beef, poultry is a substitute for pork, and beef is a substitute for poultry. In most of the food groups, the eggs group is a complementary product.

Since there is limited market participation (i.e., positive consumption) in all sources of animal protein (except fish), the responsiveness of the unconditional mean of consumption to changes in income is largely coming from the increase in the probability of consumption. In terms of the magnitude of response, the dairy food group is the most responsive of all the animal-protein sources in both the probability of consumption and in the unconditional mean, with average elasticity of 0.51 and 0.85, respectively. It is followed by beef, with average elasticity of 0.45 and 0.55, respectively, and then poultry, with 0.38 and 0.53. The least responsive is pork, with average elasticity of 0.25 and 0.51, respectively. In the case of fish, income has a small (not significant in 1999) and negative effect on the probability of consumption. This may be due to the already high proportion of household consuming fish products. The influence of income on the unconditional level of consumption ranges from 0.17 to 0.35.

Households also showed significant differential in their responsiveness based on urban or rural location. Households in urban areas showed higher consumption of animal-protein source products compared to rural households, with a positive impact with respect to the urban dummy variable. The degree of responsiveness is closely related to the impact of income, whereby dairy is the most responsive, followed by beef, then poultry. The impact on pork is mixed; urban location had a negative impact on pork consumption in both the probability to consume and in the unconditional mean of pork consumption. This impact is reversed in 1999, with a positive but small influence on pork consumption for urban location. In the case of fish, household location had a small and negative effect on the probability of consumption and a positive effect on the level of the unconditional mean of consumption.

The strong responsiveness of the consumption of animal-source protein products shown in the new elasticity estimates suggests that Indonesian households will “trade up” to more consumption of dairy products, broiler, beef, and pork as sustained economic growth and fast urbanization continue.

Summary and Conclusion

The evolution of Indonesia’s consumption pattern is a classic case of the Westernization of household diets described by Pingali (2004), in which the consumption of the

main staple, rice, is slowing down, while consumption of wheat and wheat-based products, together with animal-protein source products, is rising.

Consumption of animal-protein source products such as diary and meat is still very low in Indonesia when compared with selected Asian countries, including countries with comparable income levels and similar Islamic traditions. Fish is the most common source of animal protein. There is substantial room for expansion in the consumption of dairy and meat products, such as poultry and beef.

To quantify the potential for growth in consumption of animal-protein source products, new elasticities were estimated using SUSENAS data with a double-hurdle demand model specification. The estimates were of the expected sign, that is, positive in income and negative in own price, and were statistically significant. In terms of the relative degree of responsiveness, dairy product consumption has the highest income elasticity, followed by beef, poultry, pork, and then fish.

Moreover, with the exception of fish, all of the major sources of animal protein had few households reporting positive consumption in the SUSENAS data. As a result, a big proportion of the income elasticity of the unconditional mean of consumption is largely contributed by the high income elasticity of the probability of consumption. The low incomes of households and high market prices (some due to restrictive trade policy) of these products have constrained the growth of consumption.

After fish, the animal-protein source products with growing levels of consumption are dairy and poultry products. The production structures of these sectors are very different and may dictate the trade patterns that may emerge in response to their growing consumption. The production potential of the domestic sector in dairy is very limited, with production of milk dominated by small producers. Moreover, developing a domestic productive capacity in dairy is costly and has a long gestation period. Hence, only 30% of the milk requirement is currently met by domestic production. Despite restrictive import access allowed under the URAA, the GOI has chosen a very liberal import regime for dairy. It is expected that Indonesia will continue to import dairy products to meet its growing demand. Australia and New Zealand are major beneficiaries of this demand expansion because of their proximity to Indonesia as well as available excess supply of most of these dairy products. In contrast, even with a limited domestic corn supply and

with all of the soymeal requirement imported, Indonesia has encouraged domestic production of poultry both by local and multinational integrators. The GOI's policy is due to the easy access to improved technology in poultry production, on the one hand, and the practice of integrators to contract production to local producers in order to promote rural employment, on the other. Domestic production is encouraged with sufficient protection from foreign competition. Although the applied duty is reported to be only 5%, the more binding protection has been the licensing, strict inspection requirements, and the recent ban on imports of chicken parts.

In the case of beef, meat imports are very limited. Instead, the GOI has encouraged the importation of feeder cattle from Australia through a favorable tariff structure. This is intended to utilize farm by-products and surplus labor in the rural areas as well as to ensure that strict slaughter requirements for "halal" certification are followed. This arrangement is also made possible because cattle breeds that are adaptable to conditions in Indonesia are available from Australia. Moreover, shipping live cattle from northern Australia to receiving ports in Indonesia takes less than a week.

Tables

TABLE 1. Household budget allocation

Category	Indonesia	Low Income	High Income
		Percent	
Food	50.62	52.58	16.97
Bread and cereals	33.47	26.97	11.83
Meat	5.13	14.62	17.94
Dairy	11.87	7.89	10.03
Fruit and vegetables	14.12	20.34	14.62

Source: Seale, Regmi, and Bernstein 2003.

TABLE 2. Income elasticity of major food groups

Category	Indonesia	Low Income	High Income
		Percent	
Food	0.686	0.729	0.335
Bread and cereals	0.376	0.527	0.170
Meat	0.730	0.780	0.356
Dairy	0.783	0.860	0.381
Fruit and vegetables	0.421	0.636	0.281

Source: Seale, Regmi, and Bernstein 2003.

TABLE 3. Proportion of positive consumption and monthly per capita consumption level of animal-source protein products in Indonesia

Equation	Proportion Q>0	Sample Average (kg)
Milk		
1996	0.276	0.522
1999	0.214	0.424
2002	0.291	0.740
Beef		
1996	0.135	0.070
1999	0.099	0.050
2002	0.110	0.060
Pork		
1996	0.036	0.032
1999	0.027	0.019
2002	0.030	0.024
Poultry		
1996	0.321	0.304
1999	0.185	0.147
2002	0.322	0.297
Fish		
1996	0.873	1.533
1999	0.846	1.138
2002	0.872	1.355

Source: SUSENAS 1996, 1999, 2002.

TABLE 4. Per capita consumption of milk products of selected countries

Product-Countries	1980s	1990s	2000s
	Kilograms per person per year		
Fluid milk			
China	2.49	1.99	4.66
India	33.30	31.84	32.54
Indonesia	2.34	2.32	1.40
Japan	36.35	40.80	39.21
Malaysia	2.07	1.92	1.72
Philippines	0.54	0.31	0.55
South Korea	14.17	30.83	32.08
Butter			
China	0.05	0.07	0.08
India	0.95	1.38	2.18
Indonesia	0.06	0.04	0.04
Japan	0.64	0.71	0.69
Malaysia	0.08	0.24	0.43
Philippines	0.14	0.15	0.12
South Korea	0.57	1.12	1.20
Cheese			
China	0.11	0.15	0.18
India			
Indonesia	0.01	0.02	0.03
Japan	0.86	1.45	1.86
Malaysia	0.05	0.13	0.26
Philippines	0.10	0.18	0.21
South Korea	0.00	0.24	1.04
Non-fat dry milk			
China	0.00	0.04	0.08
India	0.12	0.10	0.17
Indonesia	0.19	0.20	0.30
Japan	2.14	2.21	1.70
Malaysia	1.57	3.52	2.54
Philippines	1.01	1.18	1.25
South Korea	0.76	1.03	0.98
Whole milk powder			
China			
India			
Indonesia	0.04	0.09	0.31
Japan			
Malaysia	3.29	2.10	2.73
Philippines	0.45	0.51	0.49
South Korea	0.26	0.12	0.14

Sources: USDA and FAO databases.

TABLE 5. Per capita monthly consumption of milk-based products

		1996 Data		1999 Data	
Products	**Units**	**Use**	**Q>0**	**Use**	**Q>0**
Fresh milk	Liter	0.0179	0.80	0.0160	0.70
Preserved milk	250 ml	0.0044	0.90	0.0050	0.60
Sweet canned liquid milk	397 g	0.0835	15.60	0.0598	10.80
Canned powder milk	Kg	0.2923	6.00	0.1915	4.50
Baby powder milk	400 g	0.1148	3.30	0.1471	3.30
Cheese	100 g	0.0007	0.30	0.0001	0.10
Milk products (yogurt)	100 g	0.0058	0.20	0.0004	0.20
Ice cream	Bowl	0.0074	4.70	0.0047	4.20

Source: SUSENAS 1996 and 1999.

TABLE 6. Per capita consumption of meat products of selected countries

Product-Countries	**1980s**	**1990s**	**2000s**
		Kilograms per person per year	
Beef			
China	0.67	2.53	4.69
India	1.92	1.31	1.42
Indonesia		2.15	2.69
Japan	7.17	10.79	10.04
Malaysia	0.81	1.03	1.29
Philippines	1.90	2.87	4.25
South Korea	4.69	8.76	11.37
Pork			
China	17.02	26.03	34.35
India			
Indonesia	2.42	2.93	2.04
Japan	15.88	16.99	18.70
Malaysia	10.03	12.52	9.13
Philippines	8.50	11.16	13.68
South Korea	11.97	17.88	25.98
Poultry			
China	1.67	4.97	7.46
India		0.60	1.41
Indonesia	1.33	1.55	1.48
Japan	12.41	13.38	13.99
Malaysia		33.22	37.32
Philippines		6.30	7.61
South Korea		8.96	10.38

Source: USDA and FAO databases.

TABLE 7. Dairy cow number and yield per cow of selected countries

	Yield per cow			Dairy Cow
Countries	**1980s**	**1990s**	**2000s**	**2000s**
	Kilograms per cow			Thousand Head
China	1,701	1,531	2,036	5,098
India	660	966	1,009	35,975
Indonesia	923	1,227	1,425	374
Japan	6,667	8,071	8,616	973
Malaysia	524	450	416	84
Philippines	2,161	2,602	2,657	4
South Korea	4,769	6,414	9,205	254

Source: USDA and FAO databases.

TABLE 8. Major milk processors in Indonesia

Milk Processor	Volume (tons/year)	Market Share
Nestlé Indonesia	153,435	49.0
Friesche Vlag Ind.	68,443	21.9
Indomilk	44,850	14.3
Sari Husada	19,645	6.3
Ultra Jaya	13,494	4.3
Foremost Indonesia	6,827	2.2
Indolakto	6,385	2.0

Source: USDA-FAS attache reports (various).

TABLE 9. Dairy product price comparison and NPR

	Retail Price[a]	World Price[b]	NPR	Bound Duty	Actual Duty
	Rupiah per kilogram			Percent	
1999	31155	17924	73.82	54.44	5.00
2000	31341	18864	66.14	53.33	5.00
2001	36433	22576	61.38	52.22	5.00
2002	38483	18768	105.05	50.00	5.00

Note: Other charges include a VAT of 10% and sales tax of 2.5%.
[a] Average retail price.
[b] U.S. powder price. Excludes transportation cost.

TABLE 10. Poultry product price comparison and NPR

	Retail Price[a]	World Price[b]	NPR	Bound Duty	Actual Duty
	Rupiah per kilogram			Percent	
1990	3158	2226	41.83		
1991	3407	2236	52.38		
1992	3806	2354	61.68		
1993	3979	2539	56.72		
1994	4256	2654	60.37		
1995	4564	2794	63.37	70.00	
1996	4704	3163	48.71	66.67	
1997	4899	3772	29.87	63.33	
1998		13910		60.00	
1999	12320	10057	22.50	56.67	
2000	11129	10428	6.73	53.33	5.00
2001	12275	13371	-8.20	50.00	5.00
2002	12154	11413	6.49	46.67	5.00
2003	11313	11746	-3.69	43.33	5.00

Note: Other charges include a VAT of 10% and sales tax of 2.5%.
[a] Average retail price.
[b] U.S. 12-City average price. Does not include transportation cost.

TABLE 11. Beef product price comparison and NPR

	Retail Price[a]	World Price[b]	NPR	Bound Duty	Actual Duty
	Rupiah per kilogram			Percent	
1990	5325	4724	12.73		
1991	6020	5196	15.87		
1992	6623	4983	32.93		
1993	7116	5463	30.24		
1994	8096	5041	60.61		
1995	9587	4288	123.56	70.00	
1996	10335	4181	147.17	67.78	
1997	13315	5399	146.63	65.56	
1998		17285		63.33	
1999	25863	14398	79.63	61.11	
2000	27727	16300	70.11	58.89	5.00
2001	32102	21839	47.00	56.67	5.00
2002	37601	24017	56.56	54.44	5.00
2003	36968	16730	120.97	52.22	5.00

Note: Other charges include a VAT of 10% and sales tax of 2.5%.
[a] Average retail price.
[b] Australian beef CIF price in U.S. ports. Excludes transportation cost.

TABLE 12. Share of non-fat dairy import sources

	1995	1996	1997	1998	1999	2000	2001	2002	2003
					Percent				
United States	5.52		1.26	4.18	1.78	3.67	17.71	13.15	21.35
New Zealand	2.29	34.12	3.69	43.99	28.55	44.28	3.79	29.63	26.24
Australia	1.39	2.31	25.50	29.34	25.51	13.69	21.76	24.49	22.15
Netherlands	11.27		2.16	2.77	4.13	9.53	11.80	14.65	2.52
Germany	13.99	6.65	3.74	2.55	3.80	9.36	5.62	3.24	3.48
Ireland	6.34	7.12	8.23	4.79	6.59	7.78	2.78	2.56	5.42
Denmark		1.59		1.77		0.73	2.26	1.64	0.85
France	7.14	2.56	3.52	1.78		0.72	1.14	1.53	
Belgium			1.63			4.49	1.90	1.27	
Sweden							0.97	1.17	0.74
Canada							0.88	1.19	
Poland	8.76	11.92	3.27	1.75	7.79		0.82	1.14	
Finland	1.78			2.30		0.62	0.76	0.63	
Czech Republic	2.26	3.32			2.00			0.62	
Argentina									
Malaysia									
UK	1.85		3.74			0.76			
Switzerland		2.38	2.16		2.62				
Others	1.46	1.88	5.80	4.14	8.22	4.83	1.66	3.86	

Source: USDA-FAS attache reports (various).

TABLE 13. Share of non-fat dairy export destination

	1995	1996	1997	1998	1999	2000	2001	2002	2003
					Percent				
United States		0.48		0.83	0.72	0.20	0.17	0.27	
Iraq						77.28	89.83	88.97	
Iran						9.84	3.86		
East Timor							2.61	8.33	19.74
Micronesia						1.23	0.90		
Philippines							0.84	0.59	
Thailand						0.35	0.45		
Portugal							0.45	0.88	
Singapore	41.33	62.22	4.16	35.97	41.87	1.34	0.26		42.15
New Zealand						0.52	0.26		
Hong Kong	0.74						0.19		
UAE								0.87	19.74
Zambia								0.66	11.84
Tanzania								0.39	
Japan								0.75	
Nigeria	0.85					0.56			4.82
Brunei	19.68	4.15	0.52						1.32
Saudi Arabia	3.45	0.57							0.44
Malaysia		2.15	63.27	18.12	37.45				
Thailand				43.49	12.78				
Netherland	0.95	4.62	2.27	1.22	1.43				
Myanmar	29.39	13.96	1.35	0.40					
Angoloa	0.95	11.62	0.46						
Others	3.62	0.33	27.97	1.18	6.18	9.51	0.24	0.68	0.00

Source: USDA-FAS attache reports (various).

TABLE 14. Share of WMP import sources

	1995	1996	1997	1998	1999	2000	2001	2002	2003
					Percent				
United States	3.46	1.12	0.33	14.51	0.17	1.28	0.55	0.15	22.25
New Zealand	35.82	36.94	4.88	3.82	34.62	47.57	43.58	34.49	22.38
Philippines						24.83	24.15	28.40	22.86
Australia	4.22	3.37	14.47	2.65	42.92	11.51	1.96	21.61	18.70
Denmark				1.29	0.49	7.14	6.55	1.72	1.65
France	1.88	0.88			1.31		1.56	2.77	3.43
Netherlands	6.30	15.24	5.12	12.62	7.44	2.23	0.98	3.62	
Singapore			1.86	4.22	1.78		0.98	2.47	1.74
Germany		1.76	2.80	0.42		1.74	0.68	1.59	
Malaysia			13.22	2.60	1.94	1.89		1.28	4.48
Belgium				5.75				1.22	
United King-dom	2.92	3.48	0.74			1.11			
Ireland	1.33		1.34			0.62			
Thailand	1.83		5.31	7.80	6.13	0.58			
China	1.33	0.56			1.56				
Denamark	2.17	9.35	14.29						
Others	4.42	0.39	0.15	0.20	1.68	0.94	10.09	1.29	2.63

Source: USDA-FAS attache reports (various).

TABLE 15. Share of whole milk powder export destination

	1995	1996	1997	1998	1999	2000	2001	2002	2003
					Percent				
Iraq							35.16	44.59	
Singapore	18.24	8.56			8.14	1.68	19.44	25.30	
Iran				17.49	46.21		16.49	14.18	
Malaysia	58.18	6.59			16.38	36.58	7.46	8.50	53.66
Syria							3.65	2.57	
Taiwan		39.00	74.80	33.99		15.46	3.53		13.81
Hong Kong					2.26	9.66	0.64	1.23	2.71
Netherlands		6.67	1.39	4.37	1.47	1.47		0.79	
Pakistan	22.30	15.28	5.57	5.92	4.18	17.85		0.71	5.96
Sri Lanka		16.34	2.88	5.36	5.18	5.17		0.64	2.98
Bangladesh			8.13	2.68	2.81	2.58			
Thailand		8.17	4.64						
Others	1.35		3.48	30.30	12.50	10.08	3.95	1.67	21.69

Source: USDA-FAS attache reports (various).

TABLE 16. Market share of major foreign supplier of beef in Indonesia

	1999	2000
United States	11.79	21.16
Australia	61.44	38.13
New Zealand	25.85	24.78
Ireland	0.49	14.75
Canada	0.43	1.18
Total	100.00	100.00

Source: USDA-FAS attache reports (various).

TABLE 17. Market share of major foreign supplier of broilers in Indonesia

	1995	1996	1997	1998	1999	2000	2001	2002
United States	80.03	4.77	41.70	47.56	76.15	83.76	84.46	8.97
Brazil				9.62	6.79	7.52	7.77	
Thailand							7.56	
Australia	0.59	1.08	13.90	1.76	7.66	2.41		82.05
China	16.30	93.67	31.15	31.71	5.29	3.57		7.05
Singapore	1.88	0.48	7.59	7.99	1.19	0.08		1.92
France					1.61	0.93		
Thailand						0.79		
Canada						0.65		
Norfolk Islands						0.17		
Malaysia				1.36		0.13		
Am. Samoa					1.08			
New Zealand					0.07			
Others	1.19		5.66		0.16		0.21	
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: USDA-FAS attache reports (various).

TABLE 18. Rho values

Equation	Coefficient	Standard Error
Milk		
1996	-0.489	0.014
1999	-0.322	0.024
2002	-0.334	0.018
Beef		
1996	-0.321	0.034
1999	-0.423	0.033
2002	-0.215	0.041
Pork[a]		
1996	-0.003	0.141
1999	-0.044	0.158
Poultry		
1996	-0.360	0.018
1999	-0.353	0.024
2002	-0.248	0.021
Fish		
1996	1.000	0.000
1999	-0.160	0.020
2002	-0.091	0.018

Source: Estimated from SUSENAS data.
[a] Estimates using 2002 data were not satisfactory and are not reported.

TABLE 19A. Demand elasticity estimates for dairy

	Participation	S. Error	Mean	S. Error	Share
1996 Data					
Expenditure	0.599	0.009	0.932	0.021	64.269
Milk price	0.010	0.012	-1.299	0.074	-0.752
Meat price	0.084	0.016	0.109	0.029	76.995
Egg price	-0.068	0.019	-0.124	0.036	54.823
Urban location	0.177		0.197		
1999 Data					
Expenditure	0.654	0.011	1.077	0.043	60.712
Milk price	-0.003	0.010	-0.689	0.061	0.405
Meat price	-0.005	0.026	0.032	0.052	-16.062
Egg price	-0.033	0.030	-0.221	0.068	15.056
Urban location	0.201		0.224		
2002 Data					
Expenditure	0.281	0.006	0.534	0.015	52.547
Milk price	0.012	0.007	-0.592	0.034	-2.040
Meat price	0.086	0.015	0.136	0.030	63.072
Egg price	-0.104	0.019	-0.132	0.040	78.769
Urban location	0.259		0.368		

Source: Estimated from SUSENAS data.

TABLE 19B. Demand elasticity estimates for fish

	Participation	S. Error	Mean	S. Error	Share
1996 Data					
Expenditure	0.086	0.004	0.211	0.000	40.707
Fish price	-0.155	0.007	-0.400	0.000	38.725
Poultry price	0.035	0.006	0.094	0.000	37.554
Beef price	0.003	0.008	-0.005	0.000	-49.189
Egg price	0.011	0.004	0.028	0.000	40.411
Urban location	0.010		0.026		
1999 Data					
Expenditure	-0.009	0.002	0.350	0.013	-2.663
Fish price	-0.011	0.002	-0.310	0.011	3.551
Poultry price	0.059	0.007	0.054	0.021	109.250
Beef price	-0.017	0.010	0.010	0.025	-169.982
Egg price	0.027	0.005	0.086	0.013	31.931
Urban location	-0.009		0.000		
2002 Data					
Expenditure	-0.006	0.001	0.170	0.280	-3.762
Fish price	-0.010	0.001	-0.286	0.474	3.550
Poultry price	0.059	0.006	-0.012	0.032	-482.157
Beef price	0.014	0.007	-0.013	0.037	-106.750
Egg price	0.010	0.004	0.038	0.063	26.787
Urban location	-0.008		0.032		

Source: Estimated from SUSENAS data.

TABLE 19C. Demand elasticity estimates for beef

	Participation	S. Error	Mean	S. Error	Share
1996 Data					
Expenditure	0.446	0.010	0.561	0.046	79.568
Beef price	-0.014	0.053	-0.447	0.066	3.169
Poultry price	0.203	0.039	0.188	0.046	108.146
Pork price	0.263	0.049	0.319	0.060	82.487
Egg price	-0.125	0.027	-0.088	0.032	141.642
Urban location	0.274		0.208		
1999 Data					
Expenditure	0.636	0.014	0.767	0.079	82.895
Beef price	-0.105	0.067	-0.774	0.096	13.540
Poultry price	0.189	0.057	0.103	0.064	183.187
Pork price	-0.019	0.053	-0.034	0.061	57.128
Egg price	-0.316	0.039	-0.305	0.044	103.645
Urban location	0.244		0.174		
2002 Data					
Expenditure	0.274	0.008	0.333	0.029	82.299
Beef price	-0.273	0.062	-0.744	0.077	36.674
Poultry price	0.119	0.054	0.116	0.065	102.710
Pork price	0.061	0.047	0.038	0.056	160.550
Egg price	-0.239	0.031	-0.234	0.037	102.096
Urban location	0.367		0.331		

Source: Estimated from SUSENAS data.

TABLE 19D. Demand elasticity estimates for pork

	Participation	S. Error	Mean	S. Error	Share
1996 Data					
Expenditure	0.215	0.021	0.420	0.088	51.144
Pork price	-0.079	0.087	-0.645	0.157	12.288
Poultry price	0.246	0.079	0.281	0.104	87.559
Beef price	-0.965	0.079	-1.241	0.170	77.708
Egg price	0.235	0.055	0.217	0.068	108.366
Urban location	-0.001		-0.046		
1999 Data					
Expenditure	0.289	0.038	0.614	0.175	47.143
Pork price	-0.655	0.095	-1.378	0.249	47.566
Poultry price	-0.164	0.098	-0.107	0.145	153.219
Beef price	-0.628	0.106	-0.651	0.193	96.596
Egg price	-0.176	0.059	-0.196	0.083	89.925
Urban location	0.081		0.038		

Source: Estimated from SUSENAS data.

TABLE 19E. Demand elasticity estimates for poultry

	Participation	S. Error	Mean	S. Error	Share
1996 Data					
Expenditure	0.369	0.010	0.538	0.015	68.552
Poultry Price	-0.149	0.025	-0.609	0.036	24.381
Beef Price	0.131	0.029	0.226	0.038	57.823
Pork Price	0.057	0.028	0.039	0.035	147.119
Egg Price	-0.076	0.016	-0.044	0.020	170.528
Urban Location	0.154		0.081		
1999 Data					
Expenditure	0.589	0.013	0.764	0.044	77.135
Poultry Price	-0.021	0.040	-0.573	0.059	3.731
Beef Price	-0.114	0.047	-0.164	0.057	69.608
Pork Price	-0.016	0.036	-0.084	0.042	19.513
Egg Price	-0.230	0.028	-0.176	0.034	130.714
Urban Location	0.162		0.097		
2002 Data					
Expenditure	0.198	0.007	0.299	0.009	66.200
Poultry Price	-0.062	0.027	-0.512	0.038	12.035
Beef Price	0.099	0.029	0.126	0.037	78.376
Pork Price	0.075	0.023	-0.053	0.029	-142.249
Egg Price	-0.171	0.016	-0.147	0.020	115.834
Urban Location	0.224		0.193		

Source: Estimated from SUSENAS data.

Endnotes

1. The years 1997-1999 are excluded in the average for the 1990s.
2. Milk products are converted into whole milk equivalent expressed in kilograms.
3. A slightly different formula is used for the impact of binary regressors (e.g., dummy variables).
4. It should be noted that it is possible that the likelihood function is not globally concave in ρ.

References

Amemiya, T. 1973. "Regression Analysis when the Dependent Variable is Truncated Normal." *Econometric* 41: 997-1017.

Blaylock, J.R., and W.N. Blisard. 1992. "U.S. Cigarette Consumption: The Case of Low-Income Women." *American Journal of Agricultural Economics* 74: 698-705.

Cragg, J.G. 1971. "Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods." *Econometrica* 39: 829-44.

Cranfield, J.A.L., T.W. Hertel, J.E. Eales, and P.V. Preckel. 1998. "Changes in the Structure of Global Food Demand." *American Journal of Agricultural Economics* 80(5): 1042-50.

Food and Agriculture Organization of the United Nations (FAO). 2003. *WTO Agreement on Agriculture: The Implementation Experience—Developing Country Case Studies.* Rome: FAO, Commodity Policy and Projections Service, Commodities Trade Division. http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/005/Y4632E/y4632e04.htm (accessed June 2005).

Gehlhar, M. ,and W. Coyle. 2001. "Global Food Consumption and Impacts on Trade Patterns." In *Changing Structures of Global Food Consumption and Trade*, pp. 4-13. WRS 01-1. Edited by A. Regmi. Washington, DC: U.S. Department of Agriculture, Economic Research Service.

Haines, P.S., D.K. Guilkey, and B.M. Popkin. 1988. "Modeling Food Consumption Decisions as a Two-Step Process." *American Journal of Agricultural Economics* 70: 543-52.

Haley, M.M. 2001. "Changing Consumer Demand for Meat: The U.S. Example, 1970–2000." In *Changing Structures of Global Food Consumption and Trade*, pp. 41-48. WRS 01-1. Edited by A. Regmi. Washington, DC: U.S. Department of Agriculture, Economic Research Service.

Heckman, J.J. 1979. "Sample Selection Bias as a Specification Error." *Econometrica* 47: 153-61.

Huang, J., and C. David. 1993. "Demand for Cereal Grains in Asia: The Effect of Urbanization." *Agricultural Economics* 8: 107-24.

Jones, A.M. 1989. "A Double-Hurdle Model of Cigarette Consumption." *Journal of Applied Econometrics* 4: 23-39.

Jones, A.M., and S.T. Yen. 2000. "A Box-Cox Double-Hurdle Model." *The Manchester School* 68: 203-21.

Maddala, G.S. 1983. *Limited Dependent and Qualitative Variables in Econometrics*. Cambridge: Cambridge University Press.

Newman, C., M. Henchion, and A. Matters. 2001. "A Double-Hurdle Model of Irish Household Expenditure on Prepared Meals." Economic Paper 200119. Trinity College, Dublin.

Pingali, P. 2004. "Westernization of Asian Diets and the Transformation of Food Systems: Implications for Research and Policy." ESA Working Paper No. 04-17. Economic and Social Department. Food and Agriculture Organization of the United Nations, Rome.

Regmi, A., and J. Dyck. 2001. "Effects of Urbanization on Global Food Demand." In *Changing Structures of Global Food Consumption and Trade*, pp. 23-30. WRS 01-1. Edited by A. Regmi. Washington, DC: U.S. Department of Agriculture, Economic Research Service.

Seale, J., A. Regmi, and J.A. Bernstein. 2003. "International Evidence on Food Consumption Patterns." Technical Bulletin No. TB1904.

U.S. Department of Agriculture, Foreign Agricultural Service (USDA-FAS). Various. Attaché reports on Indonesia. http://ffas.usda.gov/scriptsw/AttacheRep/default.asp (accessed June 2005).

Yen, S.T. 1993. "Working Wives and Food Away from Home: The Box-Cox Double Hurdle Model." *American Journal of Agricultural Economics* 75: 884-95.

———. 1994. "Cross-Section Estimation of US Demand for Alcoholic Beverage." *Applied Economics* 26: 381-83.

Yen, S.T., and C.L. Huang. 1996. "Household Demand for Finfish: A Generalized Double-Hurdle Model." *Journal of Agricultural and Resource Economics* 21: 220-34.

Yen, S.T., and H.H. Jensen. 1995. "Determinants of Household Expenditures on Alcohol." CARD Working Paper 95-WP 144. Center for Agricultural and Rural Development, Iowa State University.

Yen, S.T., H.H. Jensen, and W.B. Wang. 1996. "Cholesterol Information and Egg Consumption in the U.S.: A Nonnormal and Heteroscedastic Double-Hurdle Model." *European Review of Agricultural Economics* 23: 343-56.