DEMAND ANALYSIS OF POULTRY PRODUCTS ON JAVA

Suyanto*)

Abstrak

Penggunaan metoda tobit dapat memecahkan masalah bias dan tidak konsisten dalam pendugaan yang menggunakan data konsumsi survey rumah tangga yang umumnya tidak semua responden mengkonsumsi komoditi tertentu. Disamping itu, perhitungan elastisitas harga atau pendapatan dari rumah tangga yang sudah mengkonsumsi komoditi tertentu dan elastisitas peluang rumah tangga untuk mengkonsumsi komoditi tersebut. Hasil pendugaan parameter permintaan ayam dan telur dengan menggunakan data SUSENAS 1987 menunjukkan bahwa perubahan konsumsi ayam dan telur dipengaruhi oleh perubahan pendapatan baik di kota maupun di desa. Dengan meningkatnya pendapatan masyarakat maka konsumsi ayam dan telur juga akan meningkat yang dampaknya konsumsi bahan makanan ternak seperti jagung dan kedelai juga akan meningkat. Sementara itu konsumsi jagung dan kedelai untuk makanan manusia juga masih sangat penting sehingga persaingan konsumsi kedelai dan jagung antara manusia dan ternak akan semakin tajam.

INTRODUCTION

Income growth in low income countries which have the highest share of expenditure on food can have the effect of both a large increase on food expenditure and also an improvement in diets that include a greater proportion of higher-quality food, such as livestock products. The implication of higher demand for livestock products is higher demand for feed animal and feed grain. Meanwhile, the growth in yield of domestic agricultural products is often unable to meet growth of consumption in most low and middle income countries. As a result, food imports have increased and self sufficiency has declined.

Indonesia like other developing countries where income growth has rapidly changed the structure of food consumption, has had increased consumption of poultry products. Table 1 shows consumption of livestock products in Indonesia in 1980 and 1987. Per capita consumption and total consumption of improved chicken products increased rapidly in 1987 compared to 1980. The per capita consumption of meat from improved chickens increased by 70 percent and total consumption increased by 100 percent; the per capita consumption of eggs from improved chicken also increased by 36 percent and total consumption increased by 60 percent. In contrast, the per capita consumption of meat from village chickens decreased by 4 percent and eggs from village chicken increased by only 6 percent.

*) Research Associate of the Center for Policy and Implementing Studies (CPIS), Jakarta.

Table 1. Consumption of livestock products in Indonesia

Product	Per capita consumption (kg/year/cap)			Total consumption (000 ton)		
	1980	1987	% Change	1980	1987	% Change
Meat :						
- Improved chicken	0.33	0.56	70	48	96	100
- Village chicken	0.55	0.53	-4	80	91	14
- Beef	1.00	0.85	-15	146	146	0
- Pork	0.59	0.57	-3	86	98	14
- Other meat	0.83	0.51	-39	121	87	-28
Egg :						
- Improved chicken	1.00	1.36	36	146	234	60
- Village chicken	0.18	0.19	6	26	33	27
	0.47	0.53	3	69	91	32

Source: Food Balance Sheet for Indonesia 1980 in Mink, S.D. Corn in the Livestock Economy, 1987 and Food Balance Sheet 1987 in Statistical Year Book of Indonesia, 1989.

Increased consumption of meat and eggs from improved chicken have had a major affect on increasing feed demand since more than 90 percent of feed is used for improved chicken. With the increasing demand for feed, the growth of feed grain demand has exceeded the growth of food grain demand. According to Sarma (1985), the projected growth in feed grain demand is 8.16 percent and the projected growth of food grain is only 0.66 percent during period 1980-2000.

The purpose of this paper is to investigate the effect of income growth on consumption of poultry products and secondary food crops consumption on Java, Indonesia. This will be accomplished by estimating income and price elasticities of chicken eggs, meat from village chicken and improved chicken, processed soybean products (tofu, tempe and soy sauce) and corn.

MODEL SPESIFICATION AND ESTIMATION

Commonly in the household survey data, some households reported no consumption on particular items. Applying the OLS to observations who only reported would made the OLS estimator yield biased and inconsistent estimates because they do not take special account of the non zero mean of the disturbances (Maddala, 1983).

The tobit method that was originally developed by Tobin (1958), has been commonly used to deal with the limited dependent variable problem. The implication of using tobit method for demand analysis is that it assumes that the decision to consume a given food item is the same as the decision about the amount of food to consume.

Under the tobit model, the general formulation is given in term of an index function:

$$(1) \quad Y_i^* = X_i \beta_i + e_i$$

where X_i is a vector of explanatory variable, β_i is a vector of unknown coefficients, and the e_i 's are independently, identically, normally distributed random disturbances with mean zero and variance σ^2. The Y_i^* are unobserved latent variables. Y_i is the observed dependent variables, where:

$$(2) \quad \begin{aligned} Y_i &= Y_i^* && \text{if } Y_i^* > 0 \\ Y_i &= 0 && \text{if } Y_i^* \leq 0 \end{aligned}$$

Define $D_i = 1$ if $Y_i > 0$ and $D_i = 0$ if $Y_i \leq 0$. The probability of an observation representing an individual (household) that does not purchase any product is:

$$(3) \quad \begin{aligned} \Pr\{Y_i = 0/Y_i^*\} &= \Pr\{D_i = 1\} = \Pr\{X_i \beta i + e_i \leq 0\} \\ &= [1 - F(X_i \beta_i/\sigma)] \end{aligned}$$

The probability of a non limit observation that purchases a particular food item is:

$$(3) \quad \begin{aligned} \Pr\{Y_i = 0/Y_i^*\} &= \Pr\{D_i = 1\} = \Pr\{X_i \beta_i + e_i > 0\} \\ &= F(X_i \beta_i/\sigma)] \end{aligned}$$

With the assumption e_i -$(0, \sigma^2)$ the maximum likelihood function can be employed to get the estimation of β_i, and σ The likelihood function is:

$$(5) \quad \begin{aligned} L &= \Pi_1(1\text{-}F(X_i \beta_i/\sigma \ \Pi_2(1/\sigma \ f[(Y_i\text{-}(X_i \beta_i/\sigma)\} \\ &= \Pi(1\text{-}F(X_i \beta_i/\sigma)^{(1-Di)}\{1/\sigma \ f[(Y_i\text{-}(X_i \beta_i/\sigma)\}^{Di} \\ \ln L &= \Sigma (1\text{-}Di)\ln(1\text{-}F(X_i \beta_i/\sigma) + Di\ln\{1/\sigma \ f[(Y_i\text{-}(X_i \beta_i/\sigma)]\} \end{aligned}$$

where n1 are household who have zero consumption, n2 are households who have positive consumption, $F(X_i \beta_i/\sigma)$ is the standard normal cumulative distribution and $f(X_i \beta_i/\sigma)$ is the standard normal density distribution. The coefficient β_i and σ can be solved by differentiating ln L with respect to β_i and σ . There are computer programs available (like Shazam) which can solve this equation by using iterative procedure for those maximum likelihood values of β_i and σ

The β_i coefficient in the tobit model is not a marginal effects as we usually interpret. Thraen, Hammond and Buxton (1978) and McDonald and Moffit (1979) discussed the interpretation of the β_i coefficient in the tobit model. The β_i coefficient is a total effect of two components; one that is the change in the probability

that the household will consume a particular commodity i, and two the change in the value of the dependent variable if it is already consumed (i.e., expenditure on a particular food item). Similarly, elasticities can be calculted separately, both the elasticity of the probability that household will consumed commodity i, and the rice or income elasticity of household who already consume commodity i.

The expected value in the tobit model is:

$$(6) \quad E(y) = X_i \beta_i F(X_i \beta_i/\sigma) + \sigma f(X_i \beta_i/\sigma)$$

The marginal effect of E(y) with respect to X_i is:

$$(7) \quad dE(y)/dX_i = X_i \beta_i F(X_i \beta_i/\sigma)$$

The elasticity of E(y) with respect to X_i is:

$$(8) \quad \eta_{yx} = (dE(y)/dx_i)(X_i/E(y)) = \beta_i F(X_i \beta_i/\sigma)(X_i/E(y))$$

This elasticity represents the total effect of the probability that household will consume and quantity elasticity of household who already consume. The elasticity of the probability that household will consume is defined as:

$$(9) \quad \eta_{pr.x} = (\beta_i/\sigma) f(X_i \beta_i/\sigma)[X_i/F(X_i \beta_i/\sigma)] = {}_iX_i/\sigma [f(X_i \beta_i/\sigma)/F(X_i \beta_i/\sigma)]$$

The quantity elasticity is the total elasticity minus the elasticity of the probability, i.e:

$$(10) \quad \eta_{y^*.x} = \eta_{y.x} - \eta_{pr.x}$$

Another problem arises when expenditures on a particular item are zero is that the unit value (i.e., prices) are not identified. To solve this problem, we follow the method that used by Heien and Pompelli (1988). The procedure they used was to regress the observed prices on a regional dummy and household total expenditures. Then this regression is used to estimate the missing prices for those households which did not consume a particular food item.

The dependent variable that was used in the model (8) above was consumption per capita for commodity i, the independent variables were price of commodity i, price of rice and expenditure per capita. The variable price of a particular food item was defined as expenditure on a particular food item divided by the quantity consumed.

Data Source and Description

The National Social and Economics Surveys (SUSENAS) 1987 that are periodically conducted by the government of Indonesia were used in this study. This data source contains amount of quantity consumed, expenditure and household characteristics. These surveys were carried out throughout all provinces in Indone-

sia by the Central Bureau of Statistics. The data were collected by direct interview of the head of the household and/or member of household. The time reference period was one week for food, and one month and/or one year for non food item.

The sampling design was multistage which was established for the Indonesia census and differentiated between urban and rural. The unit of analysis is a representative household which is an aggregation of the households within the primary sampling unit. The advantages of using representative households is to minimize the problems related to "zero consumption" of food item.

The number of households interviewed for Java in the SUSENAS 1987 were 18,203 households or 1,643 representative households that include 584 representative households in urban (36%) and 1059 representative households in rural (64%) areas.

FOOD CONSUMPTION AND DEMOGRAPHIC CHARACTERISTICS

Table 2 shows that the proportion of food expenditure declined when income increased both in urban and in rural areas. The percentage of food expenditure for all income groups was higher in rural areas than in urban areas. This phenomenon is consistent with Engel's law which states that the percentage importance of food expenditures declines as income (total expenditure) increase.

Table 2. The proportion of food and non food expenditure by level of per capita income on Java, 1987

	Incomes groups							
	Urban				Rural			
	Low	Mid-low	Mid-high	High	Low	Mid-low	Mid-high	High
Food	61	55	51	40	68	66	64	58
Non food	39	45	49	60	32	34	36	42

Sources: SUSENAS 1987.

The summary statistics for demographic variables are presented in Table 3. The average number of children below 5 years and the average number of children between 5 to 10 years were higher in the low income group than in the high income groups both in urban and rural areas. The average number of people more than 10 years old in urban areas is lower in the low income groups than in the high income groups, but the average number of household members more than 10 years old in rural area is higher in the low income group than in the high income group.

Similarly, the average household size in the rural areas declined and the average household size in urban area increased as income increased. This phenomenon is probably not due to the fact that the actual family size in urban areas is higher than in rural areas but my be that urban households included other people (their relatives) who stay in their homes.

Table 3. The summary statistic of demographic variables by level of per capita income on Java, 1987

	Incomes groups							
	Urban				Rural			
	Low	Mid-low	Mid-high	High	Low	Mid-low	Mid-high	High
Number of people:								
0-4 years	0.48	0.47	0.47	0.34	0.48	0.44	0.42	0.44
5-10 years	0.65	0.59	0.61	0.44	0.63	0.56	0.58	0.53
10 years	3.49	3.61	3.85	4.12	3.30	3.26	3.30	3.24
Household size	4.62	4.67	4.92	4.89	4.41	4.26	4.30	4.21

Sources: SUSENAS 1987.

Food participation rates are defined as the percentage of sampled representative households that reported consuming a particular food item. This is important for understanding the extent of the problem of zero consumption for the subsequent econometric analysis. Table 4 presents food participation rates for several food items. The food participation rate of improved chicken meat in urban areas was 74.5 percent. This was higher than the food participation of local chicken meat. On the other hand, the food participation of improved chicken meat in rural areas was 19.4 percent which was lower than the food participation of local chicken meat (38.1 percent). In rural areas, local chicken meat is more available than improved chicken meat because commonly rural households have local chickens. These food participation were higher in urban than in rural areas. The food participation rate for chicken egg was high both in urban areas at 97.3 percent and in rural areas at 87.4 percent.

The consumption of soybeans directly was low both in urban and rural areas. The participation rates for soybeans directly was 13.4 percent in urban and 14.2 percent in rural areas. In contrast the consumption of processed soybean is high. Above 94 percent of the representative household in urban and rural areas consumed tofu and tempe, about 92 percent of urban households consumed soy sauce and about 67 percent of rural household consumed soy souce.

Table 4. Food participation rates on Java 1987

	Number		Percentage (%)	
	Urban	Rural	Urban	Rural
1. Number of representative households	584	1,059	—	—
2. Poultry:				
– Improved chicken	435	205	74.5	19.4
– Local chicken	302	404	51.7	38.1
– Chicken egg	568	926	97.3	87.4
3. Soybean:				
– Soybean	78	150	13.4	14.2
– Tofu	579	997	99.1	94.1
– Tempe	576	1,014	98.6	95.8
– Soy sauce	540	713	92.5	67.3
4. Corn:				
– Fresh corn	139	173	23.8	16.3
– Dry corn	6	58	1.0	5.5
– Corn kernel	34	354	5.8	33.4
– Flour corn	18	57	3.1	5.4
– Corn equivalent	175	508	30.0	48.0

Source: SUSENAS 1987.
Conversion rate:
1 kg fresh corn = 0.39 kg corn kernel (Tabor, 1988)
1 kg dry corn = 0.45 kg corn kernel (Tabor, 1988)
1 kg flour corn = 1 kg corn kernel (Montevarede, 1987)

There are four types of corn consumed; fresh corn, dry corn, corn kernel and flour corn. The consumption of corn was different between urban and rural areas. In urban areas the number of households who consumed fresh corn was higher than for other type of corn. On the other hand, in rural area the number of households who consumed corn kernel was higher than for other types of corn. The participation rate of dry corn, corn kernel and flour corn were higher in rural than in urban areas but the participation rate of fresh corn was higher in urban than in rural areas.

Generally, the participation rates for the four types of corn were low, and this present a problem for the demand estimation. To solve this problem, the estimation of corn demand was specified in terms of corn equivalent rather than for each type of corn. The participation of corn equivalent was 30 percent in urban and 48 percent in rural areas.

ELASTICITY ESTIMATES

The tobit estimates of the demand equation for several food item are presented in Appendix Table 1 to Appendix Table 7. In those tables, the OLS estimates are also reported as a comparison.

The own price coefficients were significant at the .05 and .01 level of significance for demand of improved chicken, chicken egg, tofu, tempe and soy sauce both in urban and rural areas, and at .10 significance level for demand for corn in urban and rural areas.

Except for demand of tempe and corn in urban areas, the expenditure per capita coefficient were significant at the .05 and the .01 level of significance for demand of all food estimated.

The price of rice was significant at least the .10 level of significance only for demand for tempe and corn in urban and improved chicken, local chicken, tempe and corn in rural areas.

Own Price Elasticities

Table 5 shows the estimated own price elasticities with breakdown into elasticities of the probability that households will consumed as price decrease given other independent variables and the own price elasticity of households who already consume poultry products, processed soybean and corn.

Table 5. Own price elasticities of demand for several foods items in urban and rural Java

	Urban			Rural		
	Total	Proba-bility	Quantity	Total	Proba-bility	Quantity
1. Poultry:						
– Improved chicken	-0.62	-0.26	-0.36	-1.38	-1.09	-0.29
– Local chicken	-0.64	-0.39	-0.25	-1.02	-0.71	-0.32
– Chicken egg	-0.51	-0.06	-0.45	-1.05	-0.33	-0.72
2. Processed soybean:						
– Tofu	-0.69	-0.08	-0.60	-0.78	-0.16	-0.62
– Soy sauce	-0.27	-0.09	-0.18	-0.35	-0.20	-0.15
– Tempe	-0.85	-0.13	-0.72	-0.85	-0.17	-0.68
3. Corn:						
– Equivalent	-0.43	-0.03	-0.11	-0.23	-0.15	-0.08

Poultry Products the total own price elasticity of demand for poultry products (that is, the combined effect of participation and level of consumption) were inelastic in urban but elastic in rural areas. The total own price elasticity of

improved chicken, local chicken and chicken egg were -0.617, -0.644 and -0.506 in urban and -1.378, -1.024 and -1.052 in rural areas. The elasticities of probability of household will consumed as price decrease given other independent variables were more elastic in rural areas. Except for improved chicken, the own price elasticities of household who already consumed were also more elastic in rural areas.

Processed Soybeans the total own price elasticities of demand for processed soybean were inelastic both in urban and rural; the total own price elasticities of demand for tofu, soy sauce and tempe were -0.69, -0.27 and -0.85 in urban in -0.78, -0.35 and -0.85 in rural. Except for tempe, the total own price elasticities were a bit more elastic in rural than in urban. The elasticities of the probability of household will consume were more elastic in rural but the elasticities of own price of household who already consume were almost the same between urban and rural areas.

Corn product the total own price elasticities of demand for corn were inelastic, -0.43 in urban and -0.23 in rural areas. The total own price elasticities and the own price elasticities of demand for households who already consumed corn were more elastic in urban areas. However, the elasticity of probability of household consumption was more elastic in rural areas.

Income Elasticities

Table 6 shows the income total expenditure elasticities with breakdown into the elasticities of probability household will consumed as income increase given other independent variables and the income elasticity of households who already consumed the poultry products, processed soybean and corn:

Table 6. Income elasticities of demand for several foods items in urban and rural Java

	Urban			Rural		
	Total	Proba-bility	Quantity	Total	Proba-bility	Quantity
1. Poultry:						
– Improved chicken	0.60	0.26	0.35	1.73	1.37	0.36
– Local chicken	0.41	0.25	0.16	1.13	0.78	0.35
– Chicken egg	0.26	0.03	0.23	0.67	0.21	0.46
2. Processed soybean:						
– Tofu	0.12	0.01	0.11	0.52	0.10	0.41
– Soy sauce	0.43	0.15	0.28	1.04	0.58	0.45
– Tempe	0.04	0.01	0.03	0.37	0.07	0.29
3. Corn:						
– Equivalent	0.03	0.02	0.01	-0.58	-0.38	-0.20

Poultry Product the total income elasticities of demand for improved chicken and local chicken were elastic in rural areas (1.73 and 1.13) but inelastic in urban areas (0.60 and 0.41). The total income elasticities of demand for chicken egg were inelastic, 0.26 in urban and 0.67 in rural areas. The total own income elasticities of demand for poultry products were more elastic in rural than in urban areas. The elasticities of the probability of that household will consume and the income elasticities of household who already consume also were more elastic in rural areas. The sign of the income elasticities of demand for poultry products were positive and this indicates that poultry products were normal good.

Processed Soybean the total income elasticities of demand for tofu and tempe were inelastic, 0.12 and 0.04 in urban and 0.52 and 0.37 in rural areas. The total income elasticity of demand for soy sauce was elastic in rural (1.04) but inelastic in urban areas (0.43). The total income elasticities, the probability elasticities of that households will consume and the income elasticities of household who already consumed were more elastic in rural than in urban areas. The sign of income elasticities of demand for processed soybean products were positive which indicates that processed soybean products were normal goods.

Corn Product. The total income elasticity of demand for corn equivalent in urban areas was positive that indicates a normal good, although very low (0.03). However, this indication was not strong enough since this is statistically not significant. The probability elasticity that households will consume and the income elasticity of households who already consume also were very low (0.02 and 0.01). In contrast, the total income elasticity of demand for corn equivalent in rural was negative that indicates an inferior good, and inelastic (-0.58). The probability elasticity that households will consume and income elasticity of households who already consume in rural were more elastic than for urban areas (-0.38 and -0.20). It is important to observe that pattern of corn consumption were different in urban and rural areas. Households in urban areas consumed more fresh corn as a snack or vegetable, and this type of corn seems to be a normal good. On the other hand, in rural areas people consumed more corn kernel as a staple food, especially for poor people. Corn kernel seems to be an inferior good (Table 7).

Table 7. Corn participation rates by level of income in urban and rural Java, 1987

Corn Types	Urban				Rural			
	Low	Mid-low	Mid-high	High	Low	Mid-low	Mid-high	High
Fresh corn	3.9	6.2	6.2	7.5	3.9	3.9	3.7	5.8
Dry corn	0.2	0.2	0.2	0.5	2.1	1.3	1.0	1.0
Corn kernel	2.7	1.5	1.0	0.5	12.6	8.1	7.3	5.5
Flour corn	0.0	1.9	0.5	0.7	1.7	1.7	1.2	0.8

Sources: SUSENAS 1987.

THE EFFECT OF INCOME GROWTH ON SEVERAL FOODS CONSUMPTION

The effect of income growth on poultry and processed soybean is presented in Table 8. By assuming constant prices, two scenarios for income growth were employed to evaluate the impact of income change. This included scenarios for slower income growth and faster income growth. CARD/MOA studies give reference used 5 percent income growth both for urban and rural Java. In fact, rural income growth on Java was lower than urban income growth during recent period. In this study, we used 5 percent and 7 percent of income growth, with slower and faster growth in urban Java and 3 percent and 5 percent of income growth as slower and faster growth in rural Java.

Table 8. The growth of several food items as income growth

Foods	Urban				Rural			
	Consumption per capita		Participation rate		Consumption per capita		Participation rate	
	Income growth				Income growth			
	Slow	Fast	Slow	Fast	Slow	Fast	Slow	Fast
	percent							
1. Poultry								
– Improved chicken	3.02	4.23	1.28	1.79	5.18	8.64	4.11	6.85
– Local chicken	2.03	2.84	1.24	1.74	3.40	5.66	2.34	3.90
– Chicken egg	1.31	1.83	0.15	0.21	2.00	3.34	0.63	1.05
2. Processed soybean:								
– Tofu	0.60	0.84	0.07	0.10	1.55	2.59	0.31	0.52
– Tempe	0.18	0.25	0.03	0.04	1.10	1.84	0.23	0.38
– Soy sauce	2.17	3.04	0.75	1.05	3.11	5.19	1.76	2.93
3. Corn	0.15	0.21	0.10	0.14	-1.74	-2.90	-1.14	-1.90

At slower income growth, the growth of per capita consumption of improved chicken is 3.02 percent in urban and 5.18 percent in rural and the growth of food participation rates is 1.28 percent in urban and 4.11 percent in rural areas. At faster income growth, the growth of per capita consumption of improved chicken is 4.23 percent in urban and 8.64 percent in rural areas and the growth of food participation rates is 1.79 percent in urban and 6.85 percent in rural areas. Similarly, the growth of local chicken is also high but lower than for improved chicken. At slower income growth, the growth of per capita consumption of local

chicken is 2.03 percent in urban and 3.40 percent in rural and the growth of food participation rate is 1.24 percent in urban and 2.34 percent in rural areas. At the faster income growth, the growth of per capita consumption of local chicken is 2.84 percent in urban and 5.66 percent in rural areas and the growth of food participation rates is 1.74 percent in urban and 3.90 percent in rural areas. The growth of chicken eggs consumption is lower than for improved chicken meat and local chicken meat. At slower income growth, the growth of consumption per capita of chicken egg is 1.31 percent in urban and 2.00 percent in rural, and the growth of food participation rates is 0.15 percent in urban and 0.63 percent in rural areas. At higher income growth rates, the growth of per capita consumption of chicken eggs is 1.83 percent in urban and 3.34 percent in rural and the growth of food participation rates is 0.21 percent in urban and 1.05 percent in rural areas. The hight growth of poultry product consumption will lead to high growth in demand of soybean and corn for feed.

The growth in consumption of tofu and tempe is higher in rural areas : 1.55 percent at the slower growth and 2.59 percent at faster growth rates for tofu consumption, and 1.10 percent at slower growth and 1.84 percent at faster growth for tempe consumption. The growth of food participation rates is relatively low: 0.31 percent at slower growth and 0.52 percent at faster growth rates for tofu consumption and 0.23 percent at slower growth and 0.38 percent at faster growth rates for tempe consumption. The growth of consumption of tofu and tempe are lower in urban areas: 0.60 percent at slower growth and 0.84 percent at faster growth for tofu consumption and 0.18 percent at slowewr growth rates and 0.25 percent at faster growth rates for tempe consumption. The growth of food participation rates are 0.07 percent at the slower growth and 0.10 percent at faster growth rates for tofu consumption, and 0.03 percent at slower growth and 0.04 percent at faster growth for tempe consumption. Both for urban and rural areas the growth of soy sauce consumption is high. At slower income growth, the growth of per capita consumption of soy sauce is 2.17 percent in urban and 3.11 percent in rural and the growth of food participation rates is 0.75 percent in urban and 1.76 percent in rural areas. At higher income growth, the growth of per capita consumption of soy sauce is 3.04 percent in urban and 5.19 percent in rural areas, and the growth of food participation rate is 1.05 percent in urban and 2.93 percent in rural areas.

The growth of corn consumption in urban areas is very low: 0.15 percent at the slower income growth rates and 0.21 percent at the faster income growth rates. The growth of participation rate is 0.1 percent at the slower income growth rates and 0.14 percent at the faster income growth rates. In contrast, the growth of corn consumption in rural areas shows that corn in an inferior good. With income growth, the growth in corn consumption was -1.74 percent at the slower income growth

rates and -2.90 percent at the faster income growth rates for rural areas. The change in participation rates is -1.14 percent at slower income growth and -1.9 percent at faster higher income growth.

In summary, the poultry products consumption, especially improved chicken meat consumption, is most responsive to change in income. This has implication for all feed product, including soybean and corn. Except for tempe consumption, the growth of poultry products and processed soybean is faster especially in rural areas compared to urban.

CONCLUSIONS

The tobit model was applied to cross-sectional data on poultry products, soybean processed products and corn consumption for urban and rural Java. Under the tobit model the estimator yields unbiased and consistent parameters.

The results in this paper shows that the growth of poultry products consumption as income growth both in urban and rural are high. This will create high demand of soybean and corn for feed with income growth. On the other hand, except for tofu and tempe consumption in urban areas, the growth of processed soybean for direct human consumption is also high. Growth in direct corn consumption is quite a bit lower, although still important in the diets of poor people in rural areas.

The policy implication of this result for Indonesia food policy is that the importance of soybean, corn and others secondary crops will become high. In other word, the secondary food crops policy which was very much neglected in the past decade should get more attention.

REFERENCES

Coarse Grain, Pulses, Roots and Tubers (CGPRT) Centre. **The Soybean Commodity System in Indonesia.** CGPRT No.6. Bogor, ESCAP CGPRT. 1985.

Deaton, A., and John Muelbauer. **Economics and Consumer Bebavior.** Cambridge University Press, Cambridge, 1980.

Green, W.H. **Econometric Analysis.** Macmillan Publishing Company New Yórk and Collier Macmillan Publlisher London. 1990.

Goungetas, B., Helen Jensen and Stanley Jonhson. **The Assessment of Food Demand Trends in Indonesia : Method and Projections.** Technical Paper No.10. Center for Agricultural and Rural Development Iowa State University and Ministry of Agriculture Republic of Indonesia. 1990.

Haines, P.S. David K. Guilkey and Barry M. Popkin. **Modeling Food Consumption Decisions as A Two-Step Process.** American Journal of Agricultural Economics, 70(1988): 542-552.

Helen, D. and Greg Pompelli. **The Demand for Beef Products: Cross-Section Estimation of Demographic and Economic Effects.** Western Journal of Agricultural Economics, 13 (1988): 37-4.

Kinsey, Jean. **Working Wives and the Marginal Prospensity to Consume Food Away From Home.** American Journal of Agricultural Economics, 65 (1983): 11-9.

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

McDonald, J.F. and R.A. Moffit. **The Use of Tobit Analysis.** Review of Economics and Statistics. 62 (1980): 318-21.

Mink, S.D. "Corn in the Livestock Economy" in Timmer, C.P., ed. **The Corn Economy of Indonesia.** Cornell University Press, Ithaca and London. 1987.

Rondot, P., *et al.* **Soybean Utilization, Processing and Production Policy in Indonesia.** The CGPRT Centre Newsletter, Bogor, Volume 8, Number 4, December 1991.

Sarma, J.S. **Cereal Feed Use in The Third World : Past Trends and Projections to 2000.** International Food Policy Research Institute, 1986.

Stampley, G.L. **Susenas Data Organization and Processing : CARD/MOA's Use of The Indonesia National Social Economic Surveys.** Technical Paper No.3. Center for Agricultural and Rural Development Iowa State University and Ministry of Agriculture Republic of Indonesia, 1989.

Tabor, Steve, *et al.* **Supply and Demand for Food Crops in Indonesia.** Jakarta, Ministry of Agriculture, 1988.

Teken, I.B., Herman Soewandi. "Food Supply and Demand and Food Policies", in Mubyarto, ed. **Growth and Equity in Indonesian Agricultural Development.** Yayasan Agro Ekonomica, 1982.

Thraen, C.W., J.W. Hammond, and B.M. Buxton. **Estimating Component of Demand Elasticities from Cross-Sectional Data.** American Journal of Agricultural Economics. 60 (1978): 674-77.

Tobin, James. **Estimation of Relationships for Limited Dependent Variables.** Econometrica, 26 (1958): 24-36.

Appendix Table 1. Parameter estimate of demand for improved chicken in urban and rural Java

Variables	Urban		Rural	
	Tobit	OLS	Tobit	OLS
Intercep	0.0458	0.4143	-1.7118	1.31926
	(-0.359)	(4.274)	(-3.9)	(3.791)
Price of improved chicken	-0.000105	-0.00006	-0.00024	-0.00021
	(-2.77)	(-2.326)	(-2.36)	(-4.272)
Price of rice	0.000436	-0.00023	0.00284	-0.00223
	(1.52)	(-1.058)	(2.541)	(-2.33)
Expenditure per capita	0.0000052	0.000003	0.000032	0.000012
	(9.7)	(9.112)	(9.43)	(4.508)
R-square	0.19	0.17	0.05	0.16
Number observation	1059	435	1059	205
Log-likelihood/F value	-173.51	29.68	-466.346	12.72

Note: Number in parentheses are t-statistic.

Appendix Table 2. Parameter estimate of demand for local chicken in urban and rural Java

Variables	Urban		Rural	
	Tobit	OLS	Tobit	OLS
Intercep	0.5365	0.57548	0.792	1.0657
	(2.48)	(4.142)	(-2.33)	(5.116)
Price of local chicken	-0.000115	-0.00014	-0.00025	-0.00021
	(-2.38)	(-2.915)	(-4.26)	(-8.442)
Price of rice	-0.001	0.000155	0.0016	-0.00096
	(-1.92)	(0.436)	(1.68)	(-1.589)
Expenditure per capita	0.00000408	0.000001	0.000029	0.000012
	(4.63)	(3.832)	(9.05)	(5.825)
R-square	0.07	0.14	0.1	0.20
Number observation	584	302	1059	404
Log-likelihood/F value	-382.62	16.16	-767.62	33.64

Note: Number in parentheses are t-statistic.

Appendix Table 3. Parameter estimate of demand for chicken egg in urban and rural Java

Variables	Urban		Rural	
	Tobit	OLS	Tobit	OLS
Intercep	0.313	0.36964	0.3033	0.3733
	(4.28)	(5.394)	(3.95)	(5.541)
Price of chicken egg	-0.000111	-0.00012	-0.00019	-0.00018
	(-2.89)	(-3.399)	(-6.95)	(-7.751)
Price of rice	0.000052	-0.00003	-0.00004	-0.00008
	(0.36)	(-0.223)	(-0.217)	(-0.494)
Expenditure per capita	0.000002	0.000001	0.000008	0.000007
	(7.55)	(8.008)	(11.48)	(10.672)
R-square	0.13	0.12	0.16	0.16
Number observation	584	568	1059	926
Log-likelihood/F value	314.81	25.46	205.09	59.89

Note: Number in parentheses are t-statistic.

Appendix Table 4. Parameter estimate of demand for tofu in urban and rural Java

Variables	Urban		Rural	
	Tobit	OLS	Tobit	OLS
Intercep	0.6718	0.6968	0.3007	0.4298
	(8.42)	(9.184)	(3.81)	(5.272)
Price of tofu	-0.000457	-0.00046	-0.00045	-0.00045
	(-9.42)	(-10.216)	(-12.9)	(-14.598)
Price of rice	-0.000249	-0.00028	0.000212	-0.00005
	(-1.27)	(-1.489)	(0.94)	(-0.233)
Expenditure per capita	0.00000123	0.000001	0.000009	0.000008
	(3.49)	(3.519)	(10.9)	(10.8)
R-square	0.16	0.17	0.25	0.26
Number observation	584	579	1059	997
Log-likelihood/F value	152.27	38.07	199.37	113.31

Note: Number in parentheses are t-statistic.

Appendix Table 5. Parameter estimate of demand for tempe in urban and rural Java

Variables	Urban		Rural	
	Tobit	OLS	Tobit	OLS
Intercep	0.7667	0.748	0.568	0.6865
	(9.17)	(9.464)	(7.14)	(9.048)
Price of tempe	-0.0004667	-0.00047	-0.00043	-0.00041
	(-9.15)	(-9.865)	(-11.63)	(-12.451)
Price of rice	-0.00042	-0.00037	-0.00037	-0.00067
	(-2.18)	(-1.962)	(-1.73)	(-3.193)
Expenditure per capita	0.00000033	0.000000	0.000006	0.000006
	(0.95)	(1.532)	(7.83)	(7.988)
R-square	0.15	0.15	0.17	0.17
Number observation	584	576	1059	1014
Log-likelihood/F value	158.789	33.38	246.4	69.10

Note: Number in parentheses are t-statistic.

Appendix Table 6. Parameter estimate of demand for soy sauce in urban and rural Java

Variables	Urban		Rural	
	Tobit	OLS	Tobit	OLS
Intercep	4.96	6.9934	-1.3057	6.657
	(3.38)	(5.007)	(-0.709)	(3.577)
Price of soy sauce	-0.04533	-0.04668	-0.039	-0.038
	(-8.29)	(-9.457)	(-8.41)	(-10.01)
Price of rice	-0.0049	-0.00823	-0.00000	-0.0125
	(-1.33)	(-2.319)	(0.0002)	(-2.392)
Expenditure per capita	0.000055	0.000049	0.000219	0.000129
	(8.13)	(7.787)	(11.367)	(7.472)
R-square	0.42	0.23	0.19	0.19
Number observation	584	540	1059	713
Log-likelihood/F value	-1486.94	52.23	-2259.33	53.81

Note: Number in parentheses are t-statistic.

Appendix Table 7. Parameter estimate of demand for corn equivalent in urban and rural Java

Variables	Urban		Rural	
	Tobit	OLS	Tobit	OLS
Intercep	0.92021	3.098	8.3291	8.049
	(1.2964)	(3.674)	(4.3173)	(5.179)
Price of corn	-0.001234	-0.0015	-0.00409	-0.00679
	(1.8424)	(-3.001)	(-1.696)	(-4.226)
Price of rice	-0.0035879	-0.0048	-0.01712	-0.00658
	(-1.9747)	(-2.135)	(-3.16)	(-1.487)
Expenditure per capita	0.00000071	-0.000007	-0.00010	-0.00009
	(0.20733)	(-1.677)	(-4.9365)	(-5.848)
R-square	0.06	0.14	0.0854	0.12
Number observation	584	175	1059	508
Log-likelihood/F-ratio	-471.915	9.15	-1785.54	23.46

Note: Number in parentheses are t-statistic.