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**HOUSEHOLD FOOD EXPENDITURES PATTERNS
IN URBAN JAVA, INDONESIA**

**A thesis presented
In partial fulfillment of the requirements
for the degree of
Masters in Agricultural Economics**

**Massey University
Palmerston North, New Zealand**

**DEDI BUDIMAN HAKIM
1994**

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ABSTRACT

Indonesia's economic growth over the past two decades has been impressive compared to many other developing countries. This growth has been achieved through both industrial and agricultural development and has resulted in substantial increases in GNP per capita, despite substantial population growth. Increasing per capita GNP, together with increased population, is driving the demand for agricultural food products, particularly higher protein foods such as meat and dairy products.

This study investigates factors affecting household expenditure on foods, and estimates elasticities for all-food, rice, vegetables, meat and milk, with a view to examining export market opportunities in Indonesia for the New Zealand meat and dairy industries.

This study uses the 1990 National Social and Economics Survey (SUSENAS) and focuses on urban areas in five provinces in Java; Jakarta, West Java, Central Java, Yogyakarta and East Java. Compared to other provinces, these provinces are centres of development in Indonesia and hence seem potential markets for New Zealand products.

Survey households are grouped into four clusters based on the number of adults, the number of teenagers, the number of children, average adult highest education level and average adult age. Engel functions are then estimated for households in each cluster. Results are used to identify potential markets for New Zealand meat and dairy products.

Results of this study indicate that average households in all clusters consider all-food, rice and vegetables to be normal goods, while meat and milk are considered luxuries. Results also suggest that, despite rice being a staple food in Indonesia, with increasing per capita income, rice will become an inferior good. This study reports relatively high expenditure elasticities for meat and milk, hence strong demand for these products can be expected in the future as household incomes increase. With increasing per capita

incomes, households can be expected to increase intake in protein relative to starch and carbohydrate rich foods.

From a New Zealand perspective, future market opportunities for meat and dairy products in Indonesia appear to be substantial, particularly for the younger, better educated and higher income market segment.

CHAPTER ONE

INTRODUCTION

1. 1. Background

In 1992, the World Bank reported that countries in East and Southeast Asia such as China, Japan, South Korea, Singapore and Thailand were distinguished as countries which have gained a remarkable growth in GNP per capita. Between 1965 and 1973, the growth of GNP per capita in these countries was on average 4.8 percent, while in 1990 it became 5.3 percent which was the highest growth over the world. For example, in the same time the growth of GNP per capita in high income countries and OECD members were 1.5 percent and 1.6 percent, whereas in the low and middle income countries it was 0.3 percent. It is predicted that in future the annual growth of GNP per capita in the East and Southeast Asia region will remain high due to rapid industrial growth.

Likewise, Indonesia has been recognized as a country which has made impressive development gains both in the agricultural and the manufacturing sectors. Not surprisingly, Indonesia is predicted to be a newly industrialised country following Singapore and South Korea. More importantly, the growth of GNP is exceeding the population growth indicating the Indonesian per capita income gains are quite impressive. As seen in Table 1.1, despite the fact that Indonesia is still categorised as a low income and high population country, the annual GNP growth is quite exciting.

Due to the relatively high annual growth of GNP per capita and relatively rapid population growth, Indonesia is a potential market for agricultural products. The growth of agricultural production, with the exception of cereal (Indonesia had achieved self-sufficiency in rice production by 1983) is still low indicating that in future Indonesia desperately needs more agricultural products, particularly animal and dairy products.

Table 1. 1. GNP and Population in Indonesia 1976-1990.

Year	GNP per capita (US\$)	Average Annual GNP per capita growth rate(%) [*]	Population (millions)
1976	240	3.4	135.2
1977	300	3.3	133.5
1978	360	4.1	136.0
1979	370	4.1	142.9
1980	430	4.0	146.6
1981	530	4.1	149.5
1982	580	4.2	152.6
1983	560	5.0	155.7
1984	540	4.9	158.9
1985	530	4.8	162.2
1986	490	4.6	166.4
1987	450	4.5	171.4
1988	440	4.3	174.8
1989	500	4.4	178.2
1990	570	4.5	178.2

^{*} From base year: 1960.

Source : World Bank. *World Development Report. Several Issues.*

It is estimated that in future the demand for agricultural products, particularly meat and animal products, will continue to increase. However, for rice consumption, despite the fact that the demand for rice will increase, it is reported that income elasticity of demand has decreased substantially, indicating per capita rice consumption will soon reach a maximal level and then start declining (Ito *et al.*, 1989). The implication of this finding is, as Ito *at al.*, (1989) stated, that consumers can be expected to increase their consumption of meat and dairy products in the future. Statistics shows that in the last five years, there was a rapid change in per capita meat product consumption compared to per capita rice consumption. For example, 1987 per capita meat consumption was 3.02 kg whereas in 1991 it became 3.40. Not surprisingly it has been predicted that in future, per capita rice consumption would decrease. It is shown in Table 1.2 that per capita rice

consumption declined considerably from 150.03 kg (1988), becoming 145.53 kg in 1991.

Table 1. 2. Selected Food Consumption in Indonesia 1987-1991 (kg/capita).

Year	Rice	Meat	Egg	Fish	Milk
1987	143.17	3.02	2.08	12.28	4.19
1988	150.03	3.08	2.21	12.76	4.19
1989	140.84	3.11	2.24	12.58	3.68
1990	150.05	3.25	2.36	12.91	3.49
1991	145.53	3.40	2.46	13.13	3.49

Source: Indonesian Central Bureau of Statistics. *Food Balance Sheets*. Several Issues.

In addition to increasing incomes, changes in food consumption in Indonesia have been partly caused by the degree of urbanization. The rapid rate of urbanization and high urban population growth have been associated with dramatic changes in diets which have been shifting away from traditional grains, root and tubers to food containing more protein such as meat and milk. It is reported that between 1970 and 1985, the level of urbanization increased from 17.5 percent to 26.2 percent of the total population. Together with increasing population, thereby increasing the level of urbanization, there has been an increase in the share of the adult-aged group in the population (Hedley, 1986). A combination of an increase in urbanization, higher incomes and a fall in dependency ratios tends to reduce the aggregate elasticities of demand for staple foods (Tabor *et al.*, 1989).

Information regarding the demand for agricultural products would be useful in developing production and marketing programmes. Consequently, the parameters affecting household consumption of various food items should be carefully investigated. Since other factors such as demographic variables also determine the likelihood of consuming particular food items, time series data may not always provide relevant information. A cross-section analysis, on the other hand, allows a much richer analysis of markets where response to income growth is especially rapid.

Studies relating to food consumption have been conducted on the national level (time series) and household level (cross-section). No previous studies of Indonesian food consumption have attempted to group households to describe market segments. As a result, little information exists on the demand parameters for household groups.

1. 2. Objectives

The objectives of this study are (i) to investigate factors affecting households food consumption patterns in Urban Java using cross-section data from the 1990 National Socio-economic Survey, (ii) to estimate expenditure elasticities for different household groups, and (iii) to discuss the implications for New Zealand meat and dairy product export opportunities in Indonesia.

1. 3. Thesis Outline

This thesis consists of eight chapters. A review of the literature on food demand studies is undertaken in Chapter II. The Engel function and model specification is presented in Chapter III. Chapter IV discusses the data handling and construction issues. The cluster analysis and Engel functions for all food, rice and vegetables are discussed in Chapter V. Chapter VI presents Engel functions for meat and milk. Chapter VII provides a discussion of expenditure elasticities from this study and other studies. Finally the conclusions and recommended areas for further study are addressed in Chapter VIII.

CHAPTER TWO

LITERATURE REVIEW

This chapter is devoted to exploring studies of food demand not only in Indonesia but also in other countries. The chapter is divided into three sections. The first deals with previous studies relating to the analysis of food demand in Indonesia. The second describes studies analysing food consumption in other developing countries such as India, Pakistan and Bangladesh. The inclusion of these studies is used for a comparison of the food consumption patterns between Indonesia and other countries. The last section summarises all these selected studies.

2. 1. Previous Studies of Food Consumption in Indonesia

Previous studies can be categorised into two groups. The first group analyses disaggregated food consumption, such as those of Timmer (1971), and Timmer and Alderman (1979). The second group examines food groups consumption in the aggregate and assumes weak separability among food. Examples are Pakpahan (1988) and Boediono (1978).

In 1971, Timmer investigated the demand for rice consumption using two different sources of cross-section data. The first study focused on a Jakarta household consumption survey undertaken between November 1968 and January 1969. The second study examined Java expenditure data from a survey conducted between September and October 1967. The results from the first study are presented below. These indicated that expenditure elasticities decreased considerably with an increase in total monthly expenditure on rice. Thus, low income consumers were more responsive to changes in expenditure/income than high income consumers.

Total Monthly Expenditure on Rice per household (Rupiah)	Expenditure Elasticity
1,000	1.45
2,000	1.03
3,500	0.77
5,000	0.64
10,000	0.45
25,000	0.28
50,000	0.20

In the first study, Timmer used expenditure data instead of income data. It is important to bear in mind that savings may influence the allocation of household budgets. Consequently, savings might be low for low and middle income consumers. Finally, because expenditure on rice was used as a dependent variable, the change in the quantity and the quality of rice could not be estimated. High income consumers may increase not only the quantity but also the quality of rice consumption as their income increases. In Timmer's second study, the quantity of rice was included enabling the comparison of rice consumption patterns across regions and income classes. The results showed that the expenditure elasticity was greater in rural areas than urban areas, with the exception of urban regions in West Java. In Java urban areas, the expenditure elasticities for rice were 0.19 (Jakarta), 0.44 (West Java), 0.42 (Central Java) and 0.52 (East Java) while in rural areas expenditure elasticities for rice were 0.54 (West Java), 0.71 (Central Java) and 1.14 (East Java).

The aggregation of food items, for example inferior goods and normal goods, would decrease the expenditure elasticity. In Indonesia, corn is considered an economically inferior good. Nevertheless, the grouping of inferior goods with normal goods such as rice would lead to underestimation of the rice expenditure elasticity (Dixon, 1982b). This is evidenced from expenditure elasticities of cereal existing between zero and one (Table 2. 1).

Table 2. 1. Boediono's Estimated Elasticities of Demand by Commodity, in Rural and Urban Areas, 1969

Commodity	Demand Elasticities			
	<u>Based on Expenditure</u>		<u>Based on Prices</u>	
	Rural	Urban	Rural	Urban
Cereal	0.71	0.50	-0.68	-0.51
Fish	1.30	1.18	-1.06	-1.03
Tobacco	1.13	1.11	-0.93	-0.97
Other Food	1.13	1.16	-0.95	-1.01
Housing	0.84	0.98	-0.71	-0.87
Clothing	1.12	1.12	-0.93	-0.98
Durables	1.69	1.64	-1.37	-1.42
Festivals	1.17	1.18	-0.96	-1.03
Miscellaneous	1.30	1.36	-1.06	-1.17

Source: Hedley (1978).

To estimate expenditure elasticities of a commodity, Boediono applied a Linear Expenditure System to data for all Indonesia using the National Social and Economics Survey (SUSENAS) IV of 1969-1970. Based on his estimates, households in rural or urban areas considered all food, with the exception of cereal, to be luxuries. The results also demonstrated that expenditure elasticities for food such as cereal, fish and other food in rural areas were greater than expenditure elasticities in urban areas. This indicated that households in rural areas tended to be more responsive toward a change in household total expenditure than households in urban areas.

In evaluating Boediono's study, Dixon (1982b) said : " the estimates were probably made on value, not quantity, and so tended to overestimate demand for physical quantities of rice since both quantity and average quality or prices per kilogram increase as expenditures increase ".

In the second study, Boediono (1978) classified food into rice, corn, roots and tubers, vegetables and fruits, sugar, fish, livestock products and prepared food and used Frisch's method to estimate income and own-price elasticities. The results are presented in Table 2. 2. Household consumption of non-carbohydrate foods such as vegetables and fruits, fish, livestock products, with the exception of sugar, were highly responsive to changes in

income compared to rice, corn, roots and tubers. As income increased, the consumption of non-carbohydrate foods was higher than of carbohydrate foods especially livestock products. Note that the the highest income elasticity in Table 2. 2 was for livestock products.

Table 2. 2. Boediono's Estimated Elasticities by the Frisch Method

Commodity	Income Elasticities	Budget Shares	Own-Price Elasticities
Rice	0.689	0.221	-0.633
Corn and roots and tubers	0.300	0.038	-0.255
Vegetables and fruits	1.170	0.082	-0.966
Sugar	1.411	0.029	-1.153
Fish	1.271	0.066	-1.041
Livestock products	2.168	0.028	-1.735
Prepared foods	1.225	0.004	-1.007

Source: Boediono (1978).

Timmer and Alderman (1979) focused on three commodities: rice, corn and cassava, together with the protein intake from these commodities, using 1976 SUSENAS. Because 1976 SUSENAS was undertaken in three rounds (round 1 (January-April), round 2 (May-August) and round 3 (September-December)), Timmer and Alderman (1979) examined the effect of regions and rounds where 1976 SUSENAS was carried out on food consumption patterns. The reason behind the inclusion of these commodities was that they accounted for two-thirds of the average Indonesian protein intake. The study showed that individuals in urban areas seemed to consume more rice than individuals in rural areas, evidenced by a positive sign and a statistical significance of an urban dummy variable. It also suggested that per capita rice consumption in round 2 (May-August) was greater than per capita rice consumption in round 3 (September-December) while per capita fresh cassava consumption in round 1 was greater than per capita fresh cassava consumption in round 3. Timmer and Alderman's estimated elasticities are presented in Table 2. 3.

Statistically significant price elasticities for four income groups were estimated for rice and fresh cassava. As seen in Table 2. 3, the poorest households were more sensitive toward changes in income, or in prices, especially those in rural areas. For example, fresh cassava price elasticities ranged from -1.284 to -0.780, and from -1.921 to -0.743 for rice. In addition, rice seemed relatively more expensive than fresh cassava. For low income groups, rice was a luxury good whose total expenditure elasticity was 1.168, compared to 0.994 for cassava. The study also showed that for lower income groups, fresh cassava was a strong substitute for rice. This implied that with an increase in the rice price, the poorest households would move away from rice to fresh cassava consumption. The elasticities of corn were not estimated.

Using the same data, Dixon (1982b) examined factors affecting food consumption in rural and urban Java. Rice, corn, cassava, gaplek (dried cassava) and sweet potatoes were included in his analysis. Income groups were divided into low, medium and high, based on the calorie intake from six basic staples. A double-log function was employed with a quadratic formulation of the expenditure variables. The results of the study are displayed in Table 2. 4. In comparison to the Timmer and Alderman study, total expenditure elasticities and own-price elasticities for rice and fresh cassava for both urban and rural areas appeared to decrease as expenditure increased. It is clear that for a high expenditure household, the negative expenditure elasticities for fresh cassava, gaplek (dried cassava), and sweet potato indicate inferior goods.

Despite the own-price elasticities having the expected signs, Dixon's results were not statistically significant at the 5 percent level. As with the Timmer and Aldermen study, elasticities for corn were not estimated.

Table 2. 3. Price Elasticities and Expenditure Elasticities of Food Demand in Indonesia

	Income Groups			
	1	2	3	4
Per Capita Total Expenditure (Rp/month)				
Mean	1,548	2,513	3,876	9,085
Range	<2000	2000-3000	3000-5000	>5000
Total Expenditure Elasticities				
Rice : Urban	0.997	0.759	0.533	0.070
Rural	1.168	0.924	0.704	0.364
Fresh Cassava Urban	0.839	0.522	0.230	-0.369
Rural	0.994	0.679	0.394	-0.046
Price Elasticities (Urban and Rural)				
Rice	-1.921 (7.1)	-1.475 (4.9)	-1.156 (5.1)	-0.743 (4.0)
Fresh Cassava	-1.284 (3.4)	-0.818 (2.0)	-0.943 (3.4)	-0.780 (4.0)
Cross-Price Elasticities				
Fresh Cassava with respect to the Price of Rice	0.996 (1.8)	0.709 (1.2)	0.787 (1.5)	0.685 (1.3)

Source : Timmer and Alderman (1979).

Table 2. 4. Food Price Elasticities and Expenditure Elasticities Estimated by Dixon

		Expenditure Group		
		1	2	3
Per Capita Total Expenditure (Rp/month)				
Mean:	Urban	3,543	8,871	22,760
	Rural	1,874	4,161	9,366
Total Expenditure Elasticities				
Rice:	Urban [*]	0.368	0.056	-0.020
	Rural [*]	0.971	0.364	0.122
	Urban [#]	0.329	0.107	-0.121
	Rural [#]	0.831	0.485	0.133
Fresh:	Urban	0.423	-0.231	n.e.
Cassava	Rural	0.773	0.476	-1.201
	Urban	0.094	-0.275	-0.654
	Rural	0.849	0.177	-0.627
Gaplek:	Rural	1.761	-0.667	-3.219
	Rural	0.833	-1.018	-2.900
Sweet:	Urban	0.801	-0.388	n.e.
Potatoe	Rural	1.829	0.516	-0.252
	Urban	0.462	-0.152	-0.782
	Rural	1.556	0.390	-0.795
Rice:	Urban	-0.31 (0.6)	-0.56 (1.4)	n.e.
	Rural	-1.28 (1.8)	-0.45 (1.4)	0.18 (0.2)
Fresh:	Urban	1.27 (1.2)	0.14 (0.6)	n.e.
Cassava	Rural	-1.09 (2.8)	-0.82 (6.1)	-0.67 (0.8)

continued

Table 2. 4. (continued)

		Expenditure Group		
		1	2	3
Gaplek:	Rural	-2.49 (1.7)	-2.06 (3.4)	-2.18 (0.5)
Sweet: Potatoe	Urban	-3.60 (2.9)	0.34 (0.2)	n.e.
	Rural	-2.43 (3.8)	-2.12 (2.5)	-4.85 (1.4)

* Estimated on separate expenditure groups

Single equation with interactive expenditure groups, dummy and price

n.e. not estimated

Source: Dixon (1982b).

Teklu and Johnson (1988) investigated the effect of economic variables (price and expenditure), and demographic variables such as household size, on food consumption in urban Indonesia. Using the 1980 nationwide multipurpose household survey (SUSGASAR) and the Linear Approximate/Almost Ideal Demand System (LA/AIDS) and Multinomial Linear Logit Model (MLLM), they found that fish, other meats and dairy products, fruits and vegetables were luxury goods, with expenditure elasticities that exceeded unity. However, the elasticity for cereal (rice) was less than unity. But when expenditure elasticities were translated into income elasticities, only for meat products was the income elasticity greater than one.

Both the AIDS and MLLM results showed that household size had a negative effect on per capita expenditure, with the exception of rice (AIDS and MLLM) and foodcrops (MLLM). This implied that an increase in household size was associated with a reduction in per capita food consumption due to economies of scale. An increase in the number of household members would lead to households reallocating their budget from luxury goods to normal goods in order to maintain a level of sufficiency.

As expected, most of the computed price elasticities were inelastic, with the exception of beans (AIDS). Among the commodities, the own-price

elasticity of rice remained low, at -0.46 (AIDS) and -0.16 (MLLM) compared to beans -1.09 (AIDS) and -0.97 (MLLM). To analyze the impact of a decrease in rice prices on food commodity expenditures and total food expenditures for urban consumers, Teklu and Johnson (1988) imposed a 10 percent reduction in rice prices. The results revealed that low income consumers benefited from this change because rice makes up a high proportion of their food expenditure. In line with the reduction in rice prices, the lower income consumers gained a real income improvement by as much as 3.6 percent compared to higher income consumers' real income improvement of 2.3 percent. Finally, in terms of policy implications, Teklu and Johnson (1988) suggested that " policy makers should take account of consumer adjustment to policy changes in their totality ".

In contrast to the previous studies, Deaton (1990) employed a method of clustering in which prices varied across clusters. Deaton concentrated on rural households and investigated rice, wheat, maize, cassava, roots, vegetables, legumes, fruits, meat, fresh fish and dried fish. Despite the inclusion of education dummy variables, the results for these dummies were not reported. The study revealed that wheat, fruit, meat and fresh fish were luxury goods with expenditure elasticities of 1.57, 1.39, 2.30, and 1.08, respectively. These findings were similar to those Tabor *et al.*, (1989) in which general food staples were normal goods, and higher value foodstuffs had higher expenditure elasticities than did the lower value starchy staples.

Compared to other studies, own-price elasticities of vegetables and meat were relatively high at 1.113 and 1.691 respectively. Deaton then argued that the low own-price elasticities for staple foods were due to few obvious substitutes. However, it was interesting to note that " .. there is some tendency for the goods that have the lowest total expenditure elasticities (dried fish, rice and cassava) to have absolutely low price elasticities. Something that might be expected for goods that are genuinely necessary".

In 1988, Pakpahan focused on urban West Java using 1980 SUSENAS. In order to examine the effect of household size, variables were constructed describing the number of people in a household. The Working Theil-Suhm

model was used and food was classified into ten commodity groups (cereal, tuber, fish, meat and poultry, eggs and milk, vegetables, soybean and nuts, fruits and sugar). The results showed that the food expenditure elasticity for a single-person household was lower than that of other household sizes. The food expenditure elasticities of household size were 0.55 (for one-person households), 0.79 (2 persons), 0.82 (3 persons), 0.82 (4 persons), 0.77 (5 persons), 0.78 (6 persons), and 0.79 (7 or more persons). Based on these elasticities, there was no evidence of household economies of scale. It was also reported that the low household size elasticity for those households containing one person implied that a single household member had a greater opportunity for spending own income on non-food items than did members of other household sizes. The expenditure elasticities showed that cereal, sugar and tobacco were necessities while fish, meat and poultry, and eggs and milk were luxuries. To examine the relationships among commodity groups, Pakpahan analyzed the cross-price effects. The results indicated that cereal and tuber were neither substitute nor complementary. Animal products such as eggs and milk, fish, and meat and poultry were substitutes for each other. The relationship between vegetables and soybean and nuts did not exhibit substitution effects, which seems in contradiction to empirical observation and a Sundanese diet. It is important to note that West Java province is predominantly Sundanese and in Sundanese daily diets, vegetables are commonly eaten together with soybean or nuts.

In contrast to Pakpahan (1988), Chernichovsky and Meesook (1984) introduced household size in their analysis by specifying three size groups, (children aged 0-4 years, children aged 5-9 years and members aged 10 and above). Also included were other household characteristics such as education level of the spouse of the household head, and sources of income. Food items were aggregated into rice, corn, wheat, cassava, potatoes, fish, meat and poultry, vegetables, legumes, fruits and others. Log-linear functions were estimated using SUSENAS 1978 to investigate the effects of prices, expenditure and household characteristics on the consumption of food. The results obtained showed that for low income households in Java and out of

Java, the staple food (rice) had the highest expenditure elasticity (Table 2. 5). For high income households, corn, wheat and potatoes had higher expenditure elasticities. In both regions, cereal (rice, corn and wheat) expenditure elasticities tended to decrease with an increase in expenditure. Surprisingly, for rich protein foods such as fish, eggs and poultry, and meat, the expenditure elasticities indicated that consumption decreased as expenditure/income increased. For dairy products, expenditure elasticities increased as expenditure increased in both Java and out of Java.

Household size, education and sources of income influence household decisions on food consumption. Households with high numbers of household members tended to reduce consumption of meat and poultry, eggs and fruits. In addition, the presence of children in a family increased the consumption of dairy products. High education levels of the spouse of the household head were associated with purchase of the more expensive foods, particularly in the case of households in Java. Chernichovsky and Meesook (1984) reported that households with incomes from agriculture and industry also had better diets in terms of nutrients than households with incomes from government employment, services and transfer payments.

Table 2. 5. Total Expenditure Elasticities of Demand for Food, Indonesia, 1978

Expenditure Group	Rice	Corn	Wheat	Cassava	Potatoes	Fish	Meat	Egg & Poultry	Dairy	Vegetables	Legumes	Fruit	Other
Java:													
Lower 40%	3.022 (16.410)	-0.622 (-2.520)	0.061 (0.672)	0.238 (0.912)	0.539 (4.389)	1.317 (8.120)	3.948 (5.561)	1.143 (7.453)	0.076 (2.377)	0.953 (10.649)	2.613 (14.257)	1.901 (10.998)	1.243 (21.753)
Middle 30%	0.914 (4.087)	-0.425 (-0.929)	-0.027 (0.148)	0.790 (1.454)	1.238 (3.884)	1.825 (5.374)	2.162 (8.196)	2.871 (5.935)	0.783 (3.900)	0.990 (95.369)	1.991 (5.248)	3.708 (8.031)	0.911 (9.573)
Upper 30%	0.034 (1.098)	0.203 (2.210)	0.943 (912.957)	-0.074 (-0.580)	1.673 (14.836)	0.979 (10.355)	2.534 (26.355)	2.544 (23.843)	2.203 (2.550)	0.559 (14.319)	0.653 (17.298)	2.617 (29.833)	0.696 (30.055)
Outer Java:													
Lower 40%	1.149 (14.565)	-0.290 (-2.014)	0.424 (5.243)	0.365 (2.002)	0.667 (4.833)	1.834 (16.703)	1.332 (13.692)	2.110 (13.037)	0.719 (10.229)	1.735 (19.505)	1.425 (10.348)	2.814 (16.958)	1.331 (28.731)
Middle 30%	0.398 (4.423)	-0.133 (-0.399)	1.224 (3.752)	0.717 (1.358)	1.666 (0.444)	1.638 (7.429)	3.112 (8.785)	3.621 (6.787)	1.856 (5.996)	0.895 (5.565)	2.362 (5.392)	4.288 (9.243)	0.945 (10.968)
Upper 30%	0.287 (6.162)	-0.223 (-2.373)	0.702 (8.851)	0.1777 (1.348)	0.974 (8.680)	1.201 (17.843)	2.278 (25.109)	2.987 (22.922)	1.859 (22.999)	1.077 (19.763)	2.142 (19.811)	3.015 (25.375)	0.866 (27.840)

Notes : 1. t-Statistics are given in parentheses

2. Expenditure groups are classified as follows:

Expenditure Group	Monthly Expenditure (Rp)	
	Java	Outer Java
Lower 40%	up to 12,999	up to 22,999
Middle 30%	13,000-23,999	23,000-35,999
Upper 30%	24,000 or more	36,000 or more

Source : Chernichosky and Meesook (1984).

2. 2. Previous Studies in Other Developing Countries

2. 2. 1. India

Swamy and Binswanger (1983) investigated three functional forms of demand equations; the normalized quadratic demand function (NQ); the generalized Leontif demand function (GL) and the transcendental logarithm demand function (TL). All three demand functions were derived from a cost utility function. Having imposed and tested restrictions on homogeneity, symmetry and adding up, the TL was the preferred functional form. Using time-series data from ten Indian states for the period 1956-1975, Swamy and Binswanger analyzed five food items (rice, wheat, inferior cereal, pulses, and other commodities).

In spite of the statistical insignificance of the expenditure elasticities, wheat had an expenditure elasticity greater than one. The study also indicated that expenditure elasticities for other commodities were greater than one for three functional forms. As a result, compared to other food, wheat was a luxury item in India. This study revealed that the expenditure elasticities for other commodities were about 1.5 regardless of the functional forms of the demand equations; for pulses expenditure elasticity was very low. Using the Transcendental logarithmic demand function, Swamy and Binswanger (1983) estimated expenditure elasticities for different expenditure levels. In general, results showed that the higher the expenditure, the lower the expenditure elasticities for rice, wheat and inferior cereal while expenditure elasticities for other commodities increased as expenditure increased. More importantly, for the highest expenditure level, rice and wheat became inferior goods whose expenditure elasticities were negative.

Based on their analysis, Swamy and Binswanger (1983) reported own-price elasticities for rice, wheat, inferior cereal and other commodities of 0.582, -0.226, -0.630 and -0.091 respectively. All foods were found to be substitutes for each other, with the exception of wheat for other commodities. In another study that used cross-section data, Swamy and Binswanger (1983) reported that the expenditure elasticity for rice was between 0.50 and 0.63 and for wheat, between 0.93 and 1.54, and for coarse cereal between

0.10 and 0.31. Own-price elasticities for cereals were reported to vary between -0.35 to -0.52 and for all foods the elasticities ranged from -0.63 to -0.80.

Huang and David (1993) estimated the effect of urbanization on cereal consumption. By using a Linear Approximate/Almost Ideal Demand System (LA/AIDS) and time series data from supply-utilization balance sheets (1960-1988), this study revealed that total expenditure elasticities for rice, wheat and coarse grain were 0.53, 0.20 and 0.53 respectively. The impact of a large proportion of expenditure on rice can be observed from the larger own-price elasticity as compared to wheat, that is -0.52 and -0.16 respectively.

The effect of urbanization on cereal consumption was measured by the elasticity of urbanization, defined as the percentage change in demand resulting from a given percentage change in the ratio of urban population to total population. Increased urbanization had a negative effect on rice and coarse grain consumption but a positive effect on wheat consumption. The elasticity of urbanization for wheat was 1.56, whereas for rice and coarse grain the estimates were -0.24 and -1.24.

Ray (1980) also employed the AIDS model. To understand the effect of household size on household consumption of food, Ray included the variable for family size into the AIDS model and then estimated expenditure, price and family size elasticities. To investigate the patterns of household consumption between urban and rural households, two different regions were separated. Together with food, Ray also analyzed clothing, fuel and light and other non-food goods. The results revealed that foods were necessities with the exceptions of grain (rural), and milk and milk products. Urban households were found to be relatively more responsive to changes in income as measured by greater changes in their budget shares, where rural households were more responsive to changes in prices. Differences between the absolute values of elasticities facing urban and rural households were apparent. For instance, the real expenditure elasticity for food in the rural area was 0.727 compared with 0.342 in urban areas.

It is important to note that household size had a negative effect on per capita urban household consumption, but *vice versa* for rural households, indicating that an increase in family size reduces per capita food consumption in urban areas, but increases per capita consumption in rural areas. For example, the urban size elasticity was -0.014 while in the rural region the household size elasticity was 0.006 .

2. 2. 2. *Pakistan*

Employing the Extended Linear Expenditure System (ELES) and using cross-section data of the Pakistan Household Income and Expenditure Survey for 1984/1985, Burney and Akmal (1991) examined the demand for food in urban and rural areas. The division into urban and rural areas enabled them to analyze the effect of urbanization on food consumption patterns. The study suggested that urban households spent around 62 percent of their income on food, compared with around 44 percent for rural households.

Three distinct patterns of the expenditure shares of the food items across income groups were: (i) continuous decline with higher income, (ii) first increase and then decline and; (iii) continuous increase. It was observed that for basic foods such as wheat, pulses and vegetables, expenditure shares declined as income increased. On the other hand, low income households increased the proportion of total food expenditure on mutton, eggs and fruits as their income rose.

The marginal propensity to consume for rural households was greater than for urban households. This implied that a change in 'supernumerary income' was greater for rural households than urban households, *ceteris paribus*. In addition, for the majority of the food items, the marginal propensity to consume seemed to decrease as incomes increased.

For the broad commodity group "food", income elasticities varied considerably across income groups, ranging from 0.49 to 0.76. However, income elasticities tended to decline as income increased. With respect to changes in income, the response of foods such as wheat, rice and other cereals was extremely low. In contrast to this, the response of mutton,

chicken and fruit was high. For several income groups, chicken was considered a luxury good, particularly for households residing in urban areas.

2. 2. 3. *Bangladesh*

Pitt (1982) analyzed food and nutrition in Bangladesh for food policy purposes. Using the Household Expenditure Survey of Bangladesh 1973/1974, data for rural areas were used to analyse nine food items (rice, wheat, mustard oil, fish, onions, spices, pulses, fresh milk and potatoes). These foods accounted for 95 percent of the calorie intake, 93 percent of the protein intake and nearly 90 percent of total food expenditure. Since the cross-section data contained zero expenditures for some households, the Tobit model was used. Because problems arise when zero consumption occurs, the application of continuous variable estimation techniques result in biased and inconsistent estimates¹. In his model, Pitt included household size, agriculture cultivator status, and number of earners in the household, to measure household characteristics. Also he classified households into high expenditure households and low expenditure households. The results indicated that expenditures varied across foods and expenditure levels. For both household classes, wheat appeared to be an inferior good since the expenditure elasticities were -0.24 and -0.10, respectively. In contrast, mustard oil, milk and potatoes were luxury goods. Surprisingly, rice, considered to be a staple food, had relatively high expenditure elasticities of around 0.94 (high expenditure households) and 1.19 (low expenditure households). The expenditure elasticities for rice, together with those for wheat and milk, did not increase as total per capita expenditure rose. In general poor households were more responsive than rich households to changes in prices. For example, own-price elasticities for wheat and milk for poor households were -0.72 and -1.08 respectively, compared to -0.06 and -0.25 respectively for richer households. The responsiveness of poor households was also reflected by the high own-price elasticity for rice which

¹ The Tobit model will be discussed further in Chapter 3.

exceeded unity. This meant that the proportionate change in quantity of rice consumed was greater than the proportionate change in the rice price.

Samad and Hossain (1993) investigated several forms of Engel functions to estimate income and expenditure elasticities. Using the Household Expenditure Survey data for 1985/1986 and 1988/1989, they classified food into oil, wheat, potato, fish, meat, pulse, soybean oil, mustard oil, sugar, and vegetables. Again, households were divided into "urban" and "rural" for comparisons of food consumption. Having estimated the model parameters, Samad and Hossain reported that households in rural areas were characterized by income elasticities that remained constant across the two periods of the study, with the exception of those for pulse and vegetables which increased slightly, and for sugar which decreased. Further, rural residents considered most food items as necessities, except for meat and sugar. It was also found that for urban residents, income elasticities in 1988/1989 were smaller than those in 1985/1986. The authors argued that the decrease in income elasticities was due to a slight shift in expenditure patterns.

In addition, the marginal propensity to consume rice (MPC) for the relatively poor households was higher than for rich households. In rural areas, the MPC's for rice were 9.7 percent (1985/1986) and 10 percent (1988/1989). In urban areas, the MPC's for rice were 3.2 percent (1985/1986) and 1.8 percent (1988/1989). In contrast to the MPC for rice, the marginal propensity to consume meat was higher for urban than rural residents.

In Bangladesh, the degree of urbanization has been found to affect the pattern of consumption. Based on this observation, Asaduzzaman (1989) examined the existence of differences in food consumption patterns between urban and rural households by using data for 1984/1984 and 1985/1986. His study showed that with increased urbanization, the demand for cereal decreased whereas the demand for high protein intake, particularly fish and meat was likely to increase significantly. His results indicated that in both regions, income elasticities for cereal were low but the cereal income expenditures for households in rural areas were almost double the income

elasticities in urban areas. For instance, in 1985/1986 the income elasticity for cereal in urban areas was 0.25 compared to 0.45 in rural areas. On the other hand, in both areas, income elasticities for non-cereal foods seemed to be high, exceeding unity. On comparing income elasticities over time, it was found that there had been a decline in income elasticities for most foods. This was said to be probably due to an increase in prices. Other results showed that with increased income, urban households might spend more on non-cereal food than foodgrains. However, marginal propensities to consume non-cereal food was higher for households in rural areas than for households in urban areas.

2. 3. Summary

A summary of some of the results of previous studies of food consumption in Indonesia and other developing countries is presented in Table 2. 6. Many Indonesian studies have focused on aggregated food groups especially cereal, meat, roots, and vegetables. Studies on food consumption in Indonesia have used cross-section data from the National Socio-economic Survey for food modules which is conducted every three years. However, some researchers did not fully exploit the household characteristics data available from those surveys. Little attention had been paid to demographic factors affecting consumer decisions about food consumption. Since consumption decisions might differ according to household composition and education, for example, these variables should be taken into account when estimating food demand in Indonesia. Compared to studies in other developing countries, the results showed relatively similar findings in terms of responsiveness of households to changes in food prices and incomes (or expenditures). Low income households were more responsive than high income households to changes in expenditures or incomes. In addition, rich-protein foods were considered to be luxuries.

Table 2. 6. Selected Studies on Food Consumption in Indonesia and Developing Countries

Researcher(s)	Data Set	Food Considered	Socio-economic and Demographic Factors
INDONESIA			
Timmer (1971)	SUSENAS 1967	Rice	Region
Boediono (1978)	SUSENAS 1969/1970	Cereal, Fish, Tobacco Other food	
Boediono (1978)	SUSENAS 1976	Rice, Corn, Roots, Tubers, Vegetables and Fruit Sugar, Fish, Livestock, Prepared Food	
Timmer and Alderman (1979)	SUSENAS 1976	Rice, Corn, Cassava	Region, Survey Period
Dixon (1982b)	SUSENAS 1976	Rice, Corn, Cassava, Dried Cassava, Sweet Potatoes	
Teklu and Johnson (1988)	SUSGASAR 1980	Fish, Other meat, Cereal, Dairy Product Vegetable and Fruit	Household Size
Deaton (1990)	SUSENAS 1981	Rice, Wheat, Maize, Cassava, Roots, Legume Vegetable, Fruit, Meat, Fresh and dried fish	Education
Pakpahan (1988)	SUSENAS 1984	Cereal, Tuber, Fish, Meat and Milk, Vegetables, Nut, Soybean, Fruit, Sugar and Tobacco	Region and Household size

Table 2. 6. (continued)

Researcher(s)	Data Set	Food Considered	Socio-economic Demographic Factors
Chernichovsky and Meesok (1984)	SUSENAS 1978	Rice, Corn, Wheat, Potatoes, Fish, Meat Poultry, Eggs, Dairy Eggs, Dairy Products, Vegetables, Legume, Fruit and Other	Household Size, Education, Source of Income
INDIA			
Swammy and Binswanger(1983)	Time Series 1956-1975	Wheat, Rice, Inferior Cereal, Pulse	Household Size
Huang and David (1993)	Time series 1960-1988	Rice, Wheat, Coarse	Region
PAKISTAN			
Burney and Akmal (1991)	Household Income and Expenditure Survey 1984/1985	Wheat, Rice, Other Cereal, Pulses, Butter, Bakery Products, Beef, Mutton, Fish, Chicken, Others	Region
BANGLADESH			
Pitt (1982)	Household Expenditure Survey 1973/1974	Rice, Wheat, Flour, Mustard Oil, Fish, Onions, Spices, Pulses, Fresh Milk and Potatoes	Household Size Cultivations, No of Earners
Samad and Housein (1993)	Household Expenditure Survey 1985/86 and 1988/1989	Oil, Sugar, Wheat, Fish, Potatoes, Meat, Pulse, Mustard Oil, Vegetable, Soyabean Oil and others	
Asaduzzaman (1989)	Household Expenditure Survey 1983/1984 and 1985/1986	Cereal, Pulses, Fish, Vegetables, Meat and Egg, Milk, Edible Oil	Region

CHAPTER THREE

ENGEL FUNCTION AND MODEL SPECIFICATION

3. 1. Engel Functions

Engel curves have been widely used to investigate patterns of household food expenditure in connection with total household income or expenditure. Engel's law, concerning behaviour in terms of the household budget allocation, states that (1) within household budgets, food is the most important item, (2) the proportion of total expenditure spent on food declines with increasing income and (3) the proportion of total expenditure allocated to luxury items increases as income increases (Philps, 1974).

By definition, an Engel curve is "a relationship between income and the expenditure on the particular commodity, all other things being equal" (Philps, 1953). This definition implies that the Engel function is a demand function derived from a constant (constrained) utility function in which all prices are assumed constant. Therefore, cross-section data, such as from household expenditure surveys, are most appropriate for investigating Engel curves¹.

The Engel function may be specified as:

$$y_i = f (x, n, s) \tag{3. 1}$$

where y_i is household expenditure on the i th commodity, x is the household income or total expenditure, n is household size and s is a set of socio-economic and demographic variables.

The study of effects of demographic variables in demand analysis has attracted many economists and researchers. Barten (1964), Brown and Deaton (1972), Muellbauer (1974) and Pollak and Wales (1980) revealed that incorporating such variables could further explain the consumption behaviour of households. Studies using such variables have usually utilised cross-section data that contained not only food consumption by household members,

¹ Using cross-section data, it is often assumed that households face the same price due to short time period of survey. However, there might be variation in prices due to spatial and quality differences (Cox and Wohlgenant, 1986; Deaton, 1990; Nelson, 1991).

but also socioeconomic and demographic information such as household size, occupation, education and residency status.

The emphasis of this study is on the estimation of Engel functions relating household expenditures on various food commodities to total household expenditure and an array of household socio-demographic variables. The objective is to then derive the marginal impacts of increases in expenditure on food consumption for households in urban Java.

3. 2. Model Specification

This study has employed the log-log-inverse functional form for the Engel relationship. As is discussed below, the advantage of this functional form is that it allows a commodity to be classified both a normal and inferior good at different levels of total household expenditure. This model is consistent with a number of empirical investigations and the theoretical effect of an increase in income on the demand for food (Chang, 1977). For example, the demand for staple foods initially increases with increasing income, but after reaching satiation point, demand eventually falls. A staple food like rice may well become an inferior good for high income households. However, the demand for a luxury food like meat may continue to increase with increasing income, and would therefore be classified only as a normal good.

The log-log-inverse functional form has been employed by Ito *et al.* (1989) and Goreux (1960) to investigate income or expenditure elasticities.

The log-log-inverse functional form for the Engel relationship is:

$$y = \exp(a+bx^{-1}) x^c \exp^{\epsilon} \quad (3. 2)$$

or,

$$\ln(y) = a + b x^{-1} + c \ln x + \epsilon \quad (3. 3)$$

where y is expenditure on a particular food item or commodity and x is total expenditure (or income).²

² Other explanatory variables in equation (3.1) have been omitted for the purpose of simplicity.

The error term associated with equation (3. 2) is assumed to be normally and independently distributed with zero mean and homogeneous variance. This latter assumption is examined in section 5. 3 of this thesis.

A commodity is defined as a normal good if $\frac{d y}{d x} > 0$, and as an inferior good if $\frac{d y}{d x} < 0$. For the log-log-inverse function, we obtain:

$$\begin{aligned}\frac{d y}{d x} &= (-b x^{-2} + c x^{-1}) y \\ &= (-b x^{-1} + c) x^{-1} y\end{aligned}\quad (3. 4)$$

For log-log-inverse function, if $b > 0$, then $\ln y \rightarrow \infty$ as $x \rightarrow 0$, an unrealistic situation. Thus $b \leq 0$ in practice.

For the case where $(b,c) < 0$, then

$$\frac{d y}{d x} > 0 \text{ for } 0 \leq x < \frac{b}{c} \quad (3. 5)$$

$$\frac{d y}{d x} = 0 \text{ for } x = \frac{b}{c} \quad (3. 6)$$

$$\frac{d y}{d x} < 0 \text{ for } x > \frac{b}{c} \quad (3. 7)$$

For this case then, the commodity is both a normal and inferior good, at different levels of total expenditure. For the case where $(b \leq 0, c > 0)$ then $\frac{d y}{d x} > 0$ for all $x > 0$, and hence the commodity in question is a normal good for all levels of total expenditure.

Figure 3.1(a) illustrates the log-log-inverse Engel curve for a commodity that exhibits both normal and inferior good characteristics at different levels of total expenditure.

Expenditure elasticity of demand for the log-log-inverse Engel Function is :

$$E_y = \frac{d y}{d x} \cdot \frac{x}{y} = (-b x^{-1} + c) \quad (3. 8)$$

The marginal propensity to consume (MPC) measures the proportion of an extra unit of total household expenditure used to purchase a particular food item. For the log-log-inverse function, MPC is given by equation (3.4).

The elasticity function corresponding to the Engel function in figure 3.1 (a) is illustrated in figure 3.1 (b). Figure 3.1 is applicable, in many countries, to staple foods such as rice, Goreux (1960) and Ito *et al.* (1989). In general, as income increases, households tend to shift their consumption away from a traditional diet which is high in carbohydrate intake, to diets which increase protein intake (eg. meat). For some food items (normal goods), it is to be expected that expenditure on the food continues to increase as income increases, though at a diminishing rate.

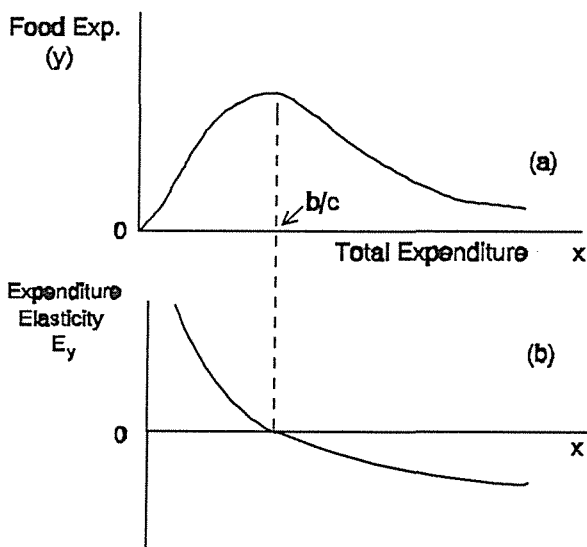


Figure 3.1. (a). Log-log-inverse Engel curve for commodity exhibiting both normal and inferior good characteristics ($b, c < 0$);

(b). Corresponding expenditure elasticity function.

The Engel function is often expressed in per capita terms with household size (n) used as an additional explanatory variable (Goreux, 1960)

and Ito *et al.*, (1989). Equation (3.3) then becomes:

$$\ln \left(\frac{y}{n} \right) = a + b \left(\frac{x}{n} \right)^{-1} + c \ln \left(\frac{x}{n} \right) \quad (3.9)$$

Equation (3.9) can be rearranged as;

$$\ln (y) = a + b \left(\frac{n}{x} \right) + c \ln(x) + (1-c+d) \ln (n) \quad (3.10)$$

or

$$\ln (y) = a + b \left(\frac{n}{x} \right) + c \ln (x) + e \ln (n) \quad (3.11)$$

Equation (3.9) and (3.11) are equivalent, but estimation using equation (3.11) should minimise potential problems of multicollinearity between the explanatory variables of equation (3.9) (Ito *et al.*, 1989), and equation (3.11) allows direct computation of household expenditure elasticities. Accordingly, equation (3.11) has been used in this study to estimate household commodity Engel functions.

3. 3. Measuring the Effects of Regional and Demographic Variables

Undoubtedly, consumption on food is influenced by demographic variables like household size, education of either household head or household maker, and region. It is believed that the larger the number of household members, the more food is consumed or purchased. This study measures household size in terms of the number of household members. The use of such a measure of household size enables researcher(s) to investigate the expenditure elasticity with respect to the number of household members. Barten (1964) proposed the adult equivalent scale to translate household size. However, since the objective of this study is not to analyze welfare, the adult equivalent scale is not used.

In terms of education, it is assumed that a well educated person might consume different food items than a poorly educated person. Several studies e.g., Cheng and Capps (1988) indicate that the education level of the household manager can significantly influence consumer decisions on food consumption.

Regionality might affect food consumption due to different cultures and tradition. Java is composed of two major ethnic groups, Javanese and Sundanese. Javanese reside in Central Java, Jogjakarta and East Java. However, since Jakarta's population represent a greater number of ethnic

groups and the SUSENAS data does not include ethnic information, it is difficult to estimate the impact of ethnicity on consumer decisions. To incorporate these effects, regional dummy variables are used.

3. 3. 1. Cluster analysis

Several studies such as Reynolds (1990), Wellman (1992), Sawtelle (1993), Cheng and Capps (1988), and Goodwin and Koudele (1990) have used dummy variables to account for household characteristics such as family composition (eg. number of children, number of adults, education level, gender characteristics, degree of urbanization and locality).

An alternative approach to the use of (perhaps a large number of) dummy variables is to group households based on similar demographic characteristics (Philps, 1974). Engel relationship may then be estimated for households within each group, thus facilitating comparisons of expenditure elasticities between household groupings.

One of the objectives of this study is to investigate and discuss the implications for New Zealand's meat and dairy industries of the responsiveness of urban Java households to changes in total household expenditure. Grouping households on the basis of demographic characteristics could prove useful in identifying market segments that are most likely to increase consumption of meat and dairy products as total household expenditures increase. One statistical technique for finding groups of similar individuals is cluster analysis.

The use of the cluster analysis technique has attracted researchers who wish to investigate the characteristics of consumers. For example, Lessig and Tollefson (1971) clustered a sample of coffee drinkers using attributes such as income, race and occupation. The aim of their study was to identify market segments based on those attributes. Other studies like Sethi and Holton (1973) identified the market segments of nations enabling them to investigate how multinational companies might design appropriate marketing strategies.

The basic aim of cluster analysis is "to devise a scheme that finds the 'natural groupings', if any, of individuals in a data set" (Ganeshanandam, 1994). In other words, cluster analysis aims at allocating a sample of individuals into a set of *mutually exclusive, exhaustive*, groups such that individuals within a group are '*similar*' to each other while individuals in different groups are '*dissimilar*'. To measure the similarity, several methods or approaches have been developed. One approach involves Euclidian distances between sample members. Since there is no particular guidance as to which method is most applicable, this study uses Euclidean distances formulated as follows:

$$d_{ij} = \left\{ \sum_k (x_{ik} - x_{jk})^2 \right\}^{1/2} \quad (3.12)$$

where x_{ik} and x_{jk} are the values of a variable x_k for the i^{th} and j^{th} individuals, respectively. The similarity (or the dissimilarity) between individuals is measured by the Euclidean distance d_{ij} . The smaller the Euclidean distance, the more similar are individuals, and *vice versa*.

Another way to detect similarities is a tree diagram (or dendrogram). The tree diagram depicts a hierarchical procedure for clustering variables or observations. The number of clusters in turn depends on the research objectives. Information on distances between individuals or a cluster is also available together with a display of the tree diagram (figure 3.2). This figure shows that because individuals 1 and 2 have the same distances, individual 1 is similar to 2. However, individual 3 is different from either individuals 1 and 2. Since individuals 1 and 2 join forming a new individual in which the distance of a new individual is close to the distance of individual 3, thus the new individual is similar to individual 3.

In this study, the *fastclus* procedure is used due to the large size of the data set (SAS/STAT User's Guide, 1988). Through this procedure, a number of clusters, say m , may be specified in advance, or determined as a part of the clustering procedure. This procedure utilizes *the nearest centroid method* (SAS/STAT User's Guide, 1988). This procedure requires three steps (MacQueen, 1967);

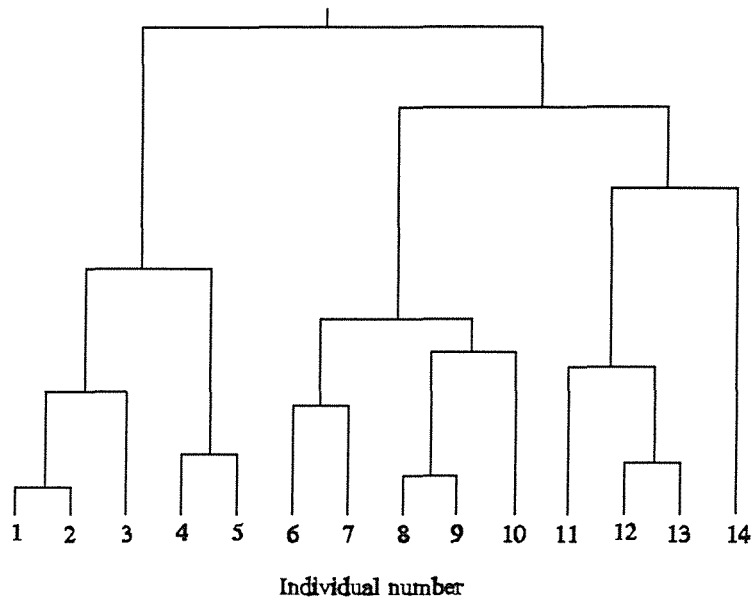


Figure 3. 2. Tree Diagram of Clustering

Source: Ganeshanandam (1994)

1. Partition items into m -initial clusters.
2. Proceed through the list of items, assigning an item to the cluster whose centroid (mean) is nearest. Recalculate the centroid for the cluster receiving the new items and for the cluster losing the item.
3. Repeat step 2 until no reassignment take place.

Households in this study were clustered into 4 groups based on five variables: (1) the number of adults defined as household members whose age is 17 and over, (2) the number of teenagers who are aged between 10 and 17, (3) the number of children who are aged less than 10 years old, (4) the average of the adults' highest education levels, and (5) the average of adult ages. For the fourth variable, highest adults education levels are categorised as : 0 for those who never attended a primary school, 1 for those who attended a primary school but did not graduate, 2 for those who graduated from a primary school, 3 for those who graduated from a junior high school, 4 for those who graduated from a senior high school and 5 for those who have attended a college or university regardless of whether they graduated or not.

3. 4. Model Development.

Households in any one cluster were located in one of five regions. On the assumption that model errors have homogeneous variance over clusters and regions, the pooled error mean square across cluster equations can be used to investigate differences in parameter estimates between clusters. This approach should improve the relative precision of the estimated parameters due to an increase in the error degrees of freedom, (Gujarati, 1988, p. 448).

Dummy variables are used to obtain intercept estimates for clusters and regions within clusters, omitting the dummy variables for cluster 1 and region 1 (Jakarta). Slope parameter estimates are obtained for cluster 1; the remaining slope estimates are obtained as differences between each cluster and cluster 1. In order to obtain parameter estimates of reasonable magnitude, total household expenditure values were multiplied by 10^{-5} , and expenditures on all food, rice and vegetable were multiplied by 10^{-4} .

The model to be estimated is as follows:

$$\begin{aligned} \ln(y_i) = & b_0 + b_1 \text{inverse} + b_2 \ln(\text{expend}) + b_3 \text{inverse}^2 + \\ & b_4 \ln(\text{expend}^2) + b_5 \text{inverse}^3 + b_6 \ln(\text{expend}^3) + \\ & b_7 \text{inverse}^4 + b_8 \ln(\text{expend}^4) + b_9 \ln(\text{size}) + \\ & b_{10} \ln(\text{size}^2) + b_{11} \ln(\text{size}^3) + b_{12} \ln(\text{size}^4) + \\ & b_{13} r^2 c^2 + b_{14} r^3 c^2 + b_{15} r^4 c^2 + b_{16} r^5 c^2 + b_{17} r^2 c^3 + \\ & b_{18} r^3 c^3 + b_{19} r^4 c^3 + b_{20} r^5 c^3 + b_{21} r^2 c^4 + b_{22} r^3 c^4 + \\ & b_{23} r^4 c^4 + b_{24} r^5 c^4 + b_{25} r^2 + b_{26} r^3 + b_{27} r^5 + b_{28} c^2 + b_{29} c^3 + \\ & b_{30} c^4 \end{aligned} \quad (3. 13)$$

where:

$\ln(y_i)$ = \log_e of weekly expenditures on rice or vegetables and monthly expenditure on all food

inverse = inverse of monthly per capita total expenditure (all observations)

inverse² = inverse of monthly per capita total expenditure for cluster 2

inverse³ = inverse of monthly per capita total expenditure for cluster 3

inverse4	= inverse of monthly per capita total expenditure for cluster 4
expend	= \log_e of monthly total household expenditure (all observations)
expend2	= \log_e of monthly total household expenditure for cluster 2
expend3	= \log_e of monthly total household expenditure for cluster 3
expend4	= \log_e of monthly total household expenditure for cluster 4
size	= \log_e of household size (all observations)
size2	= \log_e of household size for cluster 2
size3	= \log_e of household size for cluster 3
size4	= \log_e of household size for cluster 4
r2c2	= 1 if individual residing in West Java and grouped in cluster 2; 0 otherwise
r3c2	= 1 if individual residing in Central Java and grouped in cluster 2; 0 otherwise.
r4c2	= 1 if individual residing in Jogjakarta and grouped in cluster 2; 0 otherwise
r5c2	= 1 if individual residing in East Java and grouped in cluster 2; 0 otherwise
r2c3	= 1 if individual residing in West Java and grouped in cluster 3; 0 otherwise
r3c3	= 1 if individual residing in Central Java and grouped in cluster 3; 0 otherwise
r4c3	= 1 if individual residing in Jogjakarta and grouped in cluster3; 0 otherwise
r5c3	= 1 if individual residing in East Java and grouped in cluster 3; 0 otherwise
r2c4	= 1 if individual residing in West Java and grouped in cluster 4; 0 otherwise
r3c4	= 1 if individual residing in Central Java and grouped in cluster 4; 0 otherwise
r4c4	= 1 if individual residing in Jogjakarta and grouped in cluster 4; 0 otherwise
r5c4	= 1 if individual residing in East Java and grouped in cluster 4; 0 otherwise

r2	= 1 if individual residing in West Java; 0 otherwise
r3	= 1 if individual residing in Central Java; 0 otherwise
r4	= 1 if individual residing in Jogjakarta; 0 otherwise
r5	= 1 if individual residing in East Java; 0 otherwise
c2	= 1 if individual grouped in cluster 2; 0 otherwise
c3	= 1 if individual grouped in cluster 3; 0 otherwise
c4	= 1 if individual grouped in cluster 4; 0 otherwise

Instead of household total income, this study uses total expenditure. The use of income as an explanatory variable raises the issue as to what is an appropriate income concept to be used. This is because the total disposable income from household members is believed to not represent the actual purchasing power of households. During the survey period, households were reluctant to disclose their income to the interviewer. As a result, income might be overstated, or more often, understated. Prais and Houthakker (1955) and Houthakker and Taylor (1974) used total expenditure as an explanatory variable in their study. Philips (1974) said that using total expenditure instead of income can be applied to investigate the long run reactions of a representative family and in general expenditure is employed as a parameter for classifying households by social status. Therefore, total expenditure is the best proxy to reflect the actual purchasing power of households. Based on these arguments and other empirical studies, total expenditure is used in this study. However, Daud (1986) used not only total household expenditure but also total food expenditure to estimate expenditure elasticities.

3. 5. Zero-expenditure: a Binary Choice Approach

Cross-section survey data collected over a short (one week) period might be expected to include zero expenditure observations for some food items, for some households. The possibility of existing zero expenditure/purchase of the particular product may occur due to the narrow food product definition and the short time duration of a survey, or where households have sufficient inventory at that survey time, or where prices are

sufficiently high to discourage households from purchasing (Cheng and Capps, 1988). As a consequence, the inclusion of zero expenditure observations in estimating parameters by ordinary least squares would yield inconsistent and biased parameter estimates (Maddala, 1983 and Greene, 1991). Model parameter values would be overestimated if the proportion of zero expenditure is high. And a regression estimated from the non-zero expenditures does not represent the Engel curve for the population as a whole (Tobin, 1958). Tobin (1958) and Heckman (1976) have proposed remedial estimation procedures in this situation. Several studies (Cheng and Capps, 1988), (Senaur and Alderman, 1986) and (Sahn, 1988) applied a two-step procedure developed by Heckman called the Two Step Heckman procedure, and reported that the variable, the inverse of the Mills ratio, was statistically significant, apparently indicating that the deletion of zero expenditures from the original data would introduce sample selection bias. Lee (1978) has also proposed a procedure for remedying the problem of estimation due to the existence of zero expenditures. Compared to Heckman's procedure, Lee's procedure is relatively efficient and computationally simple. However, Lee's procedure is only applicable for a complete demand system. The Tobin and Heckman procedures cannot be used in a complete demand system, eg. the AIDS model (Wellman, 1992).

The use of the Heckman two-step procedure was investigated in this study. However, severe multicollinearity problems were encountered between the adjusting variable (inverse of the Mills ratio) and the other explanatory variables (see Appendix C. 1). As a result, use of Heckman two-step procedure was abandoned.

To allow for the existence of some households exhibiting zero expenditures for meat and/or milk, a combination of probit and tobit Maximum Likelihood estimators were used in this study.

The probit model is used to estimate the probability that a household consumed the particular food item in question. Some studies (Capps *et al.* 1988 and Goodwin and Koudele, 1990) have analyzed meat consumption by employing qualitative response models such as the *linear probability model*

(LPM), the *probit model* and the *logit model*. The major disadvantage of the linear probability model is that predicted probabilities are not guaranteed to lie in the interval 0-1, (Gujarati, 1988). The probit model is appropriate where the probability distribution function to be estimated is Normal. Also, there is very little difference between the logistic and normal cumulative distribution function (except at the extremities), hence the probit model was chosen in this study.

Suppose q is a random variable that takes on the values: $q=0$ if the household has consumed (say) meat during the survey period, and $q=1$ otherwise. Further, suppose X is a vector of independent variable values. Then $p=\text{prob}(q=0|X)$ is a response probability (Logistic Procedure, SAS Technical Report P-200, 1988).

The estimated probit function may be written (Greene, 1991):

$$\alpha = X \beta \quad (3. 14)$$

where β is a vector of parameters to be estimated. The corresponding probit probability is obtained as:

$$\text{Probit } (p) = \int_{-\infty}^{\alpha} f(z) dz = F(\alpha) \quad (3. 15)$$

where $f(\cdot)$ is the standard normal density function and z is the standard normal variable.

The probit model hypothesises that a household's decision whether or not to consume meat (or milk) is related to the values of a set of explanatory variables. Probit models of the following form were estimated using a Maximum Likelihood procedure (Logistic Procedure, SAS Technical Report P-200, 1988):

$$\alpha = b_0 + b_1 \text{educ1} + b_2 \text{inverse} + b_3 \ln(\text{expend}) + b_4 \text{children} + b_5 R2 + b_6 R3 + b_7 R4 + b_8 R5 + e. \quad (3. 16)$$

Educ1 is the highest education level of adults in the household. The probit model for household consumption of milk included the number of children aged 5 years and younger (children) as an explanatory variable since it was believed that the presence of young children could influence the probability that a household would report expenditure on milk. For the milk probit model,

the regional dummy variables in clusters 1 and 2 were excluded due to their non-significance in the first estimation.

This study uses tobit Maximum Likelihood estimates of the latent Engel function, as developed by Tobin (1958), using the full set of observations (both zero and non-zero expenditures for meat and milk) for each cluster (Lifereg Procedure, SAS STAT User's Guide, 1988). The same set of explanatory variables were used as for the probit models, and where significant, regional dummies were included. The latent function is that Engel function which would apply if all households exhibited positive (non-censored or truncated) expenditure on the food item in question during the survey period, (Tobin, 1958; Greene, 1991).

The way in which the tobit and probit models are used in combination to obtain population expenditure elasticity (and MPC) estimates for the truncated food expenditure items, meat and milk, is presented in Appendix C.2 (Townesley, personal communication, 1994).

CHAPTER FOUR

THE DATA SOURCE

4. 1. The SUSENAS Survey

This study uses data from the most recent 1990 household survey, the National Socio Economic Survey (SUSENAS), conducted by the Indonesian Central Bureau of Statistics (ICBS). The original data contains approximately 49,000 households, located in 27 provinces. The SUSENAS includes not only consumption data, but also demographic information on household members, such as relationship of each household member to the household head, age, marital status and health records of various household members. The SUSENAS is carried out every year with emphasis on (1) consumption and income, (2) health, education, and the housing environment, and (3) socio-culture, criminality and domestic travel. The data used in this study was taken from the consumption module of the SUSENAS. This study utilized data from magnetic tapes purchased from Indonesia Central Bureau of Statistics (ICBS).

This survey provides a more detailed analysis of consumption patterns than a food balance sheet. Food balance sheets only provide information on food availability at the national level, using assumptions regarding losses in marketing, distribution and storage, seed use, etc (Rosegrant *et al.*, 1987).

4. 1. 1. *Regional coverage.*

This study focuses on urban Java which consists of five provinces; Jakarta (the capital city of Indonesia), West Java, Central Java, Jogjakarta (a former capital city of Indonesia) and East Java. A total of 5708 urban households were sampled in SUSENAS 1990 from these provinces (Table 4.1). The locations of these provinces in Java Island are presented in Figure 4. 1.

Table 4. 1. Household Distributions by Province

Province	Household Distribution	Proportion of Sample
Jakarta	1389	24 %
West Java	1308	23 %
Central Java	1148	20 %
Jogyakarta	370	6 %
East Java	1493	27 %
Total ¹	<u>5708</u>	<u>100 %</u>

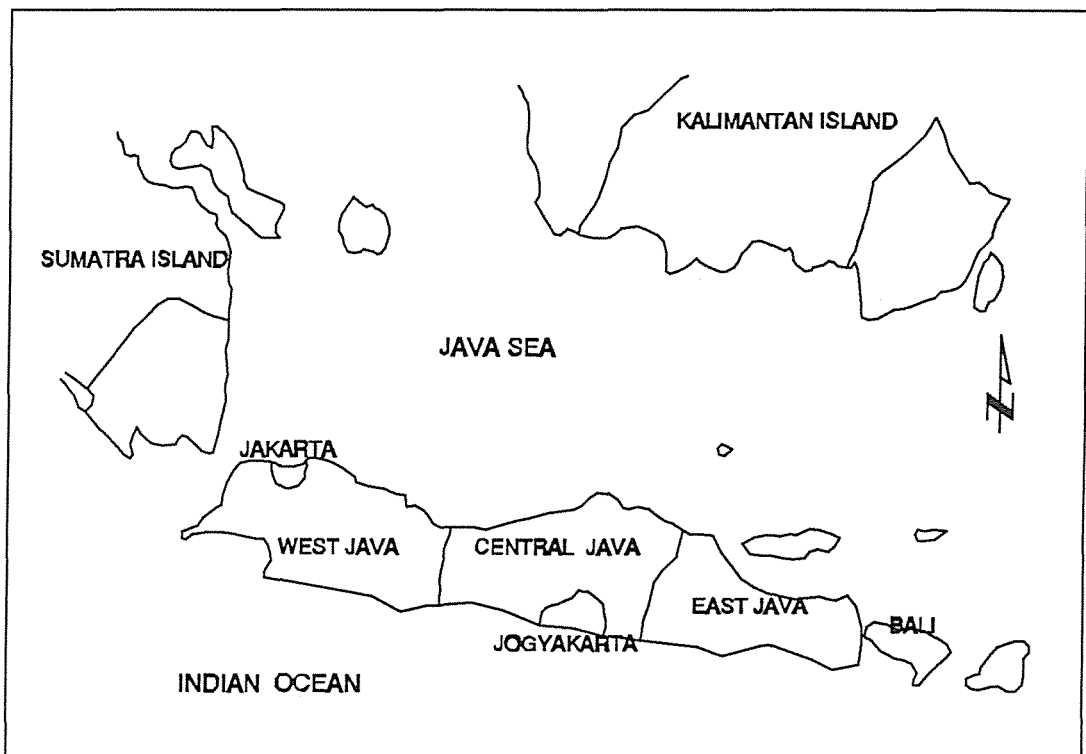


Figure 4. 1. Java Island Map

¹ In estimating Engel functions, outliers are dropped.

4. 1. 2. Commodity coverage

There were more than 200 food items listed in the SUSENAS questionnaire which were classified into cereal, pulse, vegetables, fruits, fish, milk and eggs, meat, spices, sugar, beverages, prepared food and tobacco. Data collected on food items consumed by a household included the quantity and value, with the exception of prepared foods in which the quantity consumed was unavailable.

4. 1. 3. Data collected

Information on food item consumption was collected by the Central Bureau of Statistics through a direct interview if a respondent is illiterate, while for a respondent who is literate, he or she was given a form on which details of food consumption were to be recorded over the week. Information on non-food consumption or expenditure was obtained through a direct interview.

4. 1. 4. Sampling method

The 1990 SUSENAS was a household sample survey in which the samples were selected to statistically represent all parts of the country. With 49,000 households in the total sample, the SUSENAS was capable of obtaining both national and provincial level estimates and urban and rural samples were drawn separately by ICBS. Separate estimates for urban and rural data were also obtainable.

To represent the population, a three-stage sampling procedure was applied to both urban and rural areas. In the first stage, utilizing the list of enumeration areas selected for the Population Census 1990 (SP90) as a sampling frame, a number of enumeration areas were systematically chosen. In the second stage, one segment group from each selected enumeration area was chosen. Finally, 15 homogenous households were randomly drawn to represent each selected segment group (CBS 1990).

4. 1. 5. Survey period

The survey period was one week prior to the enumeration date for food consumption. However, for non-food expenditures information, such as housing, miscellaneous goods and services, clothing, consumption on taxes and insurance premiums, and parties and ceremonies, those information were obtained within either one month or a year (CBS 1990). The 1990 SUSENAS was carried out in January-February 1990.

4. 2. General Characteristics of SUSENAS 1990

4. 2. 1. Urban definition

Because this study analyzes urban data only, the definition of urban should be precisely understood based on Indonesian conditions. For a region to be classified, it satisfies the following conditions:

- (1) having a population density of more than 5,000 persons per square kilometre.
- (2) less than 25% of employment in the agricultural sector, and
- (3) at least eight urban-related facilities available in that area, e.g., post office, bank, cinema, hospital, and school (CBS 1990).

4. 2. 2. Household definition

A household is defined as a person who lives in a part or a whole house and manages his/her needs or those of a group of people. A household generally consists of a husband, a wife and their children. However, it may also contain relatives or a servant. In some cases where a household consists of several persons, for example students, who provide their needs separately, this household is also included as a target of SUSENAS 1990. However, if the number of persons living in that house are greater than 10 persons, this household is specified as a special household and excluded from this survey.

4. 2. 3. Definition of expenditure

Expenditure is the sum of expenditure on food or non-food items, excluding expenditure or consumption for household industry or transfer to other persons outside the household. Food expenditure is calculated from the food consumed during a reference time (a week prior to enumeration) such as purchases, own production, and transfer in² and gifts. Expenditure on non-food items is defined as real expenditure on purchased or obtained goods. Any foods which are received or purchased not for consumption of household members, for example household industry, physical wages or as a gift for non-household members are excluded from a computation.

4. 3. Aggregation Theorem

A household might consume a high number of commodities during any time period. In order to reduce the computational burden, commodities may be combined into several relatively homogeneous groups. For example, either quantities or expenditures may be aggregated.

1. The aggregate quantity, Q , is the sum of several commodities which are relatively homogeneous, for example high variety rice and local rice. However, in some cases, a weighting factor should be used to meet a standard measurement. For example, butter and powdered milk may be combined into a commodity group based on the fat content.

$$Q_1 = m_{11} Q_{11} + m_{12} Q_{12} + \dots + m_{1n} Q_{1n} \quad (4. 1)$$

where m_{1n} is the weight and Q_{1n} is a quantity.

2. The aggregate expenditure. This procedure is useful for those commodities which are difficult to aggregate into one commodity definition, (eg fruit, where there is no obvious weighting factor).

This study focuses on four commodities: rice, vegetables, meat and milk. In addition, aggregate expenditure on all food is examined. The four commodity groups comprise the following foods:

² During a survey period, a household may receive foods from outside. Since 1990 SUSENAS assesses foods consumed during that survey period, a transfer is included in household food consumption.

Rice

high quality rice, local rice, rice flour and sticky rice

Meat

beef, pork, lamb , chicken and others

Milk

fresh milk, powdered milk, condensed milk, dried milk, and other milk products

Vegetable

spinach, cabbage, green bean, tomatoes, carrots, shallots, garlic and others

4. 4. Spatial Aggregation

Java island consists of the five provinces of Jakarta, West Java, Central Java, Jogjakarta and East Java. Since each province may have its own specific food consumption characteristics, the difference in food consumption patterns among households will be investigated in each province.

Compared to other provinces in Indonesia, provinces in Java are more urbanized than others. Therefore, there will be distinctive characteristics about the patterns of food consumption compared to other provinces. More importantly, Jakarta is Indonesia's major consumer centre and there is a high degree of market integration between Jakarta and other urban areas. In this province, around 12 million consumers live in the immediate metropolitan area. Together with Jakarta, other fast growing areas are Surabaya (East Java) with a population around 3.5 million, Bandung (West Java) and Jogjakarta comprising 4-5 million people. It is important to note that 60 percent of the total Indonesian population are below 25 years old and 5-9 percent of Indonesian population are already in the middle and high income class (AgExporter, 1993). These income classes are believed to demand more high-value foods.

There is also a growing number of the population residing in urban areas due to economic factors, for example job opportunities. It is of interest in this study to investigate the urban Java areas. Other studies such as Ito *et*.

al. (1989), Huang and David (1993), and Bouis (1989) indicated that rice becomes an inferior good especially in urban areas and due to an increase in per capita income. Thus households are predicted to consume diets which contain more protein intake like meat and milk products, as income increases.

Based on 1990 Population Census, around 38 million Indonesians reside in Java and most of them reside in Jakarta (8 million) and West Java (12 million). On average, the urban population growth rate has been lower than the population growth rate for Indonesia. For example, the urban population growth rate in Java was 5.28 percent (1980-1990). Despite the fact that the growth rate of the urban population in Java was lower than the Indonesian average, based on 1987 SUSENAS estimation, average per capita monthly consumption expenditures by urban Java were 85 percent higher than those of rural households. The difference was clear when per capita consumption expenditures for urban Jakarta were compared to rural households on Java. The relatively high consumption expenditures in the urban area was partly driven by the relatively higher household income compared with households in rural areas.

Asaduzzaman (1989) indicated that the patterns of food expenditures in the urban areas of developing countries were significantly different from those in rural areas. First, households in urban areas have a higher income than households in rural areas. Or in other words, households in urban areas are better off than households in rural areas. Second, people in urban areas have access to information on nutritional aspects of different types of foods because of relatively higher education levels than people in rural areas.

CHAPTER FIVE

CLUSTER ANALYSIS AND ENGEL FUNCTIONS FOR ALL FOOD, RICE AND VEGETABLES.

5. 1. Cluster Analysis

Due to the large data set, a *fastclus* procedure (SAS/STAT User's Guide, 1988) is used which can handle up to 100,000 observations. Household characteristics were clustered based on several variables such as, the number of adults, the number of teenagers, the number of children, average adult education and average adult age. The results of the clustering procedure can be found in Tables 5.1 , 5.2 and 5.3.

Summary statistics for the four clusters are presented in Table 5. 1. The observations in cluster 2 are more widely dispersed than observations in the other clusters. Centroid distance is the distance between centroid (means) of the cluster and its nearest neighbour cluster. The two clusters closest together (most similar) are clusters 3 and 4.

Table 5. 1. Cluster Summary

Cluster	Frequency (No of Household)	RMS/ STD	Nearest Cluster	Centroid Distance
1	846	1.99	4	11.73
2	326	3.08	1	16.20
3	2382	1.80	4	8.82
4	2151	1.68	3	8.82

RMS/STD=Root of mean square of Euclidian distances between clusters

The low within-cluster standard deviation relative to the total standard deviation for average adult age, together with the high R^2 and $R^2/(1-R^2)$ statistic values indicates the importance of this variable in distinguishing between clusters. A high value of pseudo F indicates that clustering all observations according to the above variables is significant at the 0.1 percent

level. Likewise the value of approximate expected over-all R-squared of 89 percent is high, assuming that the variables are uncorrelated.

Table 5. 2. Statistics for Variables

Variables	Total STD	Within STD	R-Squared	$R^2/(1-R^2)$
Number of adults	1.34	1.31	0.05	0.18
Number of teenagers	1.11	1.07	0.08	0.09
Number of children	1.04	0.99	0.09	0.10
Average adult education	1.18	1.09	0.15	0.18
Average adult age	10.45	3.56	0.88	7.61
Over-all	4.79	1.88	0.84	5.48

Pseudo F Statistic	=	10431.71
Approximate Expected Over-all R^2	=	0.89
Cubic Clustering Criterion	=	-22.05

Table 5. 3. describes the means and standard deviations of variables within each cluster. These figures indicate that cluster 4 contains the most adults and cluster 2 the fewest. The average adult age in cluster 2 is relatively high compared to the other clusters. The number of adults corresponds positively with the number of teenagers. Cluster 3 has more children. Based on this information, it can be concluded that cluster 2 represents predominantly older families, whereas cluster 3 comprises young families. Adults in clusters 3 and 4 are better educated than adults in cluster 2, which is evidenced by the higher indices of the average adult education.

Table 5. 3. Cluster Means and Standard Deviation

Cluster	Number of Adults	Number of Teenagers	Number of Children	Adult Educ	Adult Age
1	2.661 (1.09)	0.875 (1.10)	0.526 (0.88)	1.618 (1.11)	49.411 (3.93)
2	1.810 (0.77)	0.356 (0.72)	0.114 (0.42)	0.903 (0.95)	65.563 (6.72)
3	2.847 (1.40)	0.608 (0.97)	1.220 (1.04)	2.568 (1.08)	28.942 (3.32)
4	3.126 (1.34)	1.270 (1.19)	0.911 (1.04)	2.424 (1.10)	37.730 (2.92)

Referring to Table 5. 4, it can be observed that a high percentage of households in cluster 2 have no children (73 percent). Of the remaining households in cluster 2, the majority have teenage children only. Forty percent of households in cluster 1 have no children, and of the remainder, the majority have either teenagers only or both teenagers and children. Households in cluster 3 have predominantly young children only, or children and teenagers (71 percent of families). Cluster 4 contains fewer households with only young children than cluster 3, but relatively more teenagers.

Table 5. 4. Presence of Teenagers and Children (percentage of households)

Cluster	No Children	Teenager only	Children only	Teen&Child
1	40	27	11	22
2	73	19	3	5
3	16	13	47	24
4	19	27	15	39

Table 5. 5. Presence of Children (percentage of households)

Cluster	No Children	1 Child	2 Children	3 Children	4 or more Children
1	40	21	16	12	11
2	73	15	6	3	0
3	16	29	27	16	12
4	19	18	23	20	20

Information on the number of children living in each household is given in Table 5. 5. This information has important implications, particularly for estimating food consumption patterns within clusters, because the level of expenditure on food depends partly on the number of children, or the family composition of the household. It is clearly shown that beside no children (40 percent), 21 percent of households in cluster 1 report the presence of one child. Likewise, households in cluster 2 contain predominantly no children. In contrast, households in cluster 4 contain a relatively equal distribution of number of children. For instance, 18 percent of households have one child, 23 percent of them are composed of 2 children and 40 percent of them consist of either 3 or more children.

Table 5. 6 summarises the characteristics of clusters with regard to total household income, total household expenditure and food expenditure. On average, households in cluster 2 are recorded to have a low level of these variables. On the other hand, households in cluster 3 exhibit a relatively high income per household and their mean income and total expenditure are about three times that of the households in cluster 2. It is important to note that the levels of these parameters are correlated with characteristics of the clusters in terms of demographic variables, particularly the average education level and average age. It seems that a low education level and an older family is associated with a low level of income as well as expenditure, and *vice versa*. Therefore, it is to be expected that there will be a significant difference between clusters in terms of consumption or expenditure patterns due to the difference in purchasing power between households.

Average expenditure on non-food items including saving, for households in clusters 3 and 4, is also high when expenditure on non-food items is defined as the difference between total expenditure and food expenditure. In contrast, households in cluster 2 are reported to spend less on non-food items, in fact less than half the expenditure level of households in cluster 3 and cluster 4. However, it is important to note that savings are relatively small in cluster 2 compared to households in other clusters, particularly those in clusters 3 and 4.

Table 5. 6. Means of Total Household Income, Total Household Expenditure and Food Expenditure per Month by cluster (Rupiah)

Cluster	Variables	Mean	Standard Deviation	Minimum	Maximum
1	Income	198657	238353	3540	3173700
	Expenditure	163619	138227	22400	1210867
	Food	81616	51050	10521	473263
2	Income	102295	104210	10000	1425000
	Expenditure	86468	64489	11607	483590
	Food	44989	28870	6364	158169
3	Income	282417	479197	8450	8400000
	Expenditure	232423	268534	28170	5436245
	Food	112331	78870	15686	895311
4	Income	277078	316163	10000	4156750
	Expenditure	235561	196665	19556	2051170
	Food	114227	69600	12977	771489

1 \$ US= Rp. 2,037 (1994)

5 . 2. The Patterns of Food Consumption and Expenditure

This section describes the pattern of food consumption in urban Java analyzed from the SUSENAS 1990. Households in each cluster might have different patterns of consumption or expenditure on particular food items. As Prais and Houthakker (1955) suggest, households with different incomes consider the value of food items differently. Table 5.7 provides data on weekly household expenditures on rice, vegetables, meat and milk products in each cluster.

Compared to other clusters, households in cluster 2 spent on average less on rice, vegetables, meat and milk. On the other hand, perhaps because households in clusters 3 and 4 are characterized by relatively high incomes and expenditures as well as large families, they spent relatively more on each food group than households in clusters 1 and 2.

Table 5. 7. Weekly Household Expenditure on Food Items (Rupiah)

Cluster	Food Group	Mean	Standard Dev.	Minimum	Maximum
1	Rice	5273	2653	0	18521
	Vegetable	1823	1266	0	14510
	Meat	1218	2048	0	17000
	Milk	564	1844	0	27600
2	Rice	5142	2713	0	18521
	Vegetable	1652	1331	0	12000
	Meat	615	1292	0	9400
	Milk	368	1401	0	15775
3	Rice	5400	2750	0	19600
	Vegetable	2112	1493	0	19050
	Meat	1865	3136	0	42000
	Milk	990	2113	0	22500
4	Rice	5415	2602	0	18900
	Vegetable	1931	1292	0	10300
	Meat	1896	2778	0	23250
	Milk	732	1723	0	18220

Table 5.8 presents the proportion of households in each cluster reporting consumption of rice, vegetables, meat and milk during the survey period.

Table 5. 8. The Proportion of Household Reporting Food Expenditure.

Cluster	Rice	Vegetables	Meat	Milk
Cluster 1	99.65	98.47	50.65	19.78
Cluster 2	99.69	96.00	32.31	13.85
Cluster 3	99.92	98.70	62.22	34.06
Cluster 4	99.81	99.07	61.14	28.33

5. 3. Engel Function Results

The proportion of households not reporting consumption of rice and/or vegetables during the survey period (Table 5.8) is considered too small to warrant estimation of censored regression models of the Engel functions for these commodities. Households reporting zero consumption for these two commodities were excluded from the analysis. Some researchers, eg Huang

et al., (1981), Capps and Love (1983), have used the Tobit censored regression model to analyse fresh vegetable consumption for North American households. However, rice and vegetables are staple food items for Indonesian households, and reported non-consumption seems most likely to have been an unusual phenomenon for these households.

The parameter estimates for equation (3.13), obtained by Ordinary Least Square regression, are given in Appendix A.12 for all Food, Rice and Vegetables. Appendices B.1, B.2 and B.3 present plots of model errors against predicted values of the dependent variable for each commodity. Visual assessment of these error plots indicates, that for the estimated log-log-inverse Engel functions, the errors are not significantly heteroscedastic.

5. 3. 1. All food engel functions

Parameter estimates for all Food Engel functions for each cluster are presented in Table 5.9. These estimates are obtained from Appendix A.14, and report selective tests of significance between clusters as indicated below.

Table 5. 9. All Food Engel Functions

Variables	Cluster 1	Cluster 2	Cluster 3	Cluster 4
<u>Region Intercepts:</u>				
Jakarta	-0.787 [*]	-1.012 ⁺	-0.674 ⁺	-0.798
West Java	-0.753	-0.763 ⁺	-0.624	-0.719
Central Java	-0.803	-0.835 ⁺	-0.674	-0.764 ⁺
Jogyakarta	-0.859 ⁺	-0.873 ⁺	-0.725	-0.789 ⁺
East Java	-0.877 ⁺	-0.866 ⁺	-0.711 ⁺	-0.807 ⁺
<u>Explanatory Variables:</u>				
Inverse per Capita Expenditure	-0.059 [*]	-0.025	-0.042	-0.037 ⁺
Log _e Household Expenditure	0.508 [*]	0.665 ⁺	0.609 ⁺	0.603 ⁺
Log _e Household Size	0.413 [*]	0.292 ⁺	0.277 ⁺	0.316 ⁺

Note: (*,+) significant at less than 5 percent level (See discussion below).

The 'base' model in the all Food (also Rice and Vegetables) equation is for cluster 1, Region 1 (Jakarta). The intercept for Jakarta, Cluster 1 is significantly different from zero (*). The intercepts for Jogjakarta and East Java are significantly different from the Jakarta intercept in cluster 1(+), but the intercepts for West and Central Java are not. The Jakarta intercepts for clusters 2 and 3 are significantly different from the Jakarta intercept for cluster 1 (+), but the cluster 4 Jakarta intercept is not. The difference between the West Java and Jakarta intercepts for cluster 2 is different from the difference between the West Java and Jakarta intercepts for cluster 1 ($-0.763 + 1.012$ indicates that $(-0.763 + 1.012)$ is different from $(-0.753 + 0.787)$). But the difference between these differences is not significant for clusters 3 and 4. Indicated significance/non-significance for the remaining intercept values is interpreted in a similar fashion.

The parameter estimates associated with the explanatory variables for cluster 1 are all significantly different from zero (*). A (+) indicates that the cluster parameter estimate for a variable is significantly different from the corresponding estimate for cluster 1.

The comparisons presented in Table 5.9 are obviously not exhaustive, though they do amount to the number of comparisons that can be made, given the model specification (ie they account for the model degrees of freedom). It seems reasonable to conclude, on the basis of the results presented in Table 5.9, that differences in all Food Engel parameter values do exist between clusters, and that regional intercept values differ between regions within clusters.

5. 3. 2. *Rice engel functions*

Parameter estimates from the Rice Engel function for each cluster are presented in Table 5.10. Again, these estimates are obtained from Appendix A.12, and tests of significance are interpreted as for Table 5.9.

Table 5. 10. Rice Engel Functions.

Variables	Cluster 1	Cluster 2	Cluster 3	Cluster 4
<u>Region Intercepts:</u>				
Jakarta	-1.879 [*]	-1.873	-2.046 ⁺	-1.975 ⁺
West Java	-1.745 ⁺	-1.747 ⁺	-1.949	-1.894
Central Java	-1.936 ⁺	-1.928 ⁺	-2.066	-2.011 ⁺
Jogyakarta	-2.072 ⁺	-2.080 ⁺	-2.192	-2.110 ⁺
East Java	-2.000 ⁺	-2.053 ⁺	-2.096 ⁺	-2.064 ⁺
<u>Explanatory Variables:</u>				
Inverse per Capita Expenditure	-0.072 [*]	-0.044	-0.022 ⁺	-0.021 ⁺
Log _e Household Expenditure	-0.109 [*]	-0.024	-0.025 ⁺	-0.025
Log _e Household Size	1.025 [*]	0.952	0.944	0.929 ⁺

Note: (*,+) significant at less than 5 percent level.

On the basis of the tests of significance presented in Table 5.10, it seems reasonable to conclude that the Engel functions for Rice differ between cluster 1 and 3, and clusters 1 and 4, but that clusters 1 and 2, and clusters 3 and 4 are similar. Differences exist between regional and cluster intercepts.

In agreement with prior expectation, the signs of the estimated coefficients for the variables: inverse per capita expenditure and log_e household expenditure, are both negative for the Rice Engel functions. Thus, for a given household size, beyond some levels of total expenditure, rice becomes an inferior good ($MPC < 0$).

5. 3. 3. Vegetables engel functions

Parameter estimates are presented in Table 5.11, (obtained from Appendix A.12). Tests of significance are interpreted as for the all Food and Rice functions.

Table 5. 11. Vegetables Engel Functions.

Variables	Cluster 1	Cluster 2	Cluster 3	Cluster 4
<u>Region Intercepts:</u>				
Jakarta	-2.230 [*]	-2.191	-2.161	-2.270
West Java	-2.366	-2.370	-2.412 ⁺	-2.451
Central Java	-2.315	-2.231	-2.304	-2.336
Jogyakarta	-2.394 ⁺	-2.176	-2.452	-2.414
East Java	-2.426	-2.172 ⁺	-2.427	-2.480 ⁺
<u>Explanatory Variables:</u>				
Inverse per Capita Expenditure	-0.113 [*]	-0.019 ⁺	-0.117	-0.100
Log _e Household Expenditure	0.268 [*]	0.690 ⁺	0.237	0.303
Log _e Household Size	0.511 [*]	-0.004 ⁺	-0.536	0.500

Note: (*,+) significant at less than 5 percent level.

Based on the tests of significance presented in Table 5. 11, it seems reasonable to conclude that the Vegetables Engel functions are quite similar for clusters 1, 3. and 4, and these are different from cluster 2. (Recall that cluster 2 comprises households with older adults, few children and low total expenditure).

CHAPTER SIX

ENGEL FUNCTIONS FOR MEAT AND MILK

6. 1. Introduction

Table 5.8 presented the proportion of households reporting consumption of rice, vegetables, meat and milk during the survey period. The proportion of households consuming meat varied between 32.3 percent (cluster 2) and 62.2 percent (cluster3); for milk, between 13.8 percent (cluster 2) and 34.1 percent (cluster 3).

As discussed in Chapter 3.4, we are concerned with inferring the characteristics of a population (the Engel function) from a sample drawn from a restricted part of that population (Greene, 1991). The restriction being that some members of the sample have reported zero consumption expenditure on the commodities to be studied. When values of the dependent variable in a certain range are reported as a single value (zero in this case) the dependent variable is said to be censored. Estimation of the population Engel function by Ordinary Least Squares applied to either the complete set of censored and uncensored data, or to the set of non-zero dependent variable values, gives biased estimates of the population parameter values (Greene, 1991). In this situation the regression model is referred to as the censored regression model or the Tobit model (in reference to Tobin (1958) who first proposed the model). As Greene (1991 p729) states: "the Tobit model has become so routine that estimation (by Maximum Likelihood procedures) is now essentially on the level of ordinary regression".

A question remains as to whether the data are censored (or truncated) at some fixed limit value, or whether the limit value depends on some set of explanatory variables. Where the limit value is fixed and the uncensored error distribution is Normal, the Tobit model suffices to obtain the required estimates. Where the limit value is not fixed, then a probability model (the probit model) is required in addition to the Tobit model. These models, and their relationship for the case where the set of explanatory variables is the same for both models, are discussed in detail in Appendix C.2. If the limit value is fixed in this situation, then there is a known relationship between the

Tobit and Probit parameter values (apart from the intercept). A possible test of significance for the null hypothesis that the limit value is fixed discussed in Appendix C.2. The empirical relationship between the Tobit and Probit parameter estimates for meat and milk is examined in Appendix C.3.

In this study the decision was made to use both the Tobit and Probit models to obtain expenditure elasticity (and MPC) estimates for meat and milk. The way in which these models are combined to obtain estimated expenditure elasticities for the whole population in a cluster, or for the proportion of the population currently consuming the commodity of interest, is discussed in Appendix C.2.

In what follows, the explanatory variable \log_e household size has been dropped from the probit and Tobit models. For the Tobit model it was found that including this variable resulted in unstable Maximum Likelihood estimates, and parameter estimates that did not have the expected sign. These problems disappeared with the exclusion of \log_e household size, and there was no significant reduction in explanatory power of the Tobit and probit models for each cluster as judged by log-likelihood ratio tests (-2 Log L).

Sample statistics for explanatory variables used in the probit (and Tobit) models are presented in Appendix A.8 to A.11. Household expenditure for meat and milk were expressed as actual rupiah, and total household expenditure was expressed as rupiah $\times 10^{-5}$ in order to obtain parameter estimates of reasonable magnitude for the Tobit and probit models. Other explanatory variables were used untransformed. The probit dependent variable values are 0 if expenditure on the commodity was observed and 1 otherwise (Logistic procedure, SAS Technical Report P-200, 1988). For the Tobit model, the value 1 was added to all household meat and milk expenditure values so as to obtain $\log_e = 0$ for those households not reporting expenditures on these commodities.

The probit and Tobit models were estimated independently for each cluster, Jakarta is the base region for each cluster. Reported intercepts for other regions are the estimated difference in the intercept for a region relative to the estimated intercept for Jakarta. Significance levels for these parameter

estimates relate to the null hypothesis that a region has the same population intercept as does Jakarta. For the Jakarta intercept and explanatory variable parameter estimates (other than the regional dummy estimates) significance levels relate to the null hypothesis that the population parameter value is zero.

6. 2. Probit Models

This section focuses on probit analyses for meat and milk demand. The probit model investigates the relationship between the probability that a household will consume a commodity (meat or milk) and a set of explanatory variables.

6. 2. 1. Meat

Maximum likelihood estimates for the meat probit models are presented in Table 6.1 (Logistic procedure, SAS Technical Report P-200, 1988). Based on statistically significant coefficients, the results demonstrate that total household expenditure has a positive correlation with the likelihood of consuming meat. The positive sign of the coefficients indicates that households with high total expenditure have a higher probability of consuming meat than households with lower total household expenditure. In addition, the coefficient for inverse per capita expenditure is negative. Thus, as inverse expenditure increases, per capita total household expenditure for the household decreases; and as per capita total household expenditure decreases, the probability that a household will consume meat decreases. The smaller the household size at a given level of household income, the greater the probability that the household will consume meat. This result is consistent with that found by Pakpahan (1988) where smaller households were found to consume a wider variety of foods compared with larger households.

With respect to regional differences in the household decision to consume meat, households in West Java, with the exception of households in cluster 2, have a lower probability of consuming meat relative to households in Jakarta. However, due to a lack of statistical significance for models in cluster 1 and 4, this difference is not confirmed. The coefficients of all

regional dummies in cluster 2 indicate that households in Jakarta are less likely to consume meat than households in other provinces . In accord with prior expectations, average highest education level attained by adults is positively related to a higher probability of consuming meat. Again the coefficient for this variable is statistically significant in all clusters.

Table 6. 1. Probit Analysis for Meat

Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4
<u>Region Intercepts:</u>				
Jakarta	0.148 (0.196)	-0.459 (0.355)	-0.009 (0.147)	0.092 (0.167)
West Java	-0.025 (0.172)	0.581 ^{***} (0.339)	-0.186 ^{**} (0.084)	-0.050 (0.102)
Central Java	0.034 (0.175)	0.619 ^{**} (0.340)	0.102 (0.098)	0.409 [*] (0.108)
Jogyakarta	0.491 ^{**} (0.224)	1.256 [*] (0.399)	0.029 (0.141)	-0.020 (0.160)
East Java	0.242 (0.163)	0.832 ^{**} (0.345)	0.130 (0.089)	0.332 [*] (0.100)
<u>Explanatory Variables:</u>				
Education	0.214 [*] (0.058)	0.245 ^{**} (0.113)	0.210 [*] (0.033)	0.269 [*] (0.037)
Inverse per Capita Household Expenditure	-0.234 [*] (0.038)	-0.223 [*] (0.079)	-0.171 [*] (0.027)	-0.274 [*] (0.030)
Log _e Household Expenditure	0.688 [*] (0.109)	1.114 [*] (0.203)	0.704 [*] (0.072)	0.607 [*] (0.088)

Standard errors are in the parentheses.

^{*} significant at the level of 0.01

^{**} significant at the level of 0.05

^{***} significant at the level of 0.10

To assess the goodness of fit, the McFadden R-squared, -2 Log L and the correct classification of households as either consuming or not consuming meat on the basis of regression results are used. The values of McFadden R-squared are reasonably good considering the cross section data analysis (Gudjarati, 1988). Similarly, based on the values of -2 Log L for intercepts and

covariates, the combined effects of explanatory variables included in the probit analyses are significant with $p = 0.005$.

Table 6.2. Measures of Goodness of Fit for Meat Probit Models

Measure	Cluster 1	Cluster 2	Cluster 3	Cluster 4
- 2 Log L	337.3	141.4	733.5	896.0
Mc Fadden R ²	0.30	0.36	0.24	0.32
Mc Fadden Adjusted R ²	0.28	0.30	0.24	0.31
Correctly specified	76.6%	80.9%	74.7%	85.8%
Sensitivity	76.3%	64.8%	83.2%	67.1%
Specificity	76.8%	88.6%	60.7%	67.1%
False Positive rate	22.8%	26.9%	22.3%	19.6%
False Negative Rate	24.1%	15.9%	31.3%	24.9%

Note: All -2Log L's are significant with $p = 0.0001$

6. 2. 2. Milk

Probit models for milk were also estimated using maximum likelihood techniques. Parameter estimates are exhibited in Table 6.3.

Despite the fact that the coefficient of the number of children is not statistically significant in cluster 2, the positive signs of coefficients for this variable across clusters indicate that the household's decision on consuming milk is affected by the presence of children. The significant coefficients of the number of children for models in cluster 1, 3 and 4 are due to the fact that households in these clusters have relatively more children than households in cluster 2 (Table 5.3). Since the consumption of milk is related to the number of children, it is not surprising that coefficients of the number of children in clusters 1, 3 and 4 are observed to be statistically significant. This finding suggests that the more children there are in a household, the greater will be the likelihood of that household consuming milk.

As expected, the likelihood of consuming milk increases with the average education level of adults. The educational attainment of the adult household members is found to be statistically significant in all clusters. These results indicate that the higher this educational attainment, the more likely it is that those households will consume milk.

Table 6.3. Probit analysis for milk model

Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4
<u>Region Intercepts:</u>				
Jakarta	0.490** (0.230)	-0.388 (0.391)	-0.606* (0.169)	-1.017* (0.199)
West Java	-	-	0.115 (0.081)	0.207** (0.097)
Central Java	-	-	0.251** (0.100)	0.085 (0.106)
Jogyakarta	-	-	0.316** (0.146)	0.307*** (0.162)
East Java	-	-	0.031 (0.089)	0.002 (0.094)
<u>Explanatory Variables:</u>				
Children	0.289* (0.079)	0.075 (0.317)	0.350* (0.033)	0.230* (0.035)
Education	0.132** (0.060)	0.252** (0.124)	0.198* (0.035)	0.195* (0.038)
Inverse per Capita Household Expenditure	-0.347* (0.067)	-0.378* (0.137)	-0.405* (0.039)	-0.274* (0.043)
Log _e Household Expenditure	0.393* (0.130)	0.530** (0.255)	0.347* (0.069)	0.539* (0.092)

Note : Standard errors are in the parentheses

* statistically significant at the level of 0.01

** statistically significant at the level of 0.05

*** statistically significant at the level of 0.10

In agreement with prior expectation, the probability of consuming milk is positively influenced by total household expenditure. Households in all clusters tend to increase their consumption of milk when there is an increase in total household expenditure. With respect to the effect of the inverse of per capita household expenditure, for a given household size, the higher the total household expenditure, the more likely the household will consume milk.

For clusters 3 and 4 significant differences among locations are revealed in the probit models by the regional dummy variables. For clusters 1 and 2, no significant regional effects were observed for the regions relative

to Jakarta, so the models for these clusters were re-estimated without the regional dummy variables. Based on the coefficients which are statistically significant, the likelihood of consuming milk for households in Central Java and Jogjakarta (cluster 3) and West Java and Jogjakarta (cluster 4) is higher than households in Jakarta.

Measures of goodness-of-fit for the milk probit models are presented in Table 6.4. These measures can be considered quite satisfactory.

Table 6.4. Measures of Goodness of Fit for Milk Probit Models

Measure	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Chi-square for covariates	202.2	81.8	804.2	675.9
- 2 Log L	642.5	179.6	2246.6	680.6
Mc Fadden R ²	0.25	0.34	0.27	0.27
Mc Fadden Adjusted R ²	0.23	0.25	0.26	0.26
Correctly specified	81.5%	86.8%	77.8%	78.6%
Sensitivity	28.0%	26.7%	59.4%	50.9%
Specificity	95.2%	95.4%	87.3%	89.5%
False Positive rate	41.3%	45.5%	29.3%	34.3%
False Negative Rate	15.7%	10.9%	19.4%	17.8%

Note: All -2Log L's are significant with $p = 0.0001$

6. 2. 3. Probability of consuming meat and milk

Estimated probabilities of a household consuming meat and milk were calculated from the probit models at the means of the explanatory variables, and are presented in Table 6. 5. The probability of a 'mean' household consuming meat or milk differs between clusters and regions. As discussed previously, households in cluster 2 comprise relatively older family members with low household income/expenditure. Households in clusters 3 and 4 are predominantly younger families and have a relatively high household income/expenditure. Households in clusters 3 and 4 have a high probability of consuming either meat or milk compared to households in clusters 1 and 2. For example, an average household in cluster 3, selected at random, is estimated to have a probability of 0.67 (67 percent chance) of consuming meat

(0.39 probability of consuming milk). On the other hand households in cluster 2 are estimated to have low probabilities of consuming meat or milk (0.42 and 0.12 respectively). The figures in Table 6.5 can be interpreted as estimated proportions of various sub-populations of Urban Java households consuming meat and/or milk.

In relation to regional differences, because Jakarta is relatively urbanised and, on average, households in this province are better off than households in other provinces, the proportion of households estimated to consume meat and/or milk are the highest there. A relatively low proportion of cluster 1 and 2 households in West Java and Central Java are estimated to consume meat. For milk, the highest proportion of households reporting milk consumption, apart from Jakarta, are clusters 3 and 4 households in West Java and Jogjakarta.

Table 6. 5. Estimated Probabilities of Households Consuming Meat and Milk

Region	Cluster 1	Cluster 2	Cluster 3	Cluster 4
<i>Meat</i>				
Jakarta	0.72	0.40	0.76	0.78
West Java	0.47	0.43	0.60	0.59
Central Java	0.42	0.34	0.57	0.62
Jogjakarta	0.63	0.48	0.63	0.62
East Java	0.60	0.43	0.65	0.69
Average	0.58	0.42	0.67	0.70
<i>Milk</i>				
Jakarta	0.35	0.30	0.48	0.34
West Java	0.16	0.15	0.41	0.28
Central Java	0.11	0.10	0.27	0.14
Jogjakarta	0.12	0.05	0.38	0.30
East Java	0.17	0.09	0.24	0.17
Average	0.19	0.12	0.39	0.24

6. 3. Tobit Models (Latent Engel Function)

The Tobit model is commonly referred to as the latent regression: the equation that would explain variation in $E(\text{dependent variable})$ if no population

values were censored. In this study, Maximum Likelihood estimates of latent Engel functions are obtained for meat and milk, (Lifereg procedure, SAS/STAT User's Guide, 1988).

6. 3. 1. *Meat*

Table 6.6 presents estimated Tobit model parameter values for meat. All total household expenditure coefficients have a positive sign and are statistically significant at the 1 percent level. This indicates that an allocation of household budget to meat and milk consumption is affected by total household expenditure. This finding supports the hypothesis that households will increase their consumption of animal products as their income or expenditure increases. Compared to households in other clusters, households in cluster 2 have the highest increasing expenditure on meat relative to increases in total expenditure, *ceteris paribus*. In accord with prior expectation, the coefficient of inverse per capita expenditure is negative indicating that, given total household expenditure, households tend to reduce their consumption of meat due to reallocation their household budget from meat to normal goods as household size increases. Similarly, given the number of household members, consumption of meat will increase with an increase in total household income or expenditure.

Table 6.6. Tobit Results for Meat

Variables	Cluster 1	Cluster 2	Cluster 3	Cluster 4
<u>Region Intercepts:</u>				
Jakarta	-2.522 [*] (0.795)	-1.285 (1.843)	2.726 [*] (0.520)	3.415 [*] (0.550)
West Java	0.282 (0.654)	3.291 ^{**} (1.664)	-0.601 ^{**} (0.272)	-0.019 (0.305)
Central Java	0.483 (0.669)	3.398 ^{**} (1.671)	0.462 (0.324)	1.553 [*] (0.322)
Jogyakarta	2.186 [*] (0.839)	6.532 [*] (1.955)	0.022 (0.470)	-0.204 (0.496)
East Java	1.126 ^{***} (0.597)	4.527 ^{**} (1.682)	0.470 (0.288)	1.146 [*] (0.292)
<u>Explanatory Variables:</u>				
Education	0.751 [*] (0.219)	1.102 ^{**} (0.552)	0.746 [*] (0.113)	0.885 [*] (0.116)
Inverse per Capita Expenditure	-1.163 [*] (0.161)	-1.263 [*] (0.409)	-0.868 [*] (0.100)	-1.253 [*] (0.102)
Log _e Household Expenditure	3.162 [*] (0.409)	6.046 [*] (0.993)	2.394 [*] (0.209)	1.910 [*] (0.254)
Sigma	5.016 (0.194)	5.950 (0.477)	4.488 (0.092)	4.259 (0.092)
Log Likelihood	-1558	-420	-5038	-4380

Note: standard errors are in the parentheses

^{*} statistically significant at the level of 0.01

^{**} statistically significant at the level of 0.05

^{***} statistically significant at the level of 0.10

Other non-economic factors, including the highest adult education level and geographical location appear to have a significant impact on household meat expenditure. Results suggest that the educational attainment of all adults in the household have a significant impact on household expenditure on meat, and is here observed across clusters.

Geographical location also appears to be a significant variable in the determination of household expenditure on meat. Households in East Java and Central Java have higher household expenditures on meat compared with households in Jakarta, *ceteris paribus*. Results also indicate that households

in Jogjakarta (cluster 1 and 2) are recorded to spend more on meat than households in Jakarta. It is estimated that households in West Java (cluster 2) have significantly higher meat expenditure than households in Jakarta, *ceteris paribus*.

It is estimated that total household expenditure and inverse expenditure have a significant effect in determining the allocation of household budget to meat. Also, educational attainment of adults has a positive impact on household meat expenditure.

6. 3. 2. Milk

Table 6.7 presents estimated Tobit model parameter estimates for milk. Regional dummy parameter estimates for clusters 1 and 2 were found to be not significantly different from Jakarta, so the model was re-estimated excluding these variables.

The number of children in a household was included as an additional explanatory variable in the Milk Tobit model (as for the milk probit model). With the exception of households in cluster 2, number of children is significantly and positively related to household milk expenditure. It is not surprising that the number of children in cluster 2 is not significantly related to expenditure on milk since households in this cluster are characterised by older adults and fewer children (see Table 5. 3). Table 6.7 indicates that relative to households in Jakarta, households in Central Java and East Java (cluster 3), and households in West Java (cluster 4), have a higher milk expenditure, *ceteris paribus*.

Table 6. 7. Tobit Results for Milk

Variables	Cluster 1	Cluster 2	Cluster 3	Cluster4
<u>Region Intercepts:</u>				
Jakarta	-3.549*** (1.857)	-2.183 (3.096)	-2.152** (1.018)	-5.512* (1.296)
West Java	-	-	0.491 (0.463)	1.190** (0.607)
Central Java	-	-	1.369** (0.581)	0.459 (0.682)
Jogyakarta	-	-	1.731** (0.826)	1.592 (1.021)
East Java	-	-	-0.410 (0.524)	-0.045 (0.603)
<u>Explanatory Variables:</u>				
Children	2.204* (0.593)	0.686 (2.382)	2.065* (0.186)	1.607* (0.226)
Education	1.032** (0.462)	1.821** (0.946)	1.219* (0.203)	1.361* (0.243)
Inverse per Capita Expenditure	-2.800* (0.539)	-3.124* (1.114)	-2.653* (0.239)	-2.057* (0.276)
Log _e Household Expenditure	3.180* (1.014)	3.952** (1.898)	1.834* (0.387)	3.254* (0.569)
Sigma	8.552 (0.564)	8.104 (1.038)	6.785 (0.197)	7.315 (0.248)
Log Likelihood	-796	-214	-3384	-2650

Note : Standard errors are in the parentheses

* statistically significant at the level of 0.01

** statistically significant at the level of 0.05

** statistically significant at the level of 0.1

Chapter seven presents and discuss expenditure elasticity estimates based on Chapter Five and Six results.

CHAPTER SEVEN

EXPENDITURE ELASTICITIES

7. 1. Introduction

A major objective of this study was to estimate Engel expenditure elasticities for various food items, for Urban Java households. Also, it is standard practice to explain household consumption patterns on the basis of expenditure elasticities (Samad and Houssein, 1993).

In what follows, goods with expenditure elasticities greater than unity are designated luxury goods, expenditure elasticities that are positive but less than unity denote normal goods, while negative expenditure elasticities denote inferior goods.

7. 2. Results and Discussion

Table 7.1 presents estimated household expenditure elasticities for all food, rice and vegetables. These elasticity estimates are computed at the cluster means for explanatory variables. Differences are therefore partly due to differences in cluster mean characteristics, and partly due to differences in parameter value estimates.

Table 7. 1. All Food, Rice and Vegetable Expenditure Elasticities

Cluster	All Food	Rice	Vegetable
Cluster 1	0.654	0.068	0.546
Cluster 2	0.731	0.092	0.741
Cluster 3	0.696	0.020	0.478
Cluster 4	0.688	0.022	0.532

Results suggest that rice and vegetable are regarded as normal goods where their expenditure elasticities are positive but less than unity. In comparison across clusters, it is clear that households in cluster 2 are relatively responsive to a change in consumption on these foods due to a change in total household expenditure. Expenditure elasticities for all food, rice and vegetables are 0.721, 0.092 and 0.741, respectively.

Rice is a staple food of Indonesians. Expenditure elasticities for rice are very small (close to zero), indicating that households in urban Java regard rice as a near inferior good, especially for high income households in clusters

3 and 4. This means that the rate of decreasing rice consumption by households in cluster 3 and 4 is relatively faster than for households in cluster 2 (which are reported to have low average household incomes).

These findings are consistent with Ito *et al.* (1989) and Bouis (1989). Ito *et al.* (1989) reported that the expenditure elasticities for rice have been declining since 1968 to 1984 from 0.310 to 0.108. Not surprisingly, Ito predicted that in future rice will become an inferior good as has been experienced in economically advanced countries such as Japan, Taiwan, and Singapore as well as in exporting countries like Thailand. Using 1981 SUSENAS, Bouis (1989) reported that income elasticities for rice in Indonesia were 0.04 for high income households and 0.40 for low income households. Tabor *et al.* (1989) also reported that expenditure elasticities were higher for the higher value foodstuffs than for lower value starchy staples.

As discussed in detail in Appendix C.2, the marginal effect of meat and milk expenditure, due to a change in total household expenditure, is composed of two parts. First, a change in the probability that $y > 0$ as total household expenditure (x) changes, and secondly, the change in $y > 0$ as total household expenditure changes.

Tables 7.2 and 7.3 present estimated household expenditure elasticities for those households reporting consumption of meat and milk. The corresponding elasticities for all households are presented in Tables 7.4 and 7.5 (see Appendix C.2 for derivation of these elasticity values).

Table 7. 2. Meat Expenditure Elasticities for Households Reporting Consumption of meat

Province	Cluster			
	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Jakarta	2.307	2.023	1.738	1.885
West Java	1.990	2.505	1.402	1.837
Central Java	1.994	2.159	1.752	2.376
Jogyakarta	2.840	3.208	1.709	1.862
East Java	2.407	2.649	1.787	2.322
Average	2.262	2.518	1.656	2.081

Table 7.3. Milk Expenditure Elasticities for Households Reporting Consumption of Milk

Province	Cluster			
	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Jakarta	1.787	2.135	1.651	1.374
West Java	1.631	2.144	1.788	1.735
Central Java	1.523	1.968	1.886	1.474
Jogyakarta	1.563	1.951	2.031	1.741
East Java	1.619	2.021	1.433	1.359
Average	1.661	2.036	1.716	1.478

Compared to other food items, meat and milk are regarded by the average households in all clusters as luxuries since estimated expenditure elasticities are greater than unity. A one percent increase in total household expenditure is estimated to result in a greater than one percent increase in household expenditure on meat and on milk.

As expected, meat and milk expenditure elasticities for those households already consuming meat and milk are lower for average households in clusters 3 and 4 relative to average households in clusters 1 and 2. This is because households in clusters 3 and 4 are better off than their counterparts in clusters 1 and 2. Due to their lower total expenditure, expenditure elasticities for average households in cluster 2 are relatively high.

With respect to regional differences, households in West Java have the lowest meat expenditure elasticities, with the exception of households in cluster 2. This indicates that for meat expenditure, households in West Java are relatively less responsive to a change in total household expenditure. In contrast to meat expenditure elasticities, households in Jakarta (either in cluster 3 or 4) have the lowest milk expenditure elasticities. The results of this study are consistent with Pakpahan (1988), Chernovchesky and Meesook (1984), and Daud (1986) in which milk is still regarded as a luxury good.

Table 7. 4. Meat Expenditure Elasticities for all Households

Region	Cluster			
	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Jakarta	3.822	3.726	3.324	3.479
West Java	3.866	4.623	3.288	4.007
Central Java	3.820	3.966	3.768	4.767
Jogyakarta	4.823	5.858	3.575	3.910
East Java	4.262	4.650	3.684	4.441
Average	4.120	4.551	3.477	4.064

Table 7.5. Milk Expenditure Elasticities for all Households

Region	Cluster			
	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Jakarta	2.700	2.838	5.134	6.106
West Java	1.964	1.988	5.003	3.273
Central Java	1.578	1.383	4.600	3.291
Jogyakarta	1.682	0.829	5.147	5.031
East Java	1.975	1.367	3.732	3.657
Average	2.112	1.637	4.863	4.772

Tables 7.4 and 7.5 give the estimated meat and milk expenditure elasticities for all households in any cluster/region, evaluated at the explanatory variable means. These results suggest that in general, estimated expenditure elasticities for all households are greater than expenditure elasticities for those who consumed meat, with the exception of milk expenditure elasticities in cluster 2. This is because the probability of consuming milk in cluster 2 is very low, leading to small expenditure elasticities. As presented in Table 6.5, the probability of consuming milk for an average household in cluster 2 is 0.12. This indicates that households in cluster 2 are relatively less likely to consume milk.

The relatively higher expenditure elasticities reported in Tables 7.4 and 7.5, compared with those in Tables 7.2 and 7.3, account for the increase in the proportion of households estimated to enter the market for meat and milk as household income or total expenditure increases.

Comparisons of expenditure elasticities and Engel function parameter estimates for rice, vegetables, meat and milk, indicate that households attempt to improve the quality of their diets (increased dietary intake of protein relative to carbohydrate) as total household expenditure increases. This result is consistent with those reported by Tabor *et al.*, (1989).

7. 3. Comparisons of Expenditure Elasticities with Earlier Studies

Tables 7.6, 7.7, and 7.8 present some income or expenditure elasticities for rice(cereal), vegetable and animal products estimated from selected studies. However, these studies employed different demand systems, commodity definitions and time periods, thus one should be careful in interpreting the results of those studies relative to those reported in this thesis. It is important to note that most of those studies investigated food consumption in Indonesia using cross-section data. As a result, the values of elasticities are interpreted as long run elasticities after being adjusted for changes in preferences and tastes.

In general, rural expenditure elasticities are relatively higher than urban elasticities, with exception for those reported by Boediono (1978) and Hedley (1978). Surprisingly, the study of Daud (1986) gives comparatively higher income elasticities despite the fact that Daud estimated income elasticities of rice aggregated with other cereal such as wheat and corn. His results also differ from the previous studies in which the aggregation of food items into a group commodity would result in overestimated or underestimated elasticities (see Chapter Two).

Table 7.6. Estimated Income or Expenditure Elasticities of Rice from Previous Studies in Indonesia.

Data Set	Demand System	Researcher(s)	Elasticities
SUSENAS 1971	Log-log linear	Timmer	1.45 [*] 1.03 0.77 0.64 0.45 0.28 0.20
SUSENAS 1969-70 (cereal)	L E S	Boediono	0.71(U) 0.50(R)
SUSENAS 1976	Frisch	Boediono	0.689
SUSENAS 1976 (cereal)	L E S	Hedley	<u>Java</u> 0.239(U) 0.562(R)
SUSENAS 1976	Log-log quadratic	Alderman and Timmer	0.265(U) 0.581(R) 0.526(T)
	Log linear with inverse of total expenditure		0.284(U) 0.639(R) 0.572(T)
	Log linear		0.284(U) 0.654(R) 0.590(T)
	Semi log		0.237(U) 0.521(R) 0.472(T)
SUSENAS 1976	Linear	Dixon	0.194(U) 0.560(R)
Surgasar 1980	AIDS MLLM	Teklu and Johnson	0.33 0.24

continued

Table 5. 30. (continued)

Data Source	Demand System	Researcher(s)	Elasticities
Susenas 1978	Linear	Chernichovsky and Meesook	<u>Java</u>
			3.023(L)
			0.904(M)
			0.034(H)
			<u>Off Java</u>
			1.149(L)
Susenas 1981 (cereal)	AIDS	Daud	0.398(M)
			0.053(H)
			<u>Java</u>
			1.00(U)
			1.089(R)
			1.97(T)
			<u>Off Java</u>
			1.00(U)
			0.96(R)
			1.00(T)
<u>Indonesia</u>			
			0.99

Notes: 1. LES stands for Linear Expenditure System
 2. see Chapter Two.
 3. U : Urban area, R : Rural area and T : Total

Most studies reported similar expenditure elasticities of vegetables except that of Teklu and Johnson (1988). Between 1976 and 1981, income elasticities of vegetables together in some cases with pulse and fruit are reported to be high, exceeding unity. This in turn gives an indication that vegetables (over that time period) were considered to be a luxury food item despite that vegetables are on the main menu with rice in daily Indonesian meals whose elasticities were supposed to be less than unity.

Table 7.7. Estimated Income or Expenditure Elasticities for Vegetables from Previous Studies in Indonesia.

Data Source	Demand System	Researcher(s)	Elasticities
Susenas 1976	Frisch	Boediono	1.170
Susenas 1976 (pulses and fruit)	LES	Hedley	<u>Java</u> 0.856(Urban) 1.024(Rural) <u>Off Java</u> 1.123(Urban) 1.098(Rural)
Surgasar 1980 (fruit)	AIDS and MLLM	Teklu and Johnson	0.85(AIDS) 0.86(MLLM)
Susenas 1981 (pulses and fruits)	AIDS	Daud	<u>Java</u> 1.15(Urban) 1.07(Rural) 1.15(Total) <u>Off Java</u> 1.09(Urban) 1.10(Rural) 1.08(Total) <u>Indonesia</u> 1.07

Similarly, income elasticities for meat and dairy products exceed unity particularly for rural or low income groups with the exception of the finding by Daud (1986). This figure indicates that for most Indonesian households, meat and dairy products are still regarded as luxury goods which are affordable only for those who have relatively high incomes. In contrast, Daud (1986) reported expenditure elasticities for animal products of less than one.

Table 7.8. Estimated Income or Expenditure Elasticities of Meat and Dairy Products from Previous Studies in Indonesia.

Data Source	Demand System	Researcher(s)	Elasticities
Susenas 1976	Frisch	Boediono ¹	2.168
Susenas 1976	LES	Hedley ²	1.856(Urban) 1.024(Rural)
Surgasar 1980	AIDS and MLLM	Teklu and Johnson ³	1.40(AIDS) 0(MLLM)
Susenas 1978	Linear	Chernichosky and Meesook	<u>Java</u> 3.948(L) 2.162(M) 2.534(H) <u>Off Java</u> 1.332(L) 3.112(M) 3.148(H)
Susenas 1981	AIDS	Daud ⁴	<u>Java</u> 0.35(Urban) 0.24(Rural) 0.26(Total) <u>Off Java</u> 0.32(Urban) 0.21(Rural) 0.21(Total) <u>Indonesia</u> 0.251

L: Low Income Households, M: Middle Income Household and H: High Income Households

¹ animal products, ² meat, fish, milk and eggs, ³ other meat and dairy products and ⁴ meat, milk and egg

7. 4. Implications for the New Zealand Meat and Dairy Industries

New Zealand has been concentrating its export destination on East Asia, including the ASEAN nations due to remarkable economic growth compared to other countries in this region. However, based on Tradenz (1993) estimation, the China economic performance will slow down and forecast for

the European economies and Japan seem not to be promising. Alternatively, New Zealand exporters are encouraged to seek new strategies and to develop market analyses and targets. Indonesia seems to be an alternative for New Zealand products. Statistics show an increasing trend in New Zealand beef and dairy products exported to Indonesia. The increase in demand on beef and dairy products are seemingly propelled by the increase in income per capita. Also there is significant evidence that a rapid growth in urbanization is observed.

Only three commodities are reported exported by New Zealand to Indonesia: beef and veal, butter and milk including condensed, evaporated and dried milk. In fact, New Zealand started exporting beef and veal at the beginning of 1985. In 1992, milk exported to Indonesia accounted for 3.1 percent of total exports of New Zealand which contributed \$ 34 million and is slightly less than the previous year. It is important to note that in 1981, the proportion of volume and value of milk exported to Indonesia accounted for 14.9 percent and 13.5 percent of total milk export of New Zealand.

New Zealand's exports to Indonesia of beef and veal, butter and milk fluctuated from 1980 to 1992 (Table 7.9 and 7.10) caused partly by economic recession in Indonesia and other parts of the world. The 1990 export volumes of beef and veal, butter and milk reached their lowest levels since Indonesia began importing those commodities from New Zealand. In 1990, the amount of beef and veal, butter and milk exported to Indonesia totalled 314 tonnes, 1406 tonnes and 7765 tonnes, respectively. Despite the fluctuating export volumes to Indonesia, Indonesia is a potential market for New Zealand meat and dairy products due to its remarkable economic growth (Department of Statistics, 1990).

The thesis results established that meat and milk are regarded by urban Indonesians as luxury items. The results also indicated that households in clusters 3 and 4 are mostly high-income households and relatively better-educated. They are also more likely to consume meat and milk. Given the increased purchasing power due to economic growth in Indonesia, meat and

milk products will be more affordable. Thus increased demand for these food products is likely to occur in the coming years.

Table 7.9. New Zealand Meat and Dairy Products Export to Indonesia 1980-1992 (tonnes)

Year	Beef	Butter	Milk*
1980	-	10637	39933
1981	-	10339	39175
1982	-	6833	25215
1983	-	6531	27172
1984	-	6785	23171
1985	585	2926	15700
1986	542	3750	25181
1987	376	3794	19434
1988	446	3287	18236
1989	448	2996	15488
1990	314	1406	7765
1991	496	2742	14551
1992	814	2011	15033

* includes condensed, evaporated and dried milk

Sources: Department of Statistics. The External Trade. Report and Analysis 1980-1989.

_____. Overseas Trade. Various Years.

The expenditure elasticities calculated in this study for meat and milk products confirmed that the demand for meat in the future will increase due to an increase in income per capita and the increasing population of Indonesia, especially for households in the urban areas. More importantly, World Bank (1992) and Altemeier (1992) reported that in the sixth Five-Yearly Development Plan (1994-1999), expenditure demand elasticities for meat excluding poultry are 0.77 and 0.80, respectively. Fletcher *et al.*, (1991) predicted that the annual increase of per capita demand for meat was 3.48 percent and that there will be a considerable market deficit in meat consumption, in particular of beef. Based on these predictions, it is clear that market opportunities for meat and (also in future milk) are substantial.

Table 7.10. New Zealand Meat and Dairy Products Export to Indonesia 1980-1992 (NZ \$1000)

Year	Beef	Butter	Milk*
1980	-	14530	27765
1981	-	19135	41173
1982	-	21011	32671
1983	-	21165	36118
1984	-	19052	27745
1985	20587	9100	21755
1986	17018	9512	32390
1987	21485	8559	27946
1988	21794	6622	29695
1989	22256	6815	38345
1990	26659	5230	24028
1991	23775	7834	35529
1992	32876	6268	34354

* includes condensed, evaporated and dried milk.

Sources: Department of Statistics. The External Trade. Report and Analysis 1980-1989.

_____. Overseas Trade. Various Years.

The results, therefore, generally suggest two basic strategies for meat and dairy products marketing in Indonesia. First, meat and dairy products markets in Indonesia are not well investigated in terms of potential buyers for meat and dairy products. Therefore marketing effort should be directed to those households consisting of children especially where the household head and a spouse has a high education level due to their higher probability of consuming meat and dairy products. Second, the results indicate that the consumption of meat and dairy products are significantly affected by household income or expenditure, hence New Zealand marketers should target food outlets (e.g. restaurant and supermarkets) that cater to higher income households on the assumption that high-income households tend to consume meat away home¹. More importantly, household expenditure decisions on milk are also influenced by the presence of children in the

¹ The SUSENAS data did not include food away from home.

household, as a result, the increasing number of young families, residing in urban areas may create a new market for dairy products.

The results of this study indicate that households in clusters 3 and 4 are relatively high income households and have a high probability of consuming meat and milk. Therefore, the New Zealand meat and dairy industries may concentrate on potential consumers in these clusters. The results also suggest the New Zealand marketers of meat and milk products can select the province where the probability of consuming meat and milk are high, for example, Jakarta, Jogjakarta and East Java (for meat) and Jakarta, West Java and Jogjakarta (for milk products).

CHAPTER EIGHT

CONCLUSION AND RECOMMENDATIONS

8. 1. Conclusion

This study has attempted to investigate the factors affecting household food expenditure patterns in Urban Java using 1990 SUSENAS data. The clustering procedure was used to segment the population based on the number of adults, the number of teenagers, the number of children, average highest adult education and average adult age. The log-log-inverse function was employed to analyze the patterns of household food expenditure. Due to the existence of zero household expenditures for meat and milk, the probit and tobit models were used to obtain expenditure elasticity estimates for these food items.

The principal objective of this study was to evaluate the role that household characteristics play in determining expenditures on various food items particularly all-food, rice, vegetables, meats and milk. The results clearly showed that economic and demographic characteristics such as total household expenditure, household size and average highest adult education level were associated with the allocation of the household budget to expenditure on food items. The presence of children, in addition to the above variables, also influenced expenditure decisions on milk. This study also demonstrated that despite the fact that rice is a staple food, the proportion of the total household budget allocated to rice decreased as total household income or expenditure increased. More importantly, the decision on how much of the total budget to spend on rice was not strongly determined by total household expenditure, but by the number of household members.

Households in all clusters consider all-food, rice and vegetables to be normal goods, but meat and milk to be luxuries. Households were grouped into four clusters, and there were significant differences in total expenditures, food expenditure and average expenditure elasticities between clusters. For rice, households in clusters 3 and 4 (high income households, few household

members and young families) were less responsive to changes in total household expenditure than households in clusters 1 and 2. Differences between clusters in vegetable expenditure elasticities were less marked, as were differences between clusters in meat expenditure elasticities. For milk, households in clusters 3 and 4 were more responsive than households in clusters 1 and 2. Milk expenditure elasticities were highest for households in the Jakarta region (all clusters). Jakarta is more urbanised and more cosmopolitan than other urban provinces of Indonesia. This may help to explain the differences in food expenditure patterns between households in Jakarta and other provinces. Households in Jakarta spend less on staple food items but more on protein-rich foods.

The results suggest that in future due to an increase in per capita income, rice will become an inferior good, indicated by relatively low expenditure elasticities for rice of 0.02 (cluster 3) and 0.092 (cluster 2). Even though rice will gradually become an inferior good, the demand for rice is still high due to the increasing Indonesian population.

Consumers or households still consider meat and milk to be luxuries. However, during the coming years, there will be changes in the preferences and orientation of consumer attitudes toward food, in particular adoption of a "western food" orientation high in calorie and protein intake. This situation will coincide with higher incomes, increased urbanization and a fall in the household dependency ratio. These factors will drive consumers to reduce their consumption of rice and increase their consumption of protein-rich commodities, particularly meat and dairy products.

Indonesia appears to be a promising market for New Zealand products. Statistics show an increasing trend in New Zealand beef and dairy exports to Indonesia. The increase in Indonesian demand for beef and dairy products has been demonstrated to be driven largely by the increase in per capita income. More importantly, a rapid growth in urbanization is also observed. The "middle class" will become a major segment in the emerging market because of its demand for better quality. Several strategies can be undertaken to increase New Zealand meat and milk exports to Indonesia.

First, New Zealand meat and milk marketers may focus on households with high education levels and second, to target market outlets (e.g. restaurants and supermarkets) that satisfy high and middle income classes. It is important to note that the last strategy should be viewed as an opportunity for introducing and marketing New Zealand products.

8. 2. Recommendations

This study focused on the effects of total household expenditure and other demographic factors on household expenditure on several food items, particularly meat and milk. An assumption was constant prices across households and regions. No attempts have been made to investigate other economic factors such as the effects of prices and product quality on household decision on the allocation of the total household budget to food items. Therefore, further study to investigate the effects of prices and quality on food expenditures may be very important. Households might well face different prices due to quality and spatial differences.

Despite the fact that Java is a centre of government and business activities in Indonesia, other provinces such as North Sumatra, West Sumatra, Lampung and South Sulawesi are also regions making important contribution to the Indonesian economy. These regions will, in the next century, be a major market for domestic and foreign companies. Therefore, the analysis of consumer or household demand for goods, particularly foods, should take these regions into account in order to be able to evaluate future strategies.

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APPENDIX A

Tables

Table A.1. Distribution of Household Size by Region within Cluster

Cluster	Province	Mean	Std Dev.	Min.	Max.
Cluster 1	Jakarta	4.059	1.881	1	9
	West Java	4.023	1.991	1	9
	Central Java	4.142	2.064	1	11
	Jogyakarta	3.947	1.832	1	10
	East Java	3.910	2.027	1	10
Cluster 2	Jakarta	2.370	1.244	1	5
	West Java	2.231	1.299	1	7
	Central Java	2.087	1.126	1	6
	Jogyakarta	2.452	1.234	1	8
	East Java				
Cluster 3	Jakarta	4.850	2.048	1	13
	West Java	4.692	1.889	1	11
	Central Java	4.781	1.999	1	12
	Jogyakarta	4.274	1.898	1	10
	East Java	4.453	1.905	1	14
Cluster 4	Jakarta	5.383	1.839	1	13
	West Java	5.537	1.899	1	13
	Central Java	5.310	1.787	1	11
	Jogyakarta	4.846	1.876	1	8
	East Java	5.150	1.876	1	11

Table A. 2. Distribution of Number of Teenager and Children by Households in Cluster 1

Teenager Frequency	Children					Total
	0	1	2	3	> 4	
0	336	50	32	9	4	431
1	132	41	25	6	2	206
2	63	35	13	9	2	122
3	34	20	13	3	1	71
>4	5	11	3	0	0	19
Total	570	157	86	27	9	849

Table A. 3. Distribution of Number of Teenager and Children by Households in Cluster 2

Teenager Frequency	Children				Total
	0	1	2	3	
0	238	8	2	0	248
1	42	2	4	1	49
2	16	4	1	0	21
3	3	2	2	0	7
>4	1	0	0	0	1
Total	300	16	9	1	326

Table A. 4. Distribution of Number of Teenager and Children by Households in Cluster 3

Teenager Frequency	Children					Total
	0	1	2	3	> 4	
0	388	544	392	158	32	1514
1	156	159	121	42	11	489
2	85	56	57	23	6	227
3	44	38	21	6	0	109
>4	20	14	5	3	1	43
Total	693	811	596	232	50	2382

Table A. 5. Distribution of Number of Teenager and Children by Households in Cluster 4

Teenager Frequency	Children					Total
	0	1	2	3	> 4	
0	404	150	135	36	7	732
1	234	164	100	45	14	557
2	199	181	79	37	12	508
3	105	95	49	16	7	272
>4	37	22	15	7	1	82
Total	979	612	378	141	41	2151

Table A. 6. Average of Adults, Teenagers, Children, Adults Highest Education and Average Adults Age by Region within Cluster.

Cls	Province	Number of Adults	Number of Teenagers	Number of Children	Education	Average Age
1	Jakarta	2.69	0.83	0.54	2.15	48.7
	West Java	2.37	1.08	0.57	1.51	49.6
	Cent. Java	2.69	0.90	0.55	1.37	49.3
	Jogyakarta	2.68	0.79	0.47	1.71	49.3
	East Java	2.65	0.78	0.49	1.57	49.8
2	Jakarta	1.89	0.41	0.07	1.35	64.1
	West Java	1.79	0.31	0.13	1.24	66.0
	Cent. Java	1.71	0.29	0.09	0.76	64.7
	Jogyakarta	2.00	0.38	0.07	0.55	66.8
	East Java	1.82	0.44	0.16	0.78	65.9
3	Jakarta	3.03	0.62	1.20	2.95	29.0
	West Java	2.79	0.59	1.31	2.48	28.7
	Cent. Java	2.74	0.70	1.35	2.20	29.2
	Jogyakarta	2.69	0.50	1.09	2.68	28.8
	East Java	2.80	0.57	1.08	2.41	29.0
4	Jakarta	3.17	1.40	0.81	2.79	37.3
	West Java	2.94	1.44	1.16	2.38	37.7
	Cent. Java	3.07	1.28	0.97	2.10	37.9
	Jogyakarta	3.23	0.90	0.72	2.59	37.7
	East Java	3.26	1.09	0.80	2.36	38.0

Table A. 7. Average Total Income, Expenditure and Food Expenditure by Province within Clusters (Rupiah)

Cluster	Province	Income	Expenditure	F o o d Expenditure
1	Jakarta	312182	277036	120744
	West Java	188336	148731	58893
	Cent. Java	145284	127348	71262
	Jogyakarta	149146	125610	65840
	East Java	199489	152393	71413
2	Jakarta	171835	156270	58893
	West Java	98970	90435	51289
	Cent. Java	106362	74870	40689
	Jogyakarta	77564	68791	38918
	East Java	91334	82048	42506
3	Jakarta	379574	321718	144529
	West Java	312746	233990	118577
	Cent. Java	175130	158023	87465
	Jogyakarta	208957	204114	85826
	East Java	221114	177533	88852
4	Jakarta	413779	362717	154664
	West Java	247709	221133	118098
	Cent. Java	204141	168016	91900
	Jogyakarta	242749	201562	97507
	East Java	242229	193261	96025

Table A. 8. Sample Statistics for Explanatory Variables Used in various Models (Cluster 1)

Variable	N	Mean	Std Dev	Min	Max
Children	849	0.527	0.883	0	5
Education	849	1.618	1.112	0	5
Expenditure	849	1.636	1.382	0.224	12.109
Household size	849	4.013	1.986	1	11
West Java	849	0.201	0.401	0	1
Central Java	849	0.224	0.417	0	1
Jogyakarta	849	0.090	0.286	0	1
East Java	849	0.325	0.469	0	1

Table A. 9. Sample Statistics for Explanatory Variables Used in various Models (Cluster 2)

Variable	N	Mean	Std Dev	Min	Max
Children	326	0.113	0.418	0	3
Education	326	0.903	0.946	0	4
Expenditure	326	0.865	0.645	0.116	4.836
Household size	326	2.279	1.305	1	8
West Java	326	0.239	0.427	0	1
Central Java	326	0.282	0.451	0	1
Jogyakarta	326	0.129	0.336	0	1
East Java	326	0.267	0.443	0	1

Table A. 10. Sample Statistics for Explanatory Variables Used in various Models (Cluster 3)

Variable	N	Mean	Std Dev	Min	Max
Children	2379	1.221	1.046	0	6
Education	2379	2.567	1.077	0	5
Expenditure	2379	2.284	2.330	0.282	26.673
Household size	2379	4.673	1.958	1	14
West Java	2379	0.253	0.435	0	1
Central Java	2379	0.169	0.375	0	1
Jogyakarta	2379	0.056	0.230	0	1
East Java	2379	0.228	0.420	0	1

Table A. 11. Sample Statistics for Explanatory Variables Used in various Models (Cluster 4)

Variable	N	Mean	Std Dev	Min	Max
Children	2149	0.912	1.037	0	6
Education	2149	2.424	1.103	0	5
Household size	2149	5.308	1.840	1	13
Expenditure	2149	2.347	1.931	0.196	20.512
West Java	2149	0.213	0.410	0	1
Central Java	2149	0.215	0.411	0	1
Jogyakarta	2149	0.054	0.227	0	1
East Java	2149	0.273	0.446	0	1

Notes: Expenditure is tranformed to rupiah x 10^{-5}

Appendix A. 12. Regression Analyses for all Food, Rice, and Vegetables

Variables	All Food	Rice	Vegetable
Intercept	-0.787 [*] (0.024)	-1.879 [*] (0.033)	-2.230 [*] (0.055)
inverse	-0.059 [*] (0.010)	-0.072 [*] (0.014)	-0.113 [*] (0.024)
expend	0.508 [*] (0.032)	-0.109 [*] (0.044)	0.268 [*] (0.074)
size	0.413 [*] (0.034)	1.025 [*] (0.046)	0.511 [*] (0.078)
inverse2	0.034 (0.021)	0.027 (0.029)	0.094 ^{**} (0.049)
inverse3	0.017 (0.012)	0.050 (0.017)	-0.004 (0.029)
inverse4	0.022 ^{**} (0.012)	0.051 ^{**} (0.017)	0.013 (0.028)
expend2	0.157 ^{**} (0.067)	0.084 (0.092)	0.422 [*] (0.156)
expend3	0.101 [*] (0.037)	0.084 ^{**} (0.050)	-0.031 (0.086)
expend4	0.095 [*] (0.037)	0.083 (0.051)	0.035 (0.087)
size2	-0.121 ^{**} (0.070)	-0.073 (0.096)	-0.515 [*] (0.162)
size3	-0.136 [*] (0.040)	-0.081 (0.054)	0.025 (0.093)
size4	-0.097 ^{**} (0.040)	-0.096 ^{**} (0.055)	-0.011 (0.094)
r2c2	0.215 [*] (0.052)	-0.008 (0.071)	-0.043 (0.120)
r2c3	0.016 (0.027)	-0.037 (0.037)	-0.115 ^{**} (0.062)
r2c4	0.045 (0.028)	-0.053 (0.038)	-0.045 (0.064)
r3c2	0.193 [*] (0.052)	0.002 (0.072)	0.045 (0.122)
r3c3	0.017 (0.028)	0.037 (0.038)	-0.059 (0.065)
r3c4	0.0501 ^{**} (0.028)	0.021 (0.039)	0.019 (0.065)
r4c2	0.211 [*] (0.061)	-0.013 (0.084)	0.180 (0.141)
r4c3	0.020 (0.036)	0.047 (0.049)	-0.126 (0.084)
r4c4	0.081 ^{**} (0.037)	0.059 (0.050)	0.020 (0.085)
r5c2	0.237 [*] (0.052)	-0.059 (0.071)	0.215 ^{**} (0.119)
r5c3	0.053 ^{**} (0.026)	0.071 ^{**} (0.035)	-0.070 (0.059)

(continued)

Appendix A. 12. (continued)

Variables	All Food	Rice	Vegetable
r5c4	0.081 [*] (0.026)	0.032 (0.035)	-0.014 ^{**} (0.060)
West Java	0.034 (0.024)	0.134 [*] (0.033)	-0.136 (0.056)
Central Java	-0.016 (0.024)	-0.057 ^{***} (0.033)	-0.085 (0.056)
Jogyakarta	-0.072 ^{**} (0.030)	-0.193 [*] (0.041)	-0.164 ^{**} (0.070)
East Java	-0.090 [*] (0.022)	-0.121 [*] (0.031)	-0.196 (0.052)
Cluster2	-0.225 [*] (0.049)	0.006 (0.067)	0.039 (0.113)
Cluster3	0.113 [*] (0.029)	-0.167 [*] (0.040)	0.069 (0.068)
Cluster4	-0.011 (0.032)	-0.096 ^{**} (0.043)	-0.040 (0.074)
R ²	0.90	0.73	0.56
F Value	1580.49 [*]	500.72 [*]	228.20 [*]

Standard errors are in parantheses

^{*} Statistically significant at the level of 0.01

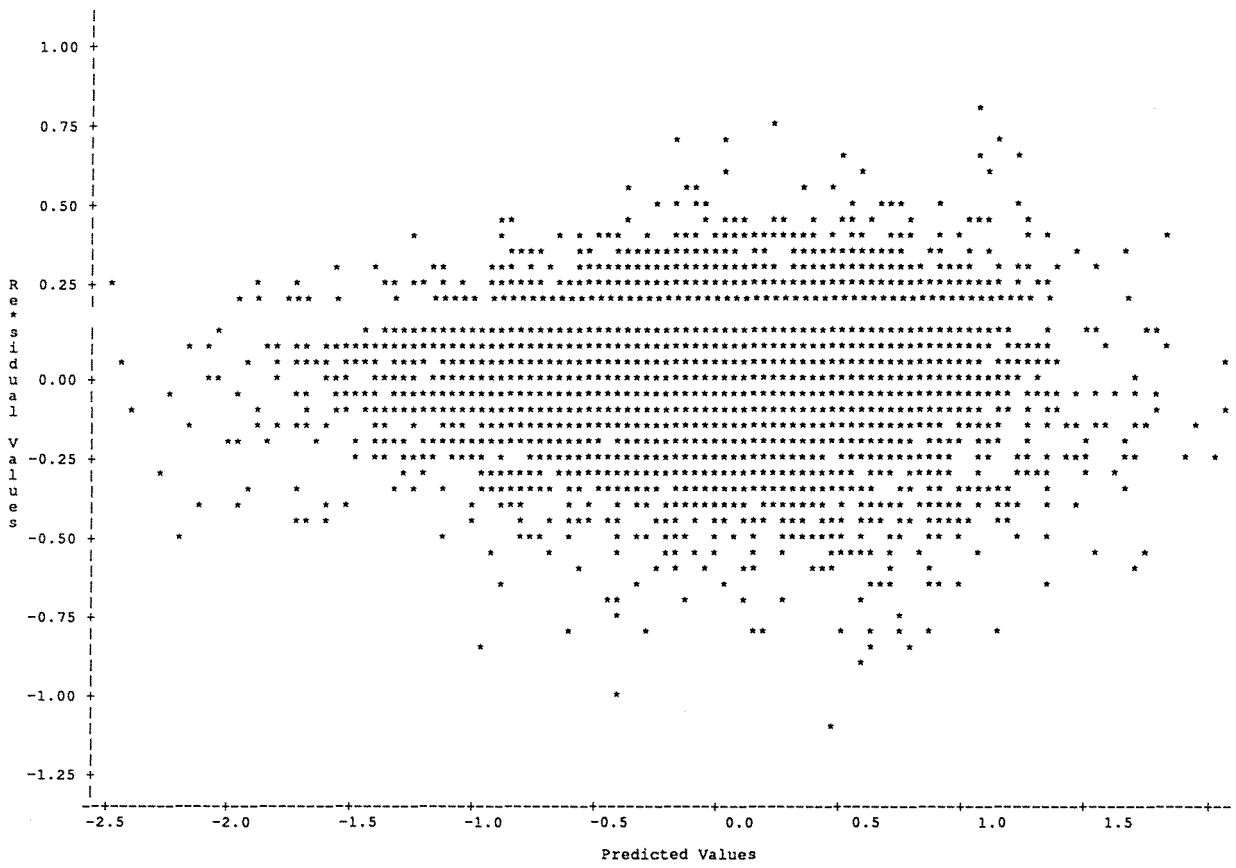
^{**} Statistically significant at the level of 0.05

^{***} Statistically significant at the level of 0.10

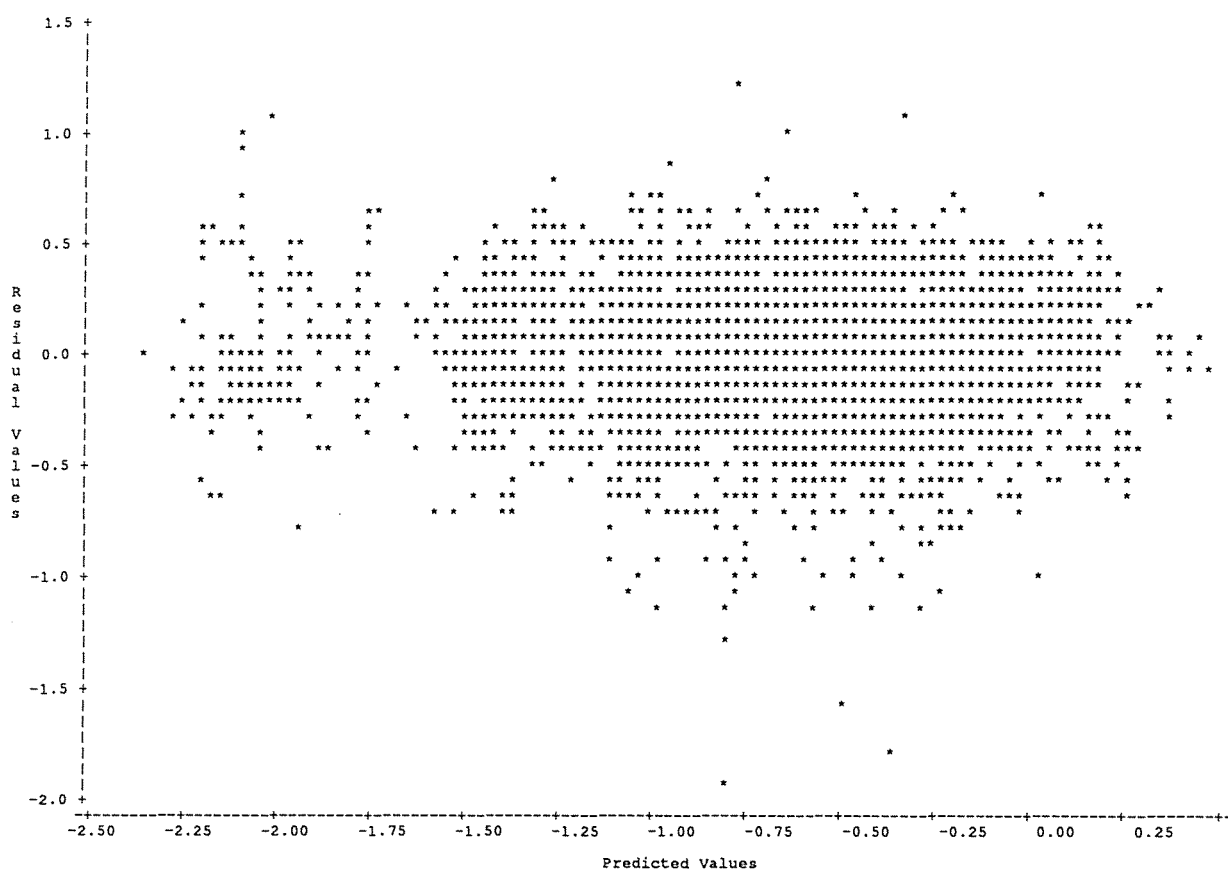
APPENDIX B

Figures

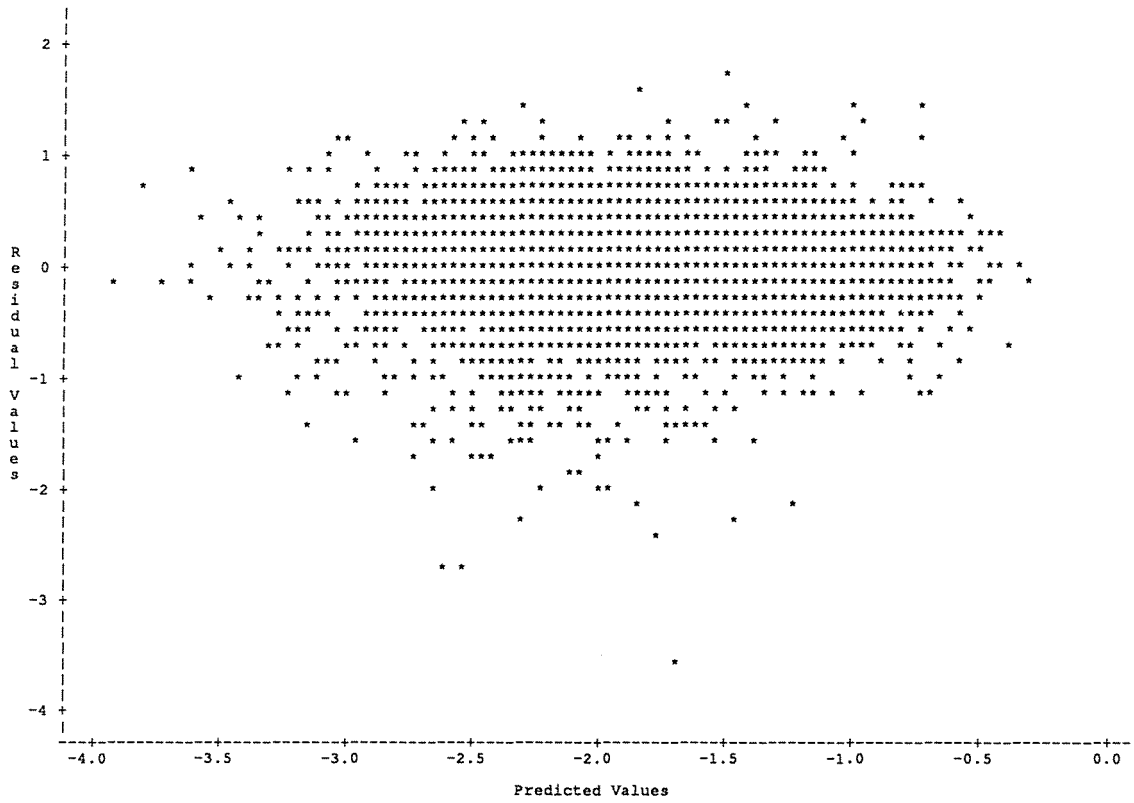
Appendix B.1. Plot of Residuals and Predicted Values of all Food Regression Model



Appendix B. 2. Plot Residual and Predicted Values for Rice Regression Model



Appendix B. 3. Plot Residual and Predicted Values for Vegetables Regression Model



APPENDIX C

Model Development

Appendix C. 1. Heckman and Greene Procedure

Heckman (1976) proposed a procedure of handling zero observation by including inverse Mills ratio (Hazard rate). Inverse Mills ratio is defined as follows:

$\lambda(\alpha) = f(\alpha)/F(\alpha)$, where $f(\alpha)$ is a density function and $F(\alpha)$ is a function of cumulative normal distribution. By applying probit procedure, $f(\alpha)$ and $F(\alpha)$ are obtained and hence $\lambda(\alpha)$ can be calculated.

In the second step, $\lambda(\alpha)$ is included into an original model. The model becomes:

$$Y = x\beta + \delta\lambda(\alpha). \text{ This model is applied to } Y > 0.$$

Greene (1991) also suggests a procedure for handling zero observations. In the first step, compute:

$t(\alpha) = (\lambda(\alpha) - (1 - F(\alpha)))$, where $\lambda(\alpha)$ is defined the same as the $\lambda(\alpha)$ proposed by Heckman. The probit coefficients are used to compute $t(\alpha)$ for every observation in the sample, both nonlimit and limit. In the second step, Y is regressed on X and $t(\alpha)$. Therefore, Greene's model is as follows:

$$Y = \beta'x + \delta t(\alpha).$$

To investigate potential problems with multicollinearity between the explanatory variables and $\lambda(\alpha)$ (Heckman) or $t(\alpha)$ (Greene), these latter variables were used as dependent variables regressed on the set of explanatory variables (X), using cluster 4 data for meat. The results are shown below:

The SAS System
 SYSLIN Procedure
 Ordinary Least Squares Estimation

Model:
 Dependent variable: GREENE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	7	418.473	59.7819	2020.962	0.0001
Error	2141	63.333	0.0296		
C Total	2148	481.806			
Root MSE	0.17199	R-Square	0.8686		
Dep Mean	0.40328	Adj R-SQ	0.8681		
C.V.	42.6486				

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEPT	1	0.0897	0.0194	4.624	0.0001
EDUCATION	1	-0.0865	0.0043	-20.073	0.0001
INVERSE	1	-0.1955	0.0032	-59.930	0.0001
EXPEND	1	0.0611	0.0093	6.557	0.0001
West Java	1	0.0174	0.0116	1.504	0.1328
C Java	1	-0.1770	0.0122	-14.509	0.0001
Jogyakarta	1	0.0360	0.0183	1.972	0.0488
East Java	1	-0.1385	0.0112	-12.329	0.0001

The SAS System
 SYSLIN Procedure
 Ordinary Least Squares Estimation

Model:
 Dependent variable: HECKMAN

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	7	165.17495	23.59642	2369.267	0.0001
Error	1306	13.00695	0.00996		
C Total	1313	178.18190			
Root MSE	0.09980	R-Square	0.9270		
Dep Mean	0.42166	Adj R-SQ	0.9266		
C.V.	23.66777				

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEPT	1	0.511854	0.016736	30.585	0.0001
EDUCATION	1	-0.112382	0.003283	-34.233	0.0001
INVERSE	1	-0.170541	0.003350	-50.905	0.0001
EXPEND	1	0.143575	0.007311	19.638	0.0001
West Java	1	0.030972	0.008339	3.714	0.0002
C Java	1	-0.155563	0.008790	-17.697	0.0001
Jogyakarta	1	0.062232	0.014246	4.368	0.0001
East Java	1	-0.136300	0.007727	-17.641	0.0001

Based on these results, it is clear that the variables $t(\alpha)$ and $\lambda(\alpha)$ are highly collinear with all explanatory variables evidenced by high R^2 values. Inclusion of those variables into a model will violate the assumptions of Ordinary Least Squares. Therefore the Heckman and Greene estimating procedures were abandoned in favour of the Maximum Likelihood Tobit procedure.

Appendix C. 2. Tobit and Probit Models and Expenditure Elasticities for Meat and Milk

In this study, household expenditure on meat and milk was a truncated (or censored) variable; at any level of total household expenditure (and levels of the other explanatory variables), not all households reported expenditure on these commodities. Estimation methods appropriate for truncated data have been widely discussed in the econometric literature (Tobin, 1958; Greene, 1991). In this study it is assumed (after exploration of alternative functional forms) that :

$$E(\ln y) = \beta_0 + \beta_1 x^{-1} + \beta_2 \ln x \quad (1)$$

where y is household expenditure on the commodity of interest and x is total household expenditure on food; and where, for convenience in what follows, the effects of other explanatory variables have been absorbed in the constant term. It is assumed that $\ln y$ follows a normal distribution with homogeneous variance σ^2 . Where values of the dependent variable are truncated, equation (1) is commonly referred to as the latent regression equation : the equation that would explain $E(\ln y)$ if all population members exhibited expenditure on the commodity of interest. Maximum likelihood estimating procedures are readily available for estimating equation (1) given truncated sample data (eg. LIFEREG procedure, SAS/STAT User's Guide, 1988). Following well established convention in the econometrics literature, application of maximum likelihood estimation procedures gives the Tobit line. In what follows, the expected value notation is dropped where appropriate and parameter estimates are not specifically identified.

Model 1

Given an estimate of the Tobit line :

$$E(\ln y) = \beta_0 + \beta_1 x^{-1} + \beta_2 \ln x$$

then define :

$$\alpha = \frac{(\beta_0 + \beta_1 x^{-1} + \beta_2 \ln x) - a}{\sigma}$$

$$= \frac{E(\ln y) - a}{\sigma}$$

where $a = \min(\ln y > 0)$

Then, for any setting of the explanatory variable x ,

$$\begin{aligned} \text{Prob}(\ln y > a) &= F(\alpha) \\ &= \int_{-\infty}^{\alpha} f(z) dz \end{aligned}$$

where $F(\cdot)$ is the cumulative Normal distribution function and $f(z)$ is the standard Normal density function.

In this model the sample values for $\ln y$ are assumed to be truncated at some value 'a', which is in turn assumed to be fixed, i.e. independent of the explanatory variables.

Denote the observed values of the dependent variable as $\ln \bar{y}$. Then

$$\ln \bar{y} = \ln y \quad \text{when } \ln y > a$$

$$\ln \bar{y} = 0 \quad \text{when } \ln y \leq a$$

Depending on the objectives of the study, interest might focus on any of the expected values :

$$E(\ln y)$$

$$E(\ln \bar{y} > a)$$

$$E(\ln \bar{y}) = E(\ln y^*)$$

$E(\ln y^*)$ is the average of those $\ln y > a$ and those $\ln y = 0$. We will denote $E(\ln \bar{y} > a)$ as $E(\ln \bar{y})$.

Now,

$$E(\ln \bar{y}) = E(\ln y) + \sigma \lambda(\alpha)$$

$$\text{where } \lambda(\alpha) = \frac{f(\alpha)}{F(\alpha)}$$

and,

$$\begin{aligned} E(\ln y^*) &= F(\alpha) E(\ln \bar{y}) \\ &= F(\alpha) [E(\ln y) + \sigma \lambda(\alpha)] \end{aligned}$$

In this study, the primary focus is on estimating expenditure elasticities for different food commodities for the population represented by the sample

data. Accordingly the focus is on $E(\ln y^*)$, and the corresponding expenditure elasticity:

$$Ey^* = \frac{dy^*}{dx} \cdot \frac{x}{y^*}$$

$$\text{Since, } \frac{d \ln y^*}{dy^*} = \frac{1}{y^*}$$

$$\begin{aligned} \frac{dy^*}{dx} &= \frac{dy^*}{d \ln y^*} \cdot \frac{d \ln y^*}{dx} \\ &= y^* \frac{d \ln y^*}{dx} \end{aligned}$$

we have :

$$Ey = x \frac{d \ln y^*}{dx}$$

Following McDonald and Moffitt (1980), write

$$\ln y^* = F(\alpha) Y \text{ where } Y = \ln y + \sigma \lambda(\alpha)$$

then ,

$$\frac{d \ln y^*}{dx} = F(\alpha) \frac{dY}{dx} + Y \frac{dF(\alpha)}{dx}$$

The term $Y \frac{dF(\alpha)}{dx}$ is the change in the probability of $\ln y$ being above

the limit (a) relative to a change in x , weighted by the expected (predicted) value of $\ln y$ above the limit at the value of x .

The term $F(\alpha) \frac{dY}{dx}$ is the change in the expected value of $\ln y > a$

relative to a change in x , weighed by the probability of $\ln y$ being above the limit.

As McDonald and Moffitt point out, this decomposition makes it clear that for truncated variables, two things happen as the values of the explanatory variables change : those already consuming the product will

change their level of expenditure on the product , and the proportion of the population consuming the product will also change.

Now, given that for Model 1 the limit value 'a' is assumed fixed, we have:

$$\begin{aligned}\frac{d F(\alpha)}{dx} &= f(\alpha) \frac{d\alpha}{dx} \\ &= f(\alpha) B \sigma^{-1}\end{aligned}$$

where $B = [-\beta_1 x^{-2} + \beta_2 x^{-1}]$

Therefore,

$$Y \frac{d F(\alpha)}{dx} = [\ln y + \sigma \lambda (\alpha)] f(\alpha) B \sigma^{-1} \quad (2)$$

$$\begin{aligned}\text{Now, } \frac{dY}{dx} &= \frac{d}{dx} [\ln y + \sigma \lambda (\alpha)] \\ &= \frac{d}{dx} \left[\ln y + \sigma \frac{f(\alpha)}{F(\alpha)} \right] \\ &= B + \sigma \frac{d}{dx} \left[\frac{f(\alpha)}{F(\alpha)} \right]\end{aligned}$$

where $f(\alpha) = (2\pi)^{-1/2} e^{-q}$, and $q = (\alpha^2)/2$

$$\frac{d}{dx} \left[\frac{f(\alpha)}{F(\alpha)} \right] = \frac{F(\alpha) \frac{d f(\alpha)}{dx} - f(\alpha) \frac{d F(\alpha)}{dx}}{F(\alpha)^2}$$

$$\frac{d f(\alpha)}{dx} = \frac{d f(\alpha)}{dq} \cdot \frac{dq}{d\alpha} \cdot \frac{d\alpha}{dx}$$

$$\frac{d f(\alpha)}{dq} = - f(\alpha)$$

$$\frac{dq}{d(\alpha)} = \alpha$$

$$\frac{d\alpha}{dx} = B \sigma^{-1}$$

Thus,

$$\frac{d f(\alpha)}{dx} = - f(\alpha) \alpha B \sigma^{-1}$$

Making the necessary substitutions, we have :

$$F(\alpha) \frac{dY}{dx} = F(\alpha) B - f(\alpha) B [\alpha + \lambda(\alpha)] \quad (3)$$

Combining equations (2) and (3) we obtain :

$$\begin{aligned} \frac{d \ln y^*}{dx} &= F(\alpha) \frac{dY}{dx} + Y \frac{d F(\alpha)}{dx} \\ &= F(\alpha) B + f(\alpha) B [\ln y \sigma^{-1} - \alpha] \end{aligned}$$

$$\text{Since, } \alpha = \frac{\ln y - a}{\sigma}$$

$$\ln y \sigma^{-1} - \alpha = a \sigma^{-1}, \text{ hence}$$

$$\frac{d \ln y^*}{dx} = B [F(\alpha) + f(\alpha) a \sigma^{-1}]$$

$$\frac{dy^*}{dx} \text{ (MPC)} = y^* \frac{d \ln y^*}{dx}$$

$$y^* = e^{[F(\alpha) (\ln y + \sigma \lambda(\alpha))]}$$

$$E y^* = x B [F(\alpha) + f(\alpha) a \sigma^{-1}]$$

$$\text{where } xB = [-\beta_1 x^{-1} + \beta_2]$$

The Tobit Maximum Likelihood procedure estimates $\ln y$ and σ , hence B , and α (hence, $F(\alpha)$ and $f(\alpha)$). The limit value a is assumed known; but $\min(\ln y > 0)$ could reasonably be used.

Model 2

Model 2 allows the limit value 'a' for $\ln y > 0$ to vary as a function of the explanatory variables. Maximum Likelihood estimates are obtained for the Probit function (Logistic Procedure, SAS Technical Report P200, 1988) :

$$\alpha = \gamma_0 + \gamma_1 x^{-1} + \gamma_2 \ln x$$

where, as before, other explanatory variables used are suppressed for the purpose of the following discussion. It follows that :

$$a = (\beta_0 + \beta_1 x^{-1} + \beta_2 \ln x) - \sigma (\gamma_0 + \gamma_1 x^{-1} + \gamma_2 \ln x)$$

If $\beta_1 = \sigma \gamma_1$ and $\beta_2 = \sigma \gamma_2$, then $a = \beta_0 - \sigma \lambda_0$ is constant, otherwise the limit value 'a' varies as a function of the explanatory variables. [A test of significance for this null and alternative hypothesis is suggested later in this Appendix]. Also, see Appendix C.3 for a comparison between the Tobit and Probit estimates.

In what follows, we assume that the limit value 'a' is not constant. As before, we are interested in evaluating :

$$\frac{d \ln y^*}{dx} = F(\alpha) \frac{dY}{dx} + Y \frac{d F(\alpha)}{dx}$$

Now,

$$\frac{d\alpha}{dx} = A, \text{ where } A = [-\gamma_1 x^{-2} + \gamma_1 x^{-1}]$$

$$\frac{d F(\alpha)}{dx} = f(\alpha) A, \text{ hence}$$

$$Y \frac{d F(\alpha)}{dx} = f(\alpha) A [\ln y + \sigma \lambda(\alpha)] \quad (4)$$

Now,
$$\frac{d f(\alpha)}{dx} = - f(\alpha) \alpha A$$

$$\frac{d}{dx} \left[\frac{f(\alpha)}{F(\alpha)} \right] = \frac{- F(\alpha) f(\alpha) \alpha A - f(\alpha)^2 A}{F(\alpha)^2}$$

$$\begin{aligned} \frac{dY}{dx} &= \frac{d \ln y}{dx} + \sigma \frac{d}{dx} \left[\frac{f(\alpha)}{F(\alpha)} \right] \\ F(\alpha) \frac{dY}{dx} &= F(\alpha) B - \frac{\sigma A f(\alpha) [F(\alpha)\alpha + f(\alpha)]}{F(\alpha)} \\ F(\alpha) \frac{dY}{dx} &= F(\alpha) B - \sigma f(\alpha) A [\alpha + \lambda(\alpha)] \end{aligned} \quad (5)$$

Combining equations (4) and (5), we obtain :

$$\frac{d \ln y^*}{dx} = F(\alpha) B + f(\alpha) A [\ln y - \alpha \sigma] \quad (6)$$

If the limit 'a' is constant, then $A\sigma = B$, and equation (6) becomes :

$$\frac{d \ln y^*}{dx} = F(\alpha) B + f(\alpha) B [\ln y \sigma^{-1} - \alpha]$$

which is the result obtained for Model 1.

Using the expression for $\frac{d \ln y^*}{dx}$ given in equation (6), for Model 2 we

have :

$$\frac{dy^*}{dx} \text{ (MPC)} = y^* \frac{d \ln y^*}{dx}$$

$$y^* = e^{[F(\alpha) (\ln y + \sigma \lambda(\alpha))]}$$

$$E y^* = x [F(\alpha) B + f(\alpha) A (\ln y - \alpha \sigma)]$$

where $\ln y$ and σ are the Tobit Maximum Likelihood estimates and α (and hence A) are the Probit Maximum Likelihood estimates.

Relationships Between Elasticities

As mentioned earlier, truncated regression analysis produces three estimates of potential interest :

- (i) $\ln y$, the latent regression which would hold if all members of the population were above the limit;
- (ii) $\ln y$, the regression that holds for those members of the population that are above the limit; and
- (iii) $\ln y^*$, the regression that holds for the average of the population; those both above and below the limit.

Clearly it is possible to compute elasticities for each of these functions. This section examines the relationship between these elasticities. Model 2 is used for this purpose, since the results for Model 1 can then be simply obtained.

We have :

$$\ln y^* = F(\alpha) \ln \bar{y}$$

$$\ln y = \ln y + \sigma \lambda(\alpha)$$

$$\frac{d \ln y^*}{dx} = F(\alpha) \frac{d \ln \bar{y}}{dx} + \ln y \frac{d F(\alpha)}{dx}$$

$$\frac{d \ln \bar{y}}{dx} = \frac{d \ln y}{dx} + \sigma \frac{d \lambda(\alpha)}{dx}$$

From earlier results we have :

$$\frac{d \ln y}{dx} = B$$

$$\frac{d F(\alpha)}{dx} = f(\alpha) A$$

$$\frac{d \lambda(\alpha)}{dx} = \frac{d}{dx} \left[\frac{f(\alpha)}{F(\alpha)} \right]$$

$$\begin{aligned}
&= \frac{-F(\alpha) f(\alpha) \alpha A - f(\alpha)^2 A}{F(\alpha)^2} \\
&= -\lambda(\alpha) \alpha A - \lambda(\alpha)^2 A \\
&= -A \lambda(\alpha) [\alpha + \lambda(\alpha)]
\end{aligned}$$

Denote,

$$\begin{aligned}
x \frac{d \ln y^*}{dx} &= E_{ALL} \\
x \frac{d \ln y}{dx} &= E_{>0} \\
x \frac{d \ln y}{dx} &= E_{LATENT}
\end{aligned}$$

We have, from the above,

$$E_{ALL} = F(\alpha) E_{>0} + x f(\alpha) A [\ln y + \sigma \lambda(\alpha)]$$

For the models estimated in this thesis,

$$xA = [-\gamma_1 x^{-1} + \gamma_2] > 0.$$

Also, $f(\alpha) > 0$, $\ln y > 0$, $\sigma > 0$ and $\lambda(\alpha) > 0$. Hence

$$E_{ALL} = F(\alpha) E_{>0} + K_1 \text{ where } K_1 > 0$$

Since, $0 \leq F(\alpha) \leq 1$, $E_{ALL} >$ or $< E_{>0}$ depending on the relative values for $F(\alpha)$ and K_1 .

As $F(\alpha) \rightarrow 1.0$, $f(\alpha) \rightarrow 0$, hence as $\text{prob} [\ln y > a] \rightarrow 1.0$,

$E_{ALL} \rightarrow E_{>0}$, as would be expected.

$$\begin{aligned}
\text{Now, } E_{>0} &= E_L + x \sigma \frac{d \lambda(\alpha)}{dx} \\
&= E_L - [x \sigma A \lambda(\alpha) (\alpha + \lambda(\alpha))]
\end{aligned}$$

The term $(\alpha + \lambda(\alpha)) > 0$, (Greene (1990)). Hence, for the models estimated in this thesis, $E_{>0} < E_L$. Again, as $F(\alpha) \rightarrow 1.0$, $\lambda(\alpha) \rightarrow 0$, hence $E_{>0} \rightarrow E_L$, as expected.

$$\begin{aligned}
 \text{Now, } \frac{d \ln y^*}{dx} &= F(\alpha) \frac{d \ln \bar{y}}{dx} + \ln \bar{y} \frac{d F(\alpha)}{dx} \\
 &= F(\alpha) \left[\frac{d \ln y}{dx} + \sigma \frac{d \lambda(\alpha)}{dx} \right] + [\ln y + \sigma \lambda(\alpha)] \frac{d F(\alpha)}{dx} \\
 &= F(\alpha) \frac{d \ln y}{dx} + A f(\alpha) [\ln y - \sigma \alpha]
 \end{aligned}$$

Now, for Model 2,

$$\begin{aligned}
 a &= (\beta_0 + \beta_1 x^{-1} + \beta_2 \ln x) - \sigma (\gamma_0 + \gamma_1 x^{-1} + \gamma_2 \ln x) \\
 &= \ln y - \sigma \alpha
 \end{aligned}$$

Although for small values of x , $\ln y < 0$, we also have $\alpha < 0$ for small values of x (prob $\ln y > a$ is small) and in this thesis $(\ln y - \sigma \alpha) > 0$. Hence

$$E_{ALL} = F(\alpha) E_L + K_2$$

Thus, $E_{ALL} > \text{or} < E_L$, depending on the relative values of $F(\alpha)$ and K_2 , where

$$K_2 = x A f(\alpha) [\ln y - \sigma \alpha]$$

Again, as $F(\alpha) \rightarrow 1$, $f(\alpha) \rightarrow 0$ and $E_{ALL} \rightarrow E_L$ as expected.

To summarise for Model 2

$$E_{ALL} > \text{or} < E_{>0} < E_L$$

$$\text{and } E_{ALL} > \text{or} < E_L$$

In many studies it is reasonable to assume that the limit value of 'a' is zero. In this case the results for Model 1 become :

$$\begin{array}{ll}
 \frac{d \ln y^*}{dx} &= F(\alpha) B & E_{ALL} &= x F(\alpha) B \\
 \frac{d \ln \bar{y}}{dx} &= B (1 - K) & E_{>0} &= x B (1-K) \\
 \frac{d \ln y}{dx} &= B & E_L &= x B
 \end{array}$$

where $K = \lambda(\alpha) [\alpha + \lambda(\alpha)]$, and $0 \leq (1 - K) \leq 1$ (Greene, 1990)

Test of Significance for 'a' Constant

For Model 2, the value for 'a' is computed for each sample value as :

$$a = (\beta_0 + \beta_1 x^{-1} + \beta_2 \ln x) - \sigma (\gamma_0 + \gamma_1 x^{-1} + \gamma_2 \ln x) \\ = \ln y - \sigma \alpha$$

where $\ln y$ and σ are Tobit Maximum Likelihood estimators and α is the Probit Maximum Likelihood estimator. The regression :

$$a = \alpha_0 + \alpha_1 x^{-1} + \alpha_2 \ln x$$

therefore gives a perfect fit for the computed 'a' values. If the coefficients $\alpha_1 = \alpha_2 = 0$, then \bar{a} (the sample mean) should be close to the value : $\beta_0 = \sigma \lambda_0$. We should be able to test this Null Hypothesis using the t-test where,

$$t = \frac{\bar{a} - (\beta_0 - \sigma \gamma_0)}{se(\bar{a})}$$

$$\text{where } var(a) = \frac{\sum(a_i - \bar{a})^2}{n - 1}$$

$$\text{and } se(\bar{a}) = \left[\frac{var(a)}{n} \right]^{1/2}$$

Perhaps the degrees of freedom used should reflect the number of parameters estimated by the Tobit and Probit equations, but in this study the sample t-statistic values clearly indicate that the Null Hypothesis should be rejected in all cases, and hence Model 2 is more appropriate for this study than Model 1 (i.e. the limit value 'a' depends on the values for the explanatory variables and is not constant).

Table C. 1. T-statistics to Test Whether 'a' is Constant

Cluster	Meat	Milk
Cluster 1	12.7 ^{a1}	-22.4 ^{a2}
Cluster 2	-14.8 ^{b1}	-7.5 ^{b2}
Cluster 3	-73.2 ^{c1}	-103.3 ^{c2}
Cluster 4	-98.0 ^{d1}	-116.8 ^{d2}

notes : ^{a1} df=848, ^{b1} df=324, ^{c1} df=2376 and ^{d1} df=2148
^{a2} df=848, ^{b2} df=324, ^{c2} df=2377 and ^{d2} df=2149

All parameters are statistically significant at the level 1 percent.

Appendix C. 3. The Relationship between Parameters from Probit(γ) and from Tobit (β/σ) for Meat Regression

Cluster	Parameters	Gamma= β/σ (Tobit)	Gamma (Probit)
1	Education	0.1498	0.2144
	Inverse	-0.2319	-0.2343
	Expenditure	0.6304	0.6881
	West Java	0.0562	-0.0246
	Central Java	0.0963	0.0344
	Jogyakarta	0.4358	0.4911
	East Java	0.2244	0.2417
2	Education	0.1852	0.2454
	Inverse	-0.2123	-0.2233
	Expenditure	1.0162	1.1137
	West Java	0.5532	0.5806
	Central Java	0.5711	0.6194
	Jogyakarta	1.0978	1.2564
	East Java	0.7156	0.8320
3	Education	0.1663	0.2101
	Inverse	-0.1933	-0.1713
	Expenditure	0.5334	0.7035
	West Java	-0.1340	-0.1864
	Central Java	0.1029	0.1022
	Jogyakarta	0.0049	0.0289
	East Java	0.1047	0.1296
4	Education	0.2079	0.0918
	Inverse	-0.2941	-0.2744
	Expenditure	0.4484	0.6066
	West Java	-0.0044	-0.0495
	Central Java	0.3647	0.4094
	Jogyakarta	0.0478	0.0195
	East Java	0.2690	0.3318

Appendix C. 4. The Relationship between Parameters from Probit(γ) and from Tobit (β/σ) for Milk Regression

Cluster	Parameters	Gamma= β/σ (Tobit)	Gamma (Probit)
1	Education	0.1207	0.1318
	Children	0.2578	0.2889
	Inverse	-0.3275	-0.3472
	Expenditure	0.3719	0.3934
	West Java		
	Central Java		
	Jogyakarta		
	East Java		
2	Education	0.2247	0.2524
	Children	0.0846	0.0752
	Inverse	-0.3855	-0.3779
	Expenditure	0.4877	0.5296
	West Java		
	Central Java		
	Jogyakarta		
	East Java		
3	Education	0.1796	0.1975
	Children	0.3043	0.3499
	Inverse	-0.3910	-0.4048
	Expenditure	0.2703	0.3466
	West Java	0.0724	0.1145
	Central Java	0.2018	0.2508
	Jogyakarta	0.2551	0.3156
	East Java	0.0605	-0.0314
4	Education	0.1861	0.1949
	Children	0.2197	0.2301
	Inverse	-0.2804	-0.2742
	Expenditure	0.4448	0.5385
	West Java	0.1627	0.2069
	Central Java	0.0627	0.0849
	Jogyakarta	0.2177	0.3072
	East Java	0.0062	0.0023