Evaluating Food Policy in Indonesia Using Full Demand Systems

Final Report

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Executive Summary

Food price policy, for rice in particular, has played a central role in the development strategy for agriculture in Indonesia. Government food pricing policies change relative prices and affect the overall economy through direct and indirect influences on production, employment of resources, income, consumption, and external trade. The 1980 multipurpose household survey (SURGASAR) provided data on consumer expenditure patterns in Indonesia. These data were used to describe and analyze food consumption patterns and nutritional status. Parameter estimates from full demand systems were used to analyze food consumption and nutritional impacts of food pricing policies.

The analysis of household food expenditure and consumption patterns confirmed several features of the average Indonesian diet. First, food as a group constituted a major component of the average household budget. Households with low income and those living outside of urban areas allocated larger shares of their budgets to food. Ranked by budget shares, rice was the dominant food for all income classes. In addition to rice, corn, cassava, and fish were prominent in the Indonesian diet. Corn and cassava were relatively more important in the diets of low income and rural households.

The level and structure of the average household diet are reflected in the supply of nutrients. Lower levels of rice and fish consumption among households in low income groups and in urban areas, for example, were associated with calorie and protein deficiencies. Income, household size and place of residence were identified as the major factors affecting variations in dietary and nutritional status.

Food consumption parameters were estimated from full demand systems. Thus, the estimated parameters reflect an assumed structure for consumer demand and the survey data. Of the empirical demand systems examined, the Almost Ideal Demand System (AIDS) was highlighted in the policy analysis. For seven food groups and rural and urban households, the estimated demand coefficients showed food budget shares to be responsive to composite food prices, income, and household size. The food budget shares were strongly responsive, in particular, to their own prices and real per capita food expenditure. The uncompensated own price elasticities were negative for all the seven food groups. For most of the commodities, values of these price elasticities were less than unity. Rice consumption was least responsive to changed own price. Among the cross price effects, the rice price had the most significant influence on the food budget shares. The estimated cross price elasticities showed quantitatively how food consumption responded to changes in prices of related commodities. The estimated food expenditure elasticities were less than unity for the staple crops (rice and palawija crops), yet greater than one for beans, fruits and vegetables, fish and meats, and dairy products. Household size elasticities were positive for staple crops and negative for the other foods.

Dietary choices have important nutritional implications for households even though the food supply is not highly varied. The household level availability of nutrients was analyzed using an empirical model reflecting the interdependencies between expenditures on foods and nutritional status. This analysis was motivated, albeit loosely, by a household production hypothesis, indicating that the food expenditure is linked to nutrient availability by a set of variables reflecting household efficiency and the opportunity cost of time.

The five nutrients or food components analyzed were calories, protein, iron, vitamin A, and thiamine. In each case, income had a positive effect on household nutrient availability. Household size had a large positive impact on the availability level. There were also differences reflecting place of residence. The estimated price elasticities suggested that nutrient demands were responsive to food commodity prices. There is no clear a priori basis for predicting the signs of the nutrient demand elasticities. Food expenditure and household size elasticities were positive for all of the nutrients and food components.

Policy implications of these estimated structural relationships are broad. First, the estimates of the structure of consumer demand and food consumption-nutrition linkages can be used for similar descriptive analyses. Second, the complete systems estimates provide an opportunity for developing more realistic and comprehensive policy models. Consumer demand parameters are key components of most models used for consumption, nutrition, and agricultural price policy analyses. The specific policy exercise used to illustrate the value of the estimated demand system was to change rice prices, a major policy variable for agriculture, consumption, and income redistribution in Indonesia.

Table of Contents

Executive Summary i

Chapter 1. Introduction 1

Major Food and Rice Policy Problem
Patterns and Trends of Production and Consumption
Price Stabilization and Subsidy Policies
Critical Parameters for Assessing Policy Impacts
Objectives of the Study
Organization of the Study

Chapter 2. The Data and Definition of Variables 17

Data Source
Food Groups
Budget Shares
Conversions to Nutrients
Socioeconomic Variables

Chapter 3. Food Expenditure, Consumption, and Nutrient Availability 33

Household Food Expenditure Patterns
Household Food Consumption and Availability of Nutrients
A Profile of Households Below Minimum Calorie Requirements

Chapter 4. Food Demand and the AIDS 68

Empirical Model
Engel Curves
Food Demand System
Evaluation

Chapter 5. Food Cost and Nutrient Availability. 93

Model Specification and Estimation
Results
Evaluation

Chapter 6. Conclusions and Policy Implications. 107

Appendix A: Studies on Food Consumption and Nutrient Availability in Indonesia

Appendix B: Earlier Food Demand Studies for Indonesia

Appendix C: Consumer Demand Theory--A Review

Appendix D: Food Demand and the Multinomial Linear Logit Model--Indonesia

Appendix E: A Local Stochastic Approximation to Indonesian Food Demand Patterns

CHAPTER 1

INTRODUCTION

Food price policy, for rice in particular, plays a central role in Indonesian development strategy for agriculture. The government's rice pricing policy has a dual role: to provide an incentive for producers to increase production and to moderate consumer demand. The pricing scheme and its implementation have important consequences for Indonesia, especially as extended in recent years to other staple or secondary food crops. Relative food prices impact the economy through their direct or indirect influence on production, employment of resources and income, consumption and external trade. This report provides food demand parameter estimates for Indonesia and an analysis of policy impacts on food consumption and nutrition status.

Major Food and Rice Policy Problem

A major policy issue for Indonesia is the general move toward a phasing out of subsidies for major food commodities. At the same time, changing domestic and international rice market conditions and currency revaluations have affected the price of rice in Indonesia. Presently, subsidies are in place for wheat and rice. Fertilizer subsidies are also used to offset the production disincentive effects of the rice subsidy to consumers. However, the agricultural sector in Indonesia can and does produce numerous other food commodities. These food commodities are potentially important for the diet of the Indonesian population. In phasing out the subsidies on rice and wheat, the government is responding to the budget constraints and, as well, the importance of moving to a more diversified agriculture and food consumption base.

There are two important questions related to decisions for changing the subsidization of rice, wheat and fertilizer. First, it is important to identify the impacts of these changes in government policy on production and consumption behavior. Clearly, the method of implementing the policies will condition these production and consumption impacts. In addition, it is necessary to anticipate the incidence of the policy effects on the agriculture of Indonesia and on the consumption and nutrition status of the Indonesian population. Second, there is the question of the government cost of alternative phase-out policies. These government costs will be determined to a large extent by world market prices for rice, wheat and other food items. Thus, in implementing the policies, it is critical that the government of Indonesia evaluate their consequences conditioned on outcomes of world markets for these major agricultural commodities.

Patterns and Trends of Production and Consumption

The value added in Indonesian agriculture originates primarily from the production of crops. Food and nonfood crops contributed not less than three-fourths of the value added in the 1970s. The other subsectors, i.e., forestry and livestock and fishery, each contributed, on average, 10 percent respectively.

The food crops include wetland and dryland rice, corn, cassava, sweet potatoes, soybeans and peanuts. Rice is the main food crop. Over 50 percent of the contribution of food crops to the value added in agriculture is from the production of rice (Table 1.1). Cassava and corn are two other food crops that have a significant contribution to agricultural output. The nonfood crops include coconuts, rubber, coffee, tobacco, spices and palm (oil and kernels). These nonfood crops contribute

about 20 percent of the value added in agriculture. Based on 1977/80 production data (Statistical Yearbook), the nonfood crops in order of contribution to value added in agriculture were coconuts, rubber, coffee, and sugar cane.

Despite the multiplicity of other crops, rice remains dominant in Indonesian agriculture. Since 1968, rice production has progressed in three phases (Table 1.2). Between 1968 and 1971, the annual rate of growth in rice production was 5.5 percent. This period marked both the widespread adoption of chemical and biological technology and the beginning of a restructured BIMAS intensification program. The growth rate averaged 4.7 percent per annum in the period of 1972 to 1976. The slow growth in this period has been associated with long droughts and the population explosion of brown hoppers. Since 1977, production has grown at an annual rate of 8.7 percent. The rapid increase in production in the late 1970s and early 1980s is related to the effective realization of the Indonesian official motto for good cultivation: use of fertilizers, use of good seeds, better water management, better plant protection, and use of better cultivation methods.

The rising trend in rice production reflects the growth in both yield and area harvested. During the period between 1968 and 1981, the area harvested and yield grew at annual rates of 1.1 and 3.2 percent, respectively. That is, 75 percent of the growth in production was associated with an increase in yield and the remainder with the area harvested.

While the yields of other food crops have also increased, the areas harvested for several of these food crops have declined. The changing patterns of production have been much influenced by government programs for

producers. During the last five-year plan when emphasis was shifted from rice production to broader food production programs, the area planted to other food crops responded.

The average diet of an average Indonesian includes rice, regardless of residential location. But, according to Table 1.3, the average diet in rural Indonesia is more diversified--rice is combined with other secondary food crops (corn, cassava, sweet potatoes). In contrast, for the urban population, dietary habits are more centered on rice consumption and secondary crops are less important.

Food consumption patterns are similar in Java and off-Java. First, rice dominates as the staple, even though per capita rice consumption among the urban population is higher (albeit small) than for the rural population in Java. The opposite is true off of Java. Second, the other food crops constitute a significant share of the average diet in rural areas of both regions. It seems that these crops are, in fact, more prominent than rice in some of off-Java islands (e.g., Sagu in Mollucca). Finally, the urban populations in both regions have a mono-staple diet, rice.

Price Stabilization and Subsidy Policies

Rice was the first food crop for which the government intervened in Indonesia. Beginning in 1970, a policy was introduced to set floor and ceiling prices for rice. The floor price was to be set high enough to stimulate domestic production and improve farm income. The ceiling price, on the other hand, was to provide a price subsidy to the consumers, and, as evidenced in the late 1970s, to contain the rate of inflation.

Presently, the floor price is determined on the basis of an incremental benefit-cost ratio that results from participation in the BIMAS program.

The government sets the floor price such that the magnitude of the benefit-cost ratio is sufficient to induce farmers to join the intensification program and increase rice production. The floor price is adjusted each year to reflect changes in the economic environment.

The concept of ceiling price has changed over the years. In the early 1970s, ceiling prices for deficit and surplus regions were set with a sufficient margin to attract private traders and millers. Since the late 1970s, ceiling prices have been used as a means to control the rate of inflation. A bundle of rice types, identified in the cost of living index, is used in setting ceiling prices using as a guideline an upper bound on the annual inflation rate.

As can be noted from Table 1.4, the levels of floor and ceiling prices have increased over time. The nominal floor price for milled rice has increased from Rp 37/kg in the early 1970s to Rp 195/kg in 1981/82, an average growth rate of 14.9 percent per annum. The ceiling price has also increased but by a slower rate of 13.0 percent per annum. While the floor price was raised annually to stimulate the participation of farmers in the BIMAS program, the ceiling price was raised more slowly. This pattern is more evident in the price margin over the years. The price spread has declined from a peak of 46 percent in 1974/75 to 15.4 percent in 1981/82. Between 1975 and 1982, the price spread was less than 20 percent in all the years except in 1975 and 1980/81.

A comparison of the Indonesian retail prices with import parity prices of rice (Table 1.5) shows that the latter were higher for most of the 1970s and early 1980s. The only years in which Indonesian prices exceeded the world prices were 1973, 1976, 1977, and 1982. Since the devaluation of the Rupiah in 1983, the domestic price has again been held below the border

price. This suggests that rice for consumption in Indonesia has been priced below its opportunity cost as measured by its border prices. This pricing policy has put a burden on the budget of government of Indonesia.

The village unit cooperatives (KUD) and the Agency of Logistics (BULOG) are charged with the implementation of the floor price policy. If the local free market price of rice falls below the specified floor price, the KUDs buy the rice sold by the farmers at the floor price less a quality discount. BULOG pays the floor price plus commission to the KUDs procuring the rice. The role of private traders and millers has diminished over time as the KUD units have expanded in implementing in the price support program and as the government has withdrawn subsidized credit and favorable commissions from the private sector.

To maintain the ceiling price, BULOG is required to release supplies onto the market as long as the rice market price exceeds the ceiling price. The market operations (i.e., the injection of rice from the national stocks into the market) are carried out by BULOG's distribution centers (DULOGS) throughout the country.

Based on the experience in the rice sector, a floor price for corn was implemented in 1978 in East Java, the main producing area in Indonesia. The level of the floor price was determined on the basis of an incremental benefit-cost ratio with the constraint that the price of corn should not exceed half the price of rice. Beginning in 1979, the floor price was implemented throughout the country, while at the same time floor prices for soybeans and peanuts were also established. The floor prices of soybeans and peanuts are generally below the prevailing free market prices. The

mechanisms for the implementation of these policies are the same as for rice.

Input prices controlled by the government are for fertilizers and pesticides. Various types of fertilizers are used, but urea and TSP account for about 90 percent of all fertilizers applied. Domestic fertilizer prices were well below both the import parity prices and domestic costs of production and distribution. In 1982 for instance, the estimated domestic price for urea was Rp 90/kg compared to the import parity price of Rp 160/kg. For TSP, the official price of Rp 90/kg was also lower than the import parity price of Rp 171/kg.

In response to such favorable relative prices, the use of fertilizers has increased steadily in the 1970s at an annual rate of 15 percent. The use of urea, in particular, has increased at the annual rate of 14.4 percent in Java and 15 percent in Indonesia as a whole. Because of the regional concentration of the BIMAS program, most of the fertilizer consumption has been on wetland paddy fields in Java.

Pesticides are also heavily subsidized by the government. As for fertilizers, the farmers can buy various types of recommended pesticides at a relatively low fixed price. This subsidy is designed to induce farmers to apply sufficient amounts in food crop production.

Critical Parameters for Assessing Policy Impacts

What are the key variables policy analysts and the Government of Indonesia use in assessing the trade-offs of policy options for consumption and nutrition? As rice is important to the diets of Indonesians, phasing out of the subsidy policy has broad potential implications for nutrition. The subsidized policies are, in fact, income transfers to consumers,

especially those in urban areas. The low income population allocates a higher budget share to rice and other staples, making changes in policy important. Rural poor are less dependent on rice and are more likely to benefit from higher prices as producers or rural wage earners.

Two key types of information are used for identifying the potential impacts of these changes in subsidization policy on the nutritional status of Indonesian households. First, survey data can identify consumption patterns of households with different socioeconomic characteristics and importantly, different incomes. These baseline data provide indicators of nutritional status for different groups within the Indonesian population. Moreover, comprehensive nutrient data banks can be used with these survey data to better analyze nutritional status, beyond caloric intake. Second, information on responses to changes in relative prices provides the basis for understanding how the households will adjust to the policy changes. Clearly, from a household viewpoint, the critical aspect of the changed subsidy policy is the associated change in relative prices. Elasticities of demand provide basic descriptive information on food demand patterns, and can be used in assessments of policy impacts and incidence. Access to accurate estimates of these parameters is prerequisite to effective policy design in Indonesia, where a few crops dominate consumption patterns and most of the population is low income.

Past estimates of demand parameters have suggested that expenditure elasticities, especially for rice, have declined over time. Available estimates of price elasticities are largely limited to own-price effects. For rice, existing estimates show the own-price elasticity to be negative,

although the level among these estimates is not consistent. Cross-price elasticity estimates are either absent or highly erratic in value.

More generally, the existing food demand parameters for Indonesia are of limited use for policy analysis. First, most of these estimates are based on ad hoc demand models and hence, lack consistency with consumer demand theory making comparability difficult. Second, the majority of the studies estimate only expenditure elasticities for rice, cassava, and potatoes. Price elasticity estimates are largely absent or highly tentative. Finally, the available parameters are only for food. No systematic linkage has been developed to nutrient demand.

Objectives of the Study

The intent of this study is to provide parameters which can be used to estimate probable effects of policy change on food consumption and nutrition status. This entails: (1) understanding consumption patterns of households with different socioeconomic characteristics, (2) identifying the nutritional status of households, and (3) estimating food and/or nutritional demand parameters. Using these results, a linkage between policy driven price changes and nutrition status can be established.

The research approach uses the theory of consumer demand directly. Specifically, food consumption parameter estimates are from a full demand system. The empirical demand systems applied reflect three considerations. First, they are consistent with consumer demand theory. Second, they are flexible yet simple enough to be estimated and adapted to the data situation in Indonesia. Third, the market demand systems are consistent with the individual demand structure.

Separate demand parameters are estimated for rice and fish. The demand parameters for the secondary staple crops (corn, cassava, and potatoes) are estimated as a group. Similarly, other commodities are grouped into composite bundles to make the estimation problem tractable.

Organization of the Study

The report uses the 1980 multipurpose household survey data (SURGASAR) to estimate the demand systems and link the parameters to nutrition status. The data source and definitions are detailed in the next section. Then, an overview of food expenditures, food consumption and nutrient availability is provided to describe general consumption patterns and identify households at nutritional risk. Next, food demand parameters are estimated based on an Almost Ideal Demand System (AIDS). Two other demand systems were estimated as well and the results are included in appendix D and E. Availability of nutrients is then examined, linking the food demand parameters to nutritional status. The final section provides a discussion of possible uses of the estimated demand and nutritional linkage parameters in food policy analysis.

Table 1.1. Distribution of Agricultural Value Added at Constant 1973 Prices, 1969-80

Commodity Group	1969	1979	1980
	----------percent----------		
Food Crops	60.7	58.6	60.6
Rice	36.2	35.7	38.5
Secondary	24.5	22.9	22.1
Non-Food Crops	19.7	19.5	19.0
Forestry	7.4	10.4	9.0
Livestock & Fishery	12.2	11.6	11.5

SOURCE: Republic of Indonesia. Ministry of Agriculture. Statistical Information on Indonesian Agriculture. Jakarta: June, 1983.

Table 1.2. Annual Average Rates of Growth in Food Crop Production: Area Harvested and Yield, by Region 1968-1981

Crop	Java		Off-Java		Indonesia	
	Area	Yield	Area	Yield	Area	Yield
	percentage					
Rice						
68/71	1.2	4.7	1.3	3.4	1.2	4.3
72/76	0.7	3.5	2.2	3.2	1.5	3.2
77/81	3.6	6.7	2.1	4.0	2.9	5.8
68/81	1.0	3.4	1.1	3.2	1.1	3.2
Corn						
68/71	-6.9	-0.3	-5.4	1.5	-6.5	0.3
72/76	-1.4	3.9	0.4	4.9	-0.7	4.3
77/81	4.1	6.1	2.5	4.7	3.6	5.9
68/81	-0.4	4.1	0.4	3.3	-0.2	3.9
Cassava						
68/71	-1.8	-1.1	-4.0	4.5	-2.0	0.2
72/76	-3.0	6.1	0.7	6.5	-2.1	6.3
77/81	0.0	1.9	2.0	-0.3	0.6	1.1
68/81	-1.2	2.8	1.9	1.5	-0.5	1.5
Sweet Potatoes						
68/71	-10.4	-0.6	4.0	2.8	-3.5	1.9
72/76	-3.4	9.0	-2.9	4.7	-3.1	6.8
77/81	-7.5	0.3	-1.5	0.0	-4.9	0.3
68/81	-5.1	3.1	-0.7	1.3	-2.7	2.2
Soybeans						
68/71	2.4	5.7	-8.4	11.4	0.0	7.0
72/76	-3.6	1.3	5.7	5.8	-1.8	3.3
77/81	5.7	2.4	5.3	-0.6	5.7	1.8
68/81	0.9	2.1	3.5	3.2	1.3	2.3
Peanuts						
68/71	-2.1	1.4	4.6	0.9	-1.7	1.4
72/76	3.4	0.0	9.3	3.7	4.0	0.9
77/81	0.0	3.8	1.7	3.4	0.0	3.5
68/81	1.9	2.2	6.2	1.5	2.9	2.0

SOURCE: World Bank, "Policy Options and Strategies for Major Food Crops," Report 36865-IND, April 4, 1983.

Table 1.3. Annual Rural and Urban Consumption Per Capita, by Crop, 1969/70, 1976, and 1978

Region/Crop	1969/70			1976			1978		
	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
	Kilograms								
Indonesia									
Rice	103.2	101.3	113.8	111.2	110.5	114.3	109.2	109.2	109.2
Corn	22.0	25.4	3.2	9.9	11.9	0.7	11.4	14.0	1.0
Cassava, fresh	21.9	23.7	12.3	26.2	29.9	9.5	20.2	22.9	8.8
Cassava, gaplek	7.7	8.9	1.4	6.4	7.9	0.2	7.3	8.8	0.0
Sweet potatoes	8.8	9.6	4.3	10.8	12.3	4.1	5.7	6.2	2.6
Java									
Rice	92.7	89.8	108.5	103.3	102.4	107.3	99.8	98.8	104.0
Corn	28.2	33.3	2.9	11.5	14.0	0.5	15.1	17.7	1.0
Cassava, fresh	21.4	23.3	11.5	21.6	24.9	6.7	20.3	22.9	7.8
Cassava, gaplek	9.5	11.1	1.7	8.0	9.7	0.1	9.4	11.4	0.0
Sweet potatoes	7.9	8.6	4.2	7.5	8.4	3.4	3.6	4.2	2.6
Off-Java									
Rice	123.1	122.7	126.6	124.8	124.4	126.6	130.0	130.0	119.6
Corn	10.2	11.2	3.8	7.0	8.3	1.1	5.7	6.8	1.6
Cassava, fresh	22.9	24.3	14.0	34.2	36.5	14.4	20.2	22.4	10.4
Cassava, gaplek	4.3	4.9	0.5	3.8	4.6	0.3	3.1	3.6	0.0
Sweet potatoes	10.5	11.3	4.7	16.4	18.8	5.3	8.8	10.4	2.6

SOURCE: Dixon, John A., "Food Consumption Patterns and Related Demand Parameters in Indonesia: A Review of Available Evidence," June 1982 (in turn are based on Susenas Survey data.)

Table 1.4. Floor and Ceiling Prices, the Price Margins, Domestic Procurement, and Market Operations for Milled Rice

Year	Floor Price (Rp/kg)	Ceiling Price (Rp/kg)	Price Margin (%)	Procurement ('000 tons)	Percent of Production	Market Operation ('000 tons)
1969/70	37	50	35.1	349	2.6	364
1970/71	37	50	35.1	349	2.6	364
1971/72	37	50	35.1	349	2.6	364
1972/73	37	50	35.1	349	2.6	364
1973/74	45	--	--	349	2.6	364
1974/75	68.50	100	46.0	536	3.5	342
1975/76	97	120	23.7	539	3.6	559
1976/77	108	125	15.7	410	2.6	979
1977/78	110	127.5	16.0	404	2.5	2,006
1978/79	119.50	140	17.2	881	5.0	1,032
1979/80	158.0	175	10.8	431	2.4	2,036
1980/81	175.0	220	25.7	1,650	8.1	1,630
1981/82	195.0	225	15.4	na	na	na

SOURCE: Amnt, Soegent, "Promoting National Food Security: The Indonesian Experience," In Food Security: Theory, Policy and Perspectives from Asia and the Pacific Rim, 1982.

Table 1.5. Trends in Imported and Domestic Rice Prices per Ton (U.S. Dollars) in Jakarta

Year	Imported Price (Retail Jakarta)	Domestic Price (Retail Jakarta)
1970	148.64	112.4
1971	115.45	109.3
1972	127.45	119.0
1973	175.76	205.2
1974	558.69	242.2
1975	330.49	262.7
1976	263.37	309.6
1977	287.33	319.6
1978	382.22	318.8
1979	362.00	272.5
1980	466.40	319.0
1981	470.10	325.0
1982	320.90	348.0

SOURCE: World Bank, "Policy Options and Strategies for Major Food Crops," Report 36865-IND, April 4, 1983.

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CHAPTER 2

DATA AND DEFINITION OF VARIABLES

Data Source

The 1980 multipurpose household survey (SURGASAR) provides the data for the empirical work in this study. The survey, conducted throughout Indonesia in the months of February and March 1980, included a total of 60,000 households. Every household in the sample was visited once during the survey week.

The sampling procedure identified households based on the 1980 population census. The administrative districts (KABUPATEN) were grouped into four strata on the basis of population density. The villages (DESA) in each structure were listed and subdivided into enumeration areas along fixed natural boundaries. The enumeration areas were then further partitioned into census blocks. The census blocks were used as the primary sampling units, with no more than 100 households per unit.

A stratified sampling procedure in three stages was used throughout the country. A sample of villages was first drawn with selection probabilities determined proportional to the number of blocks (or, number of households) in each structure. One to two census blocks were then randomly drawn from each of the sample villages. All the households in these selected primary sampling units were listed, then five to ten households were systematically chosen from each block.

At the initial phase of the analysis for this report, a four percent subsample of the sampled households was used to examine the data set. The purposes of this diagnostic analysis were twofold: first, to gain an improved understanding of the data file; and second, to generate summary statistics for a subsequent work. Based on knowledge gained from this

preliminary investigation, a subsample of 8,112 households (3,608 urban and 4,504 rural) was drawn for use as the survey data base for the analysis of consumption patterns. The subsample was determined to represent the original sample with prespecified reliability levels for key variables. Allocation of the subsample by region reflected variances of the selected variables and the geographic distribution of the sampled households.

Food Groups

The 1980 survey covered three broad areas: demography, labor force, and health of children (schedule II); consumption and expenditure (schedule III); and household earnings and receipts (schedule IV). This study is based on variables drawn from schedules on demographic and labor force characteristics and household consumption and expenditures.

The data on food consumption were for household food consumption in the week prior to the survey. The main food groups identified in the survey were cereal grains, roots and tubers, beans, fruits, vegetables, fish, animal products (meats, poultry, and dairy products), beverages, and other processed and prepared foods. For each food item (except prepared foods), there was information on quantity and market value. These data, in addition, included information on monthly expenditures on housing, fuel and lighting, clothing and footwear, and other durable goods and services.

For the analytical work, the commodities were aggregated based primarily on concepts of separable commodity groups. The twelve food commodity groups identified by these criteria were:

1. Rice
2. Palawija Crops (nonrice cereals, roots and tubers)

3. Beans and Bean Products
4. Fruits
5. Vegetables
6. Meats and Dairy Products
7. Fish
8. Fat and Oils
9. Prepared Foods
10. Sugar and Other Sweeteners
11. Beverages
12. Miscellaneous Foods

Food commodities important in household food budgets and the Indonesian government's policy agenda were identified separately. In particular, rice, palawija crops, and fish were treated as separate food groups. Also, the nutrient characteristics of the food items were considered. For instance, cereals, palawija crops, sugar and sweeteners are important sources of calories; beans, fish, and meats and dairy products are high in protein; vegetables and fruits are largely important for vitamin content. A detailed breakdown of the food groups is given in Table 2.1.

All the 12 food commodity groups were used to estimate Engel curves. For the estimation of the full demand systems, the food commodity groups were reduced to seven: rice; palawija; beans; vegetables and fruits; fish; meats, poultry, and dairy products; and "other" foods. The "other" foods category included fats and oils, beverages, sugar, and other miscellaneous foods.

Budget Shares

Household expenditures on each commodity group, as a fraction of total expenditures were calculated as budget shares. The expenditures were a money value measure of total food utilized from the household's own inventory, transfers, and purchases during the survey reference week. These average budget shares were used as dependent variables in the subsequent demand analysis. The variable names and estimated shares are given in Table 2.5 and in Chapter 3, respectively.

Conversions to Nutrients

The quantity of food available for consumption by the household was used to calculate availabilities of selected nutrients: kcalories, proteins in grams, calcium in milligrams, iron in milligrams, vitamin A in international units, thiamine in milligrams, and Vitamin C in milligrams. The coefficients for translating the food commodities into nutrients came from food composition tables prepared by the Indonesian Ministry of Health (Republic of Indonesia, 1981). These tables provide estimates of the edible proportions of food commodities and their nutrient content.

The translation of the quantities of foods consumed into nutrient equivalents required three steps. First, the food items were reorganized and redefined in accordance with the listing of foods in the food composition tables. Nutrient coefficients were available for only 96 food commodities. Food commodities without reported nutrient coefficients were excluded in calculating available nutrients. Those items that were not expressed in metric weights were standardized and converted into metric quantities, with several specific assumptions as described in Table 2.2. Second, the edible quantities of the 96 food items were computed using the

standard conversions. Finally, the nutrient consumption coefficients were applied to the edible quantities to derive household specific nutrient availabilities. Because the quantities of food were unadjusted for waste and other losses, the nutrient values are viewed as "availabilities."

Socioeconomic Variables

Income: Total household expenditure is used as a proxy for household income, even though the survey data contain information on measured household income. This decision was made on the basis of three considerations. First, income data were less reliable than expenditure data. Second, income is the primary determinant of household expenditure and hence, highly correlated with total expenditures. Third, household expenditure is often considered to be a better measure of permanent (or "typical") income, thus a better indicator of resources available for consumption.

Two important adjustments were made in organizing and shaping the data on income, or total expenditure. The survey data contain household food expenditure for the week prior to the survey. Household total expenditure, on the other hand, was reported for the month preceding the survey week. To reconcile the time dimension of these variables, the monthly expenditure data were converted to weekly equivalents. Second, about one percent of the sampled households with extreme values of expenditures were deleted from the data. A preliminary investigation revealed that there was no systematic pattern in the distribution of the demographic characteristics (sex, age, education, and occupation status) of these excluded households compared to others.

In order to investigate behavioral variations in food consumption and expenditure patterns by income level, households were partitioned by income group. These income groups were based on a preliminary investigation of the household income distribution from the sample. This investigation provided an understanding the income profile of the sampled households, the degree of income inequality, and the skewness of the income distribution.

A Lorenz curve for Indonesia, depicting the relation between a cumulative percentage of income receipts and cumulative percentage of income, is shown in Figure 2.1. Expressed in terms of a Gini coefficient (GI), the income inequality index was 0.39 for all Indonesia in 1980. In addition, according to Kamaluddin (1986), the degree of income inequality was greater in urban (GI = .38) than in rural (GI = .35) Indonesia. Inequality was greater in Java (GI = .43) than in outer Java (GI = .35) islands.

Additional information in Table 2.3 shows the skewness of the income distribution. The lower 40 percent of the sampled households had 20 percent of the total income. The middle 40 and the upper 10 percent of households had 55 and 25 percent of the total income, respectively. The distribution was thus skewed to the right with a higher share of total income in the upper income groups.

The cut off points for partitioning the sample by income group were determined using the estimated income distribution. In addition, nonsample information was utilized from other studies (CBS., 1984; Chernichovsky and Meesook, 1984). The sampled households were partitioned into four groups: low; middle-low; middle-high; and high.

These four income groups were used in the descriptive analysis of food and nutrient consumption patterns of the sampled households.

Prices: Because no market prices were available in the survey data, price indexes for the seven food commodity groups were computed at the district level. This process required three steps. First, the district level value and quantity were computed for each individual food item. Second, the mean shares of the items within their respective commodity groups were computed. Finally, using the group-specific shares as weights, district level implicit prices were computed for the food groups. A geometrically weighted index was then used in generating the indices,

$$P_j = \Pi P_{jr}^{\alpha_{jr}} \quad j = 1,\ldots, 12,$$

where P_j is the district level price index of commodity group j, P_{jr} is the district price of item r in j^{th} group, α_{jr} is the mean share of commodity r in the jth group. Implicitly, households by district were assumed to face similar prices.

Household Size: The size variable is defined as the number of persons in a household. This size measure, unadjusted for variation in household composition, was used as an exogenous variable in estimating the food demand systems. For the estimation of demand for nutrients, however, household size was redefined as a weighted sum of the number of household members in eight age-sex groups. The weights are based on age-sex specific minimum calorie requirements, normalized for the adult male between 16-50 years of age. Table 2.4 shows the minimum requirements and the adult equivalent scales.

Region: A binary variable was defined where the sampled households were grouped into two broad geographic regions--Java and outer Java. Households in Java included those in all provinces of Java and Bali.

Education: Two levels of education were defined for household heads: those who had completed elementary education or more, and those who had not.

Occupation: Urban household heads were grouped by three occupation categories: administrative and clerical; sales and services; and production and other work. For rural households, there were only two categories: agriculture and related work; and other.

A listing of all the variables used for the subsequent analysis is given in Table 2.5.

Table 2.1. Food Groups and Associated Food Items--Indonesia

Food Group	Food Items
Cereals:	
Rice:	rice (including glutinous rice and rice products)
Nonrice*:	(fresh and dried corn with husks, corn kernels, and flour), wheat, and other grains
Roots and Tubers*:	cassava (cassava root, dried cassava, cassava flour), sweet potatoes, potatoes and others (taro root, sago, etc.)
Beans and Bean Products	soybeans (soybeans, soybean curd, soybean cakes, soybean paste) and other beans (peanuts, mung beans, kidney beans, cow peas, peanut cake)
Fruits:	citrus fruits, mango, apple, avocado, rambutan, duku, durian, salak, pineapple, banana, papaya, water roseapple, guava, sapodillas, starfruit, spanish plum, and watermelon
Vegetables:	spinach, swamp cabbage, cabbage, green beans/peas, yard long beans, tomatoes, carrots, cucumbers, cassava leaves, eggplant, bean sprouts, shallots, garlic, red chilli peppers, and cayenne pepper
Meats and Dairy Products	
Meat:	beef, buffalo, mutton, pork, preserved meat, other meats
Poultry:	chicken and other poultry
Eggs:	eggs (chicken and other poultry)
Dairy products:	milk (fresh milk, processed milk, condensed milk, powdered milk, milk products)
Fish:	fresh marine and freshwater fish, salted and dried fish, canned fish, shrimp, crab, squid, etc.
Fats and Oils:	coconut, cooking oil, butter
Prepared and Partially Prepared Foods:	noodles, bakery products (bread, biscuits), homemade food and drink, shrimp chips and other chips
Sugar and Sweetener:	sugar (cane and palm sugar), syrup
Beverages:	soft drinks, tea, coffee, and chocolate powder
Other Foods:	salt, spice, shrimp paste, fish sauce, soysauce, and monosodium glutamate

*Nonrice cereals, roots and tubers are combined as palawija crops in the analysis

Table 2.2. Assumptions and Sources Used for Converting Nonspecific Quantities and Volume Measures to Metric Weights

Food Item Code	Description	Source
340	One chicken--assumed to weigh 1 kilo	D. Chernichovsky and D.A. Meesook
350	Other poultry--assumed to be turkey, assumed weight of 4.5 kilos	D. Chernichovsky and D.A. Meesook
371	Eggs, chicken--assumed to be 60 percent of the size of a U.S. large grade egg of 50 grams	USDA
372	Eggs, other--assumed to be turkey eggs and to be equal in size of a U.S. large egg of 50 grams	USDA
381	Fresh milk--one litre of milk assumed to weigh 1.032 kilograms	D. Chernichovsky and D.A. Meesook
970	Soy sauce--a 350 cc bottle assumed to weigh 0.35 kilogram net	D. Chernichovsky and D.A. Meesook
980	Coconut--assumed to weigh 500 grams	D. Chernichovsky and D.A. Meesook
1120	Syrup--one litre assumed to weigh 1.04 kilograms	D. Chernichovsky and D.A. Meesook
1180	Beer--one litre assumed to weigh 1 kilogram	D. Chernichovsky and D.A. Meesook
990	Cooking oil--one litre assumed to weigh one kilo	D. Chernichovsky and D.A. Meesook
1130	Soft drinks--one litre assumed to weigh 0.93 kilogram	D. Chernichovsky and D.A. Meesook

FIGURE 2.1

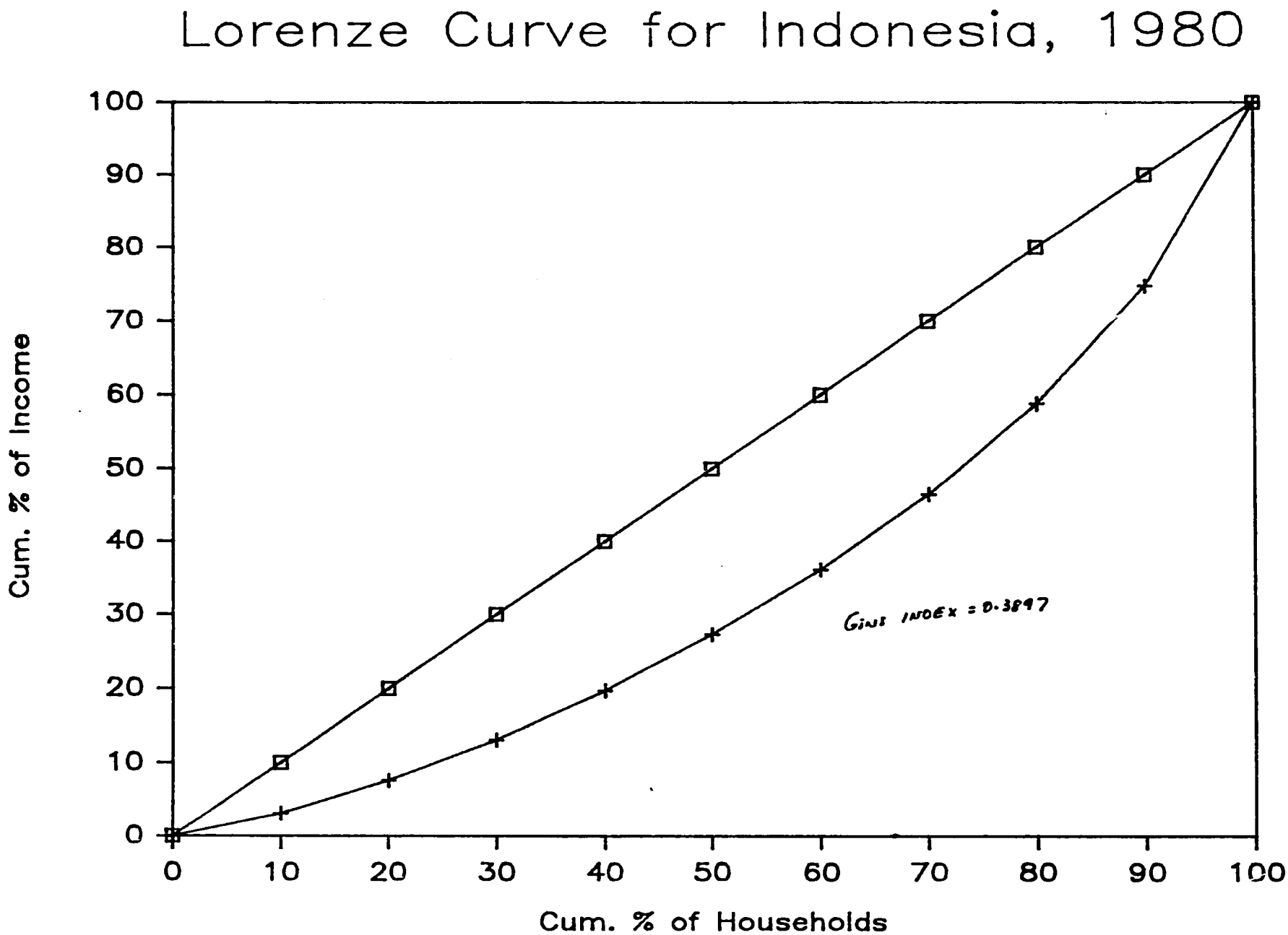
Lorenze Curve for Indonesia, 1980
Cum. % of Income
Cum. % of Households
0
10
20
30
40
50
60
70
80
90
100
GINI INDEX = 0.3897

Table 2.3 Income Distribution for Households

Income Group (Rp/person/month)	Percent of Households	Percentage of Total Income
up to 7200	40	19.7
7200-11400	30	26.8
11401-19000	20	28.3
above 19000	10	25.2

Table 2.4. Minimum Daily Calorie Requirements and Equivalent Scales

Sex-Age Group	Calories per Person per Day	Scale
All Children		
0-3	1100	.4339
4-9	1475	.5819
Male		
10-15	2205	.8698
16-59	2535	1.0000
60 and over	2020	.7968
Female		
10-15	2040	.8047
16-59	1840	.7258
60 and over	1500	.5918

SOURCE: Downey, R. Indonesian Inequality: Integrated National Accounting of Who gets What. Ph.D Dissertation. Cornell University. Ithaca, 1984.

Table 2.5. Variable Codes and Definitions

Variable	Definition
Food Group	
FG1	Rice
FG2	Palawija crops
FG3	Beans
FG4	Fruits
FG5	Vegetables
FG6	Animal products (meats, poultry, and dairy products
FG7	Fish
FG8	Fat and oils
FG9	Prepared foods
FG10	Sugar and Sweeteners
FG11	Beverages
FG12	Miscellaneous foods
FG13	Nonfoods
Budget Share	
W1	Budget share of rice
W2	Budget share of palawija crops
W3	Budget share of beans
W4	Budget share of fruits
W5	Budget share of vegetables
W6	Budget share of animal products
W7	Budget share of fish
W8	Budget share of fats and oils
W9	Budget share of prepared foods
W10	Budget share of sugar and sweeteners
W11	Budget share of beverages
W12	Budget share of miscellaneous foods
W13	Budget share of nonfoods
Nutrients	
CAL	Total calories available per household per week
PROT	Total protein available per household per week
IRON	Total iron available per household per week
VITA	Total vitamin A available per household per week
VITB	Total thiamine available per household per week
Socioeconomic Variables	
TEXP	Household total expenditure per week
FEXP	Household food expenditure per week
PRC	District price of rice
PPAL	District price of palawija crops
PBN	District price of beans
PVG	District price of vegetables
PFR	District price of fruits
PMPD	District price of meats, poultry, and dairy products
PFS	District price of fish
HHS	Unadjusted household size
AHHS	Adjusted household size

Table 2.5. (continued)

Variable	Definition
Exogenous Variables, continued	
DRE	Binary variable for region DRE = 1 if Java DRE = 0 if outer Java
EDU	Educational level of household heads EDU = 0 if no or incomplete elementary education EDU = 1 if completed elementary or more
MOC	Classification of occupation of household heads
	Urban MOC2 = 0 MOC3 = 0 if administrative or clerical work MOC2 = 1 MOC3 = 0 if sales or service work MOC2 = 0 MOC3 = 1 if production or other
	Rural MOC = 1 if agriculture or related work MOC = 0 otherwise

References

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CHAPTER 3

FOOD EXPENDITURE, CONSUMPTION, AND NUTRIENT AVAILABILITY

Household Food Expenditure Patterns

Descriptive information on expenditure, participation rates, food budget shares, food consumption practices, and availability of nutrients is provided for urban and rural households. Food expenditure participation rates measure the proportions of the sampled households that reported purchase (or use) of food items. Food budget shares are computed to determine the relative importance of the food groups, and to examine food expenditure patterns. The descriptive analysis of household food consumption and nutrient availability was undertaken to gain a better understanding of Indonesian dietary patterns. These results are later used as background information for specifying and evaluating the empirical demand models.

Food Expenditure Participation Rates

Over two-thirds of the rural and urban households reported (participation in) consumption of rice, vegetables, fruits, fish, fats and oils, and sugar (Table 3.1). Rice was the most frequently consumed food crop. About one-third of the sample households reported consumption of roots and tuber crops (cassava in particular) and animal products.

The most notable variations between rural and urban households were in consumption of corn, cassava, potatoes, wheat, soybeans and animal products. Relatively larger proportions of rural households reported consumption of corn and cassava (Table 3.1). Higher proportions of urban households reported consuming wheat, potatoes, and animal products.

Regional variations between Java and the outer Java were evident in the consumption of soybeans and fish. Soybeans had high consumption participation

rates among households in Java. The proportion of households consuming fish, however, was higher in outer Java.

There was little variation in participation rates for rice and vegetables among income groups (Table 3.2). For wheat, potatoes, fruits, fish and animal products, however, the participation rates increased with income. The proportions of participating households for corn and sweet potatoes in urban, and corn in rural areas declined consistently with income.

The most significant variations across provinces were in consumption of corn, soybeans, and fish (Table 3.3). Higher proportions of households reported consuming corn in East Java, Sulawesi, and Bali and Nusa Tenggara. Relatively larger proportions of the households in west, central, and east Java, and in Kalimantan reported consumption of cassava. Most of the households in Java reported consumption of soybeans. Participation rates for consumption of fish were lower in central and east Java.

Food Budget Shares

The food budget shares varied by region and income class.

Regional Variations

Urban households spent on average Rp 1,735 (U.S. $2.78) per capita per week on food, while rural households had an average expenditure per capita per week of Rp 1,375 (U.S. $2.20). Also, the urban households in all income groups had higher food expenditures than rural households (Table 3.4). Similarly, households in urban Java and outer Java spent more on food than households in rural Java and outer Java. Both rural and urban households in Java had lower mean food expenditures than households in outer Java.

Food budget shares reflect these average variations in expenditure patterns. On average, food accounted for 64 percent of total expenditure for

urban households. The average food share was 74.9 percent for rural households. Among income groups, the food budget shares were higher in rural than in urban areas. The higher food budget shares for households in rural areas reflect the low level of income.

Within the food budget of the average urban household, 27 percent was for rice--the main staple crop (Table 3.5). Rice was followed by fruits and vegetables (13.3 percent), animal products (12.4 percent), fish (10.8 percent), and prepared foods (9.2 percent). The secondary crops (corn, wheat, cassava, sweet potatoes, and potatoes) accounted for 2.1 percent of the food budget.

In the rural food budget for the average household, rice accounted for 35 percent. The rice share was followed by vegetables and fruits (12.3 percent), fish (10.6 percent), and animal products (7.3 percent). The secondary food crops jointly represented 5.3 percent of the food budget in rural households.

Food expenditure patterns were, by and large, similar between Java and the outer Java islands. The most notable variations were in the budget shares for fish and beans. Fish had a higher share of the food budget in outer Java, while the reverse was observed for beans, and soybeans, in particular.

Variations in budget shares are more pronounced among the provinces (Tables 3.6 and 3.7). Although rice was the staple in all the provinces, it was more prominent in the food budget in west Java. The mean budget share for corn was greater in east Java, Sulawesi and the other provinces (Nusa Teuggara, Maluku and Irian Jaya). The cassava share was higher in central and east Java and the "other" provinces. Fish was more dominant in the food budgets in Kalimantan, Sulawesi, and Sumatera.

Variation by Income Class

As shown in Table 3.8, the share of food in total household budget declined with income. For households with higher incomes, food expenditure patterns changed. First, the budget shares for most of the staple crops--rice, corn, cassava, and sweet potatoes declined with income. Despite the decline in budget share of rice, households in higher income groups tended to consume more rice. The budget shares for wheat and potatoes increased with income. Secondly, for the nonstaples only the budget shares for fruits and animal products increased with income. The shares for most manufactured food products also rose with income.

A number of observations are suggested by these results. First, on average, food accounted for no less than 60 percent of total household expenditure. Second, rice was the single dominant food in the Indonesian diet. Third, urbanization, income level, and place of residence had important influences on household budgets. Compared with the rural households, the urban households had a lower average budget share for staple foods and a higher share for animal products (beef, poultry and dairy products) and processed foods. These variations were, however, more limited among the same income groups. The urban and rural high income households used mainly rice as a staple. And for this group, staple foods had a lower budget share; animal products and processed foods had higher budget shares. The low income urban and rural households, on the other hand, were more diversified in the staple food consumption, with a larger budget share allocated to staples. These results support findings of previous studies, summarized in Appendix B.

In addition, the budget allocation practices reflect the influence of regional production patterns, and food consumption habits and customs.

Households that resided in central and east Java, Sulawesi, and the "other" provinces had, for example, relatively higher budget shares for corn and cassava. Similarly, fish had a higher budget share in Kalimantan, Sulawesi, and Sumatera.

Household Food Consumption and Availability of Nutrients

This section extends the descriptive analysis to investigate the relation between food consumption and availability of nutrients at the household level. Variations in per capita consumption of foods and nutrients are examined relative to four questions. What are the main food commodities in the average Indonesian diet? How do the levels of consumption of these commodities vary by income, location and place of residence? Which of these food commodities are the more important sources of nutrient availability? How does nutrient availability vary with income, location, and place of residence of households? The information gained from these descriptive results will be used subsequently to identify households at nutritional risk and to establish a link between food consumption, food cost, and nutrient availability.

Food Consumption Practices

Household food consumption is measured as a total food utilized from own inventory, transfers, and purchases during the survey week. The figures in the tables to be discussed are expressed on a per capita basis without adjustment for food wastage and loss during food preparation. Moreover, no account has been taken of variations in household food consumption due to differences in household composition, efficiency in food utilization, and quality of food. The per capita figures are, therefore, gross measures of food consumption.

Based on quantity, rice was a leading food crop in the average diets of Indonesian households. Corn (dried corn with husks, and corn grain and flour) and cassava (dried cassava, in particular) were next in the ranking of the food commodities (Table 3.9). These patterns were similar by location (urban vs rural), region (Java vs outer Java) and income group.

An average Indonesian had available for consumption 2.3 kg of rice per week. Average rice consumption levels were 2.4 kg in rural areas and 2.19 kg in urban areas. For the island groups, per capita consumption of rice was 2.43 kg in outer Java and 2.11 kg in Java. Among income groups, the poor had lower per capita rice consumption than the wealthier groups. Households within the lowest 40 percent of the income distribution consumed, for example, 1.98 kg of rice, while for those in the top 10 percent of the income distribution, consumption was 2.63 kg/week.

Corn is consumed in three main forms, fresh corn with husks, dried corn with husks, and corn grain and flour. The average diet had 0.82 kg of fresh corn, 1.37 kg. of dried corn, and 1.26 kg of corn grain per week per person (Table 3.9). The mean consumption levels of all the three forms were higher in rural diets than in urban diets. Fresh and dried corn were consumed in larger quantities in outer Java than on Java. Among income levels, there was an apparent decline in consumption of dried corn, and a consistent drop in corn grain and flour consumption with increased income. Corn consumption was most prevalent among the poor and the rural households.

Cassava was consumed in fresh and dry forms. An average weekly diet contained 1.20 kg. of dried cassava and 0.75 kg of fresh cassava. On average, both forms were consumed more in rural than in urban areas, and in outer Java than in Java (Table 3.9). The summary figures are, however, inconclusive regarding the relation between quantity of cassava consumed and income.

For soybeans and associated products, average consumption was 0.32 kg. per person per week. The averages were 0.36 kg. in Java and 0.26 kg. in outer Java. Urban consumers had higher consumption (0.34 kg.) than rural consumers (0.27 kg.). On average, per capita consumption of soybeans increased with income. "Other" beans had consumption patterns similar to soybeans with respect to income. But, unlike soybeans, they were more important in rural than in urban areas, and in outer Java than in Java.

Fish, the most important source of animal protein, was consumed in three forms: fresh fish, dried fish, and canned fish. The average Indonesian diet had 0.35 kg. of fresh fish, 0.12 kg. of dried fish, and 0.10 kg. of canned fish per person per week. Fresh fish was, in particular, dominant among the consumers in outer Java. Fish consumption was higher among high income households.

The average weekly diets also contained 0.63 kg of fruits, 0.66 kg. of vegetables, 0.22 kg. of meats and poultry, and 0.18 kg. of dairy products. On per capita basis, the average consumption of all these food commodities increased with income.

The foregoing results on food consumption suggest several distinct patterns.

1. Average consumption of rice was highest among all the food commodities regardless of size, location, and income of households.
2. Corn and cassava, in particular, were important staple foods for rural and the low income households.
3. The average Indonesian diet contained mainly rice, corn and cassava, fruits and vegetables, and fish.

4. By and large, food consumption was higher in outer Java than in Java and in rural than in urban areas.
5. All the food commodities, except cassava and corn, showed systematic variation with income. There was a tendency for a shift from starchy staple crops to fruits, and animal products as income increased.

Caution should be exercised in interpreting and using these results. First, other factors which could possibly explain variation in consumption levels were not controlled. Second, the comparisons of the average values and the subsequent interpretations and inferences are not based on statistical tests. Finally, individual diets may diverge substantially from the average diets reported. Averages were used, but perhaps representative or modal consumption levels would reflect more accurately the diets of Indonesian households.

Nutrient Availability

Data on nutrient availability have the same limitations as those for quantities in food consumption. No adjustments have been made to account for variations due to differences in household composition, in household technology and the quality of food. Notwithstanding these limitations, however, nutrient availabilities per person can be used to describe nutrient consumption patterns.

The average Indonesian diet had an equivalent of 1912 calories per day (Table 3.10). These averages were 2029 calories in rural areas, 1767 calories in urban areas; 1740 calories in Java and 2059 calories in the outer Java. By income group, the poor had lower calorie consumption than the high income

households (Table 3.11). Households in the bottom 40 percent of the income distribution, (under 7200 Rp/person/month) averaged 1545 calories while households in the upper 10 percent averaged 2567 calories per day. Minimum daily requirements for calories range between 1900 and 2100. Relative to this standard, the urban low income households (Java in particular) were most deficient.

Availability of protein was adequate in aggregate; the average of 47 gm/day was above the estimated minimum requirement (43 gm). Variations between rural and urban areas, and Java and outer Java is lands were limited (Table 3.10). Notable differences existed only among income groups (Table 3.11); the range was between 35 gm per day for those with expenditures per person under Rp 7200 per month to 69 gm per day for those with per capita expenditures above Rp 19000. Households in the lowest 40 percent of the income distribution were, in particular, prone to protein deficiency.

Among the minerals, iron deficiency was prominent in the average diet. Consumption of iron per day was 11.2 gm, 78 percent of the minimum requirement. Daily per capita availabilities were 9.7 mg. in urban areas, 12.4 mg. in rural areas, 12.1 mg. in Java, and 10.4 mg. in outer Java. Only those households in the top 10 percent of the income distribution had adequate iron consumption. Iron deficiency was, thus, broad based.

Within the vitamins, levels of thiamine appeared to be less than adequate in the average diets of the urban consumers. Additional judgments on vitamin consumption must be made with a great deal of caution, because of the high standard errors of the means in Tables 3.10 and 3.11. The large standard errors suggest a wide variability in the levels of vitamin consumption.

Variations in per capita availability of the diet components were largely a reflection of food composition behavior. That is, the availability of these

diet components was conditioned on the consumption patterns of the main food commodities. Rice was the principal source of energy. Corn and cassava were also important energy sources for the rural and the poor households. Rice and fish were the main foods providing protein. Rice was also a leading contributor to the availability of iron and thiamine. Vegetables and fruits were largely important in supplying vitamins.

Differences in consumption of food commodities among socioeconomic groups were reflected in availability of nutrients. The high consumption of calories in rural areas was largely a reflection of the high levels of consumption of rice, and the other staple crops. Similarly, the high per capita availability of calories and protein in outer Java as compared with Java was due to a higher per capita consumption of the starchy foods and fish in the other islands. Despite the diversity of diets among the poor, the low levels of consumption of the staple crops contributed largely to their deficiency in calories and protein.

At present, average Indonesian diets contain a disproportionate amount of calorie-rich food. But, as consumers experienced a rise in income, there was an apparent shift from starchy staples to animal products and processed foods. This shift in diet structure was evident largely among higher income groups.

Shifts in diet structure may also signal adjustments toward more efficient sources of nutrients. According to Indonesian Food Composition Tables (Republic of Indonesia, 1981), fish, beans, meats and poultry, and milk products are rich in protein. Beans, meats, and cereal products are high in iron and thiamine. The shift to animal products and processed foods showed a change in diet composition, toward foods richer in protein, minerals, and vitamins.

In summary, nutrient availabilities at household level suggest several prevalent patterns.

1. Availability of calories, protein, iron, and thiamine were the most limiting nutrients in the Indonesian diet.
2. Shortages of calories and protein were more prevalent among the poor in urban areas. Iron deficiency, on the other hand, was prevalent for all the population.
3. Cereals and tuber crops provided the bulk of the main nutrients. Rice was the dominant source of calories, protein and iron. Corn and cassava were important foods in rural areas.
4. The importance of starchy foods diminished with rising income and urbanization.
5. The level and composition of food commodities consumed largely explained variations in nutrient availability.

A Profile of Households Below Minimum Calorie Requirements

Nutrient consumption at a household level depends on availability and accessibility to foods, and efforts to meet their nutritional needs. Level of income, prices of food and nonfood items, and place of residence are often considered key determinants of accessibility to and consumption of foods. Efficient use of foods to maintain a stable and balanced diet requires that consumers select foods that are rich in the essential diet components. Hence, level of education, accessibility to information on nutritional content of foods and diet requirements, and experience play important roles in food choices.

This section explores these broader issues for households deficient in selected nutrients. The objective is to answer some exploratory questions. Who are the nutrient deficient groups? Is calorie consumption a good proxy

for nutritional status? Is deficiency in nutrition an income related phenomenon? What other socioeconomic factors characterize households with deficient diets? Answers to these questions will aid in the more structured analysis and are of direct importance for Indonesian food and nutrition policy.

This analysis has used calorie consumption to identify the population at dietary risk. The choice of calories as an index is justified on three grounds. First, it is simple and practical to construct. Second, calories reflect carbohydrates, protein and fat, the principal micro nutrients. Third, calorie deficiency has been shown to be indicative of insufficient availability of other nutrients. From Table 3.12, observe that there was a systematic relationship between calorie consumption and the availability of protein, minerals, and vitamins. To the extent this systematic pattern prevailed, calorie consumption level was a good proxy for consumption of the other nutrients.

The recommended daily calorie requirements for an average Indonesian ranged between 1900 and 2100 calories. To isolate households in this range, a simple procedure was followed. First, the surveyed households were distributed into 100 percentile groups. Not more than 2 percent of the households were found with per capita consumption of less than 800 or more than 4003 calories. Second, the households at the extremes were examined to determine if there was a systematic pattern in their distribution by income level, region, occupation status and education. These households were randomly distributed and, hence, deleted from the sample on the presumption of reporting errors. Third, the remaining households were distributed into five calorie groups. Table 3.13 gives the mean and range of actual calorie consumption for these five groups. Finally, the households deficient in calories were identified.

Households in Group 4 (the 60th to 80th percentile) had calorie availability in the range consistent the minimum daily requirements. Households in this group were designated as "calorie adequate". Those in the lowest two groups (the 1 to 40 percentile) with an average calorie consumption of less than 1650 calories were considered "calorie deficient". These calorie deficient households were the focus of our analysis.

The spatial distribution of all the sample households is given in Table 3.14. A great majority of the households that lived in Java (55 percent in urban and 43 percent in rural) were calorie deficient. In Sulawesi, the percentages were 42 in urban and 28 in rural areas. Rural Bali and Nusa Tenggara, Kalimantau and Sumatra had nearly one-third of the households calorie deficient. About 40 percent of the urban households in these provinces were in the lowest calorie group.

Two important patterns emerge from examining the distribution of these households by location. First, even though calorie deficiency was highly concentrated in Java, it was not a region specific. Shortages in calories were characteristic of households in all provinces. Second, the incidence of calorie deficiency was high in urban compared to rural areas.

Age and education of household head had weak relationships to calorie deficiency (Table 3.15). Both young and old, and those with and without education were included, with little pattern among the five calorie groups.

Similarly, no notable shift was observed when the households were grouped by main occupation of head of household and the distribution among calorie groups (Table 3.16) observed. A slight decline in proportions of production workers and those in sales and service occupations was observed with increased calorie consumption levels. This shift is not, however, strong enough to

establish a conclusive pattern. In short, occupational status had limited use in discriminating among calorie deficient and nondeficient households.

Income had a strong systematic relationship to calorie deficit and nondeficit households. A great majority of the calorie deficit households were among the poor (Table 3.17). Sixty-eight percent of the urban and 95 percent of the rural calorie deficient households, for example, had less than Rp 10,000 per month per person. Also, Table 3.17 shows that calorie deficiency existed for all income groups. Low as well as high income households were included, albeit with a notable shift in proportions, in the deficient and nondeficient calorie groups. Even though income was a strong discriminating variable, calorie deficiency was not strictly income determined. The influence of income on calorie consumption is suggested by the previous results on food consumption patterns. The low calorie households spent less on food, consumed less on per capita basis, and diversified less among nutrient dense food sources (Table 3.18).

The low level of per capita food consumption is partly related to differences in family size in the households in calorie groups. Generally the calorie deficit households had more persons to feed which, for the same level of income and consumption efficiency, indicated that larger households consumed less per capita than smaller households.

The results of the tabular analysis suggest the following general conclusions:

- Variations in dietary status were largely related to income, household size, level of urbanization, and place of residence. No individual socioeconomic variable explained a major share of the variation in dietary status.

- A high incidence of calorie deficiency was concentrated among the low income, urban, and large family households. Higher proportions of these households were in Java.
- Calorie deficient households, in general, spent less on foods, consumed less on per capita basis, and tended to have diets that were less concentrated on nutrient dense food sources.

Summary

The analysis of household food expenditure and consumption patterns showed several characteristics of the average Indonesian diet. First, food as a group constituted a major component of the average household budget. Households with low income and those living outside of urban areas spent relatively larger shares of their budgets on food. Rice was the dominant food for all income groups, however, its share declined with increases in household income, as households shifted to more income elastic food commodities.

Based on per capita consumption, rice, corn, cassava, and fish were the prominent foods in the Indonesian diet. Average consumption of these commodities was higher in rural areas compared to urban areas. Corn and cassava were relatively more important in the diets of low income and rural households.

The level and structure of the average household diet determined the supply of nutrients. For example, lower levels of rice and fish consumption among households in low income groups and in urban areas were associated with higher rates of calorie and protein deficiency. Deficiencies in available iron were widespread. The nutritional status of the population could be improved with increases to income and shifts toward more nutrient-efficient sources of foods.

Income, household size, and place of residence were the major factors affecting variations in dietary status. In addition, these were important variables identifying "calorie deficient" households.

Table 3.1. Food Expenditure Participation by Location and Region

Food Groups	Rural			Urban		
	Java	off-Java	Indonesia	Java	off-Java	Indonesia
	percent					
Cereals	99.4	99.6	99.5	97.4	99.0	98.2
Rice	94.8	98.8	96.9	97.3	99.0	98.1
Corn	27.6	19.7	23.2	9.4	6.9	8.1
Wheat	5.0	11.7	8.7	14.3	16.0	15.2
Root and Tubers	62.4	61.7	62.0	56.5	55.4	55.9
Cassava	49.9	42.8	46.0	31.4	27.3	29.2
Sweet potatoes	19.3	16.5	17.7	19.3	16.5	17.7
Potatoes	7.5	15.9	12.1	25.3	30.8	28.2
Beans	80.6	42.9	59.8	92.5	72.9	82.2
Soybeans	72.7	25.5	46.7	90.0	61.6	75.1
Fruits	61.4	97.9	66.2	73.7	76.7	75.3
Vegetables	97.9	97.9	97.9	95.8	98.4	97.1
Fish	81.9	94.3	88.8	83.2	96.5	90.2
Meat and poultry	16.2	24.7	20.8	41.2	36.2	38.5
Eggs	35.4	40.1	38.0	62.8	60.9	61.8
Dairy products	7.6	18.2	13.4	34.5	45.0	40.0
Fats and oils	91.9	92.8	92.4	94.3	96.4	95.4
Beverages and tobacco	97.2	96.3	96.7	96.8	96.2	96.5
Prepared foods	69.8	55.6	62.0	84.4	71.3	77.5
Sugar	92.0	90.6	91.2	94.8	96.1	95.5
Other foods	99.2	99.4	99.3	96.5	98.6	97.6

SOURCE: 1980 SURGASAR Data

Table 3.2. Food Expenditure Participation by Location and Income Group

Food Group	Rural				Urban			
	under 7,200	7,200-11,400	11,401-19,000	above 19,000	under 7,200	7,200-11,400	11,401-19,000	above 19,000
	percent							
Cereals	99.5	99.3	99.9	99.6	98.9	99.6	98.9	93.6
Rice	95.0	98.8	99.7	99.6	98.6	99.6	98.9	93.6
Corn	29.5	18.0	15.1	12.1	10.9	7.2	6.3	8.2
Wheat	3.6	9.9	18.0	26.3	5.1	14.0	20.7	24.1
Root and Tubers	58.5	64.7	67.3	68.1	54.7	54.7	55.6	60.4
Cassava	46.1	47.0	43.6	47.4	36.5	31.5	25.7	19.5
Sweet potatoes	15.0	20.3	20.4	23.7	19.2	17.4	13.0	14.1
Potatoes	5.7	14.6	25.0	26.7	11.0	26.4	34.5	47.3
Beans	59.7	57.9	62.0	65.1	78.1	84.9	83.6	80.6
Soybeans	50.3	43.3	42.4	42.2	72.5	77.9	76.1	71.8
Fruits	56.3	73.6	81.0	84.1	58.8	74.0	83.4	89.9
Vegetables	97.2	98.8	98.5	98.7	98.1	98.6	97.6	92.3
Fish	83.9	92.5	96.1	96.1	84.0	92.8	93.5	89.4
Meat and Poultry	9.9	24.5	41.6	52.2	15.7	31.6	50.2	67.4
Eggs	26.0	44.8	56.7	68.1	38.5	62.1	73.1	78.6
Dairy products	4.1	16.7	28.8	45.7	14.6	35.5	53.0	66.3
Fats and Oils	90.0	94.2	96.8	96.1	95.7	96.4	96.3	91.5
Beverages and Tobacco	96.0	96.9	98.5	98.7	96.4	96.6	97.0	95.7
Prepared foods	54.8	66.9	72.1	78.5	66.4	75.0	83.1	58.3
Sugar	88.4	92.7	96.7	95.7	94.5	96.2	97.1	93.1
Other foods	99.3	99.1	99.6	99.1	98.5	98.5	98.4	93.3

SOURCE: 1980 SURGASAR Data

Table 3.3. Food Expenditure Participation by Province—Indonesia

	Jakarta	West Java	Central Java	DI Yogyakarta	East Java	Bali/ Nusa Tenggara	Sumatera	Kalimantan	Sulawesi	Others
	percent									
Cereals										
Rice	96.7	99.7	93.6	91.7	93.8	98.3	99.6	99.5	97.1	97.4
Corn	7.1	8.6	18.3	17.4	41.0	40.7	5.7	5.6	35.7	10.4
Wheat	16.3	10.9	6.3	8.3	7.5	8.3	11.2	19.7	18.4	23.4
Root and Tubers	43.4	60.5	68.7	61.5	57.3	45.2	65.7	54.0	45.7	72.7
Cassava	17.7	41.9	52.5	44.0	42.4	33.0	36.5	40.7	30.4	48.1
Sweet potatoes	13.4	19.2	25.0	18.3	18.4	13.3	17.2	11.5	10.3	13.0
Potatoes	25.9	18.6	10.3	14.7	12.9	4.3	31.5	13.2	7.1	6.5
Beans	92.0	82.7	90.4	83.5	86.2	52.8	62.8	49.6	40.0	41.6
Soybeans	91.3	70.2	89.7	83.5	84.8	32.2	52.2	34.0	14.4	22.1
Fruits	76.7	70.5	67.9	57.8	58.1	67.0	70.4	81.7	78.9	76.6
Vegetables	95.0	96.2	98.2	86.2	98.7	96.1	99.6	98.3	96.0	96.1
Fish	89.2	91.6	73.9	36.7	80.2	78.7	96.5	97.4	98.3	96.1
Meat and poultry		17.7	13.7	16.1	15.0	30.2	23.6	27.8	20.1	32.3
Dairy products	48.4	19.0	13.8	24.8	14.4	11.7	32.2	32.8	25.9	44.2
Fats and oils	93.9	90.4	94.9	88.1	94.6	88.5	96.5	93.8	90.6	97.4
Beverages	89.9	91.3	95.0	91.7	90.4	73.7	88.4	94.9	91.4	92.2
Prepared foods	89.6	75.3	79.8	93.6	59.1	59.6	63.1	63.1	57.3	66.2
Sugar	94.3	92.0	93.7	93.6	95.8	78.0	94.1	98.9	91.6	96.1

SOURCE: 1980 SURGASAR Data

Table 3.4. Family Size, Weekly Food Expenditure and Food Budget Shares

	Sample Households	Family Size	Food Expenditure (Rp/week)	Food Share (%)
Indonesia--Rural	4,502	4.8	6,602	74.9
Java	2,023	4.5	4,710	72.0
off-Java	2,479	5.1	8,144	76.4
Expenditure Group: (Rp/person/month)				
under 7,200	2,338	5.2	4,617	79.0
7,200-11,400	1,267	4.7	7,456	76.8
11,401-19,000	644	4.1	9,718	72.6
above 19,000	232	3.5	13,028	62.8
Indonesia--Urban	3,608	5.4	9,366	63.7
Java	1,711	5.2	8,276	60.5
off-Java	1,897	5.5	10,348	66.1
Expenditure Group: (Rp/month/person)				
under 7,200	908	6.0	5,558	74.0
7,200-11,400	1,145	5.6	8,453	70.2
11,401-19,000	944	5.1	11,005	63.8
above 19,000	611	4.3	14,196	53.6

SOURCE: 1980 SURGASAR Data

Table 3.5. Average Food Budget Shares by Location and Region

	Rural			Urban		
	Java	off-Java	Indonesia	Java	off-Java	Indonesia
	percent					
Cereals	40.2	35.6	37.1	27.2	27.4	27.3
Rice	36.5	33.6	34.6	26.6	26.7	26.7
Corn	3.5	1.4	2.1	0.3	0.3	0.3
Wheat	0.1	0.5	0.4	0.3	0.4	0.4
Root and Tubers	2.9	2.7	2.8	1.4	1.5	1.4
Cassava	1.9	1.4	1.5	0.4	0.5	0.5
Sweet potatoes	0.5	0.4	0.4	0.3	0.2	0.2
Potatoes	0.4	0.5	0.4	0.6	0.7	0.6
Beans	5.2	2.0	3.1	6.2	3.2	4.5
Soybeans	4.0	0.8	1.8	4.8	1.8	3.1
Fruits	4.1	4.3	4.3	5.1	4.5	4.7
Vegetables	6.9	8.4	8.0	6.9	9.8	8.6
Fish	6.7	12.5	10.6	6.2	14.0	10.8
Meat and poultry	3.3	5.2	4.6	7.1	5.9	6.4
Eggs	1.6	1.7	1.7	3.5	2.8	3.1
Dairy products	0.7	1.1	1.0	3.1	2.8	2.9
Fats and oils	4.8	4.6	4.7	4.1	4.3	4.2
Beverages and tobacco	10.3	10.8	10.7	10.6	10.9	10.8
Prepared foods	6.5	3.7	4.6	12.7	6.6	9.2
Sugar	3.6	4.3	4.1	3.1	3.6	3.4
Other foods	3.2	2.5	2.7	2.8	2.7	2.7
Food Expenditure	72.0	76.4	74.9	60.5	66.1	63.7

SOURCE: 1980 SURGASAR Data

Table 3.6. Average Food Expenditure Shares by Province--Rural Indonesia

	Java-Bali					Outer-Java			
	West Java	Central Java	DI Yogyakarta	East Java	Bali	Sumatera	Kalimantan	Sulawesi	Others
	percent								
Cereals	44.1	39.5	35.2	35.2	38.5	35.5	31.3	40.1	38.4
Rice	43.3	34.7	32.8	27.6	36.9	34.8	30.5	33.8	31.7
Corn	0.5	4.7	2.3	7.4	1.6	0.3	0.2	5.3	6.1
Wheat	0.2	0.1	0.1	0.1	0.0	0.4	0.6	0.7	0.6
Root and Tubers	2.2	3.9	3.4	3.1	3.7	2.8	1.4	3.5	4.0
Cassava	1.1	2.8	2.5	2.4	1.3	1.3	0.9	1.5	2.3
Sweet potatoes	0.4	0.7	0.5	0.4	1.8	0.4	0.2	0.6	0.2
Potatoes	0.5	0.2	0.4	0.2	0.1	0.7	0.2	0.2	0.1
Beans	4.0	6.3	8.3	6.1	3.1	2.2	1.6	1.6	2.8
Soybeans	2.4	5.6	7.1	5.1	1.5	1.0	0.5	0.1	0.7
Fruits	4.7	4.0	3.6	3.5	3.3	3.5	6.0	5.2	5.3
Vegetables	5.4	8.4	8.8	7.7	8.5	9.7	6.5	6.1	7.2
Fish	9.4	4.1	0.8	5.4	6.1	11.6	16.6	13.0	9.4
Meat and poultry	3.5	2.9	2.9	3.6	3.6	5.2	4.6	5.0	7.2
Eggs	1.3	1.5	2.8	1.9	2.2	1.7	1.9	1.5	1.4
Dairy products	0.8	0.6	1.4	0.7	0.5	1.2	1.2	0.7	1.1
Fats and oils	3.8	5.4	6.1	5.6	5.5	4.9	4.1	4.4	4.4
Beverages and tobacco	9.4	9.3	8.4	12.8	11.3	11.4	11.5	8.4	8.8
Prepared foods	6.0	7.4	11.1	5.8	8.5	3.8	4.0	3.0	3.1
Sugar	2.5	4.1	5.2	5.0	2.4	3.9	5.4	5.0	3.7
Other foods									
Food Expenditure	74.9	70.5	64.3	69.2	74.8	76.0	77.1	76.9	76.9

SOURCE: 1980 SURGASAR Data

Table 3.7. Average Food Expenditure Shares by Providence--Urban Indonesia.

Food Group	Jakarta	West Java	Central Java	DI Yogyakarta	East Java	Bali	Sumatera	Kalimantan	Sulawesi	Others*
	percent									
Cereals										
Rice	20.74	30.23	30.0	20.28	25.01	30.93	26.71	21.40	28.40	26.91
Corn	0.08	0.13	0.24	0.22	1.04	0.25	0.12	0.13	0.45	1.45
Wheat	0.21	0.34	0.20	0.17	0.29	0.17	0.33	0.51	0.68	0.72
Root and Tubers										
Cassava	0.19	0.44	0.76	0.45	0.60	0.11	10.39	0.39	0.55	1.06
Sweet potatoes	0.16	0.27	0.37	0.22	0.39	0.59	0.22	0.14	0.12	0.13
Potatoes	0.54	0.84	0.43	0.42	0.53	0.61	0.83	0.62	0.30	0.29
Beans										
Soybeans	4.20	4.08	6.00	5.37	5.60	2.99	1.97	1.73	0.87	1.85
Fruits	5.25	5.01	6.44	5.52	5.16	4.90	3.96	7.11	5.27	4.05
Vegetables	6.98	6.17	7.84	6.41	7.31	6.53	10.61	8.10	7.09	8.43
Fish	6.14	8.80	3.06	1.71	5.48	5.47	12.77	17.25	16.66	9.93
Meat and poultry	7.48	6.75	6.45	5.52	9.08	11.33	5.99	6.20	4.61	8.50
Eggs	3.92	3.18	3.35	3.83	3.42	3.56	2.82	3.55	2.30	2.05
Dairy products	3.76	2.06	2.50	2.66	3.30	2.23	2.72	2.83	3.41	3.26
Fats and oils	4.19	3.55	4.15	4.70	4.40	4.15	4.54	3.46	3.61	4.70
Beverages and tobacco	11.37	10.39	9.38	8.59	10.67	8.18	10.84	11.31	10.69	10.35
Prepared foods	18.37	10.82	9.99	24.85	8.29	11.35	8.05	6.34	6.00	7.04
Sugar	2.64	2.15	4.57	5.03	4.11	2.27	3.35	4.05	4.32	3.49
Other foods	2.45	2.76	2.94	2.77	3.40	2.10	2.30	3.04	2.28	3.28
Food Expenditures	54.31	62.99	63.46	52.79	60.82	51.07	64.73	62.81	65.32	63.70

*The other provinces are Nusa Tenggara, Maluku, and Irian Jaya

SOURCE: 1980 SURGASAR Data

Table 3.8. Average Food Expenditure Shares by Income Group

Food Group	Rural				Urban			
	Expenditures (Rp/person/month)				Expenditures (Rp/person/month)			
	under 7,200	7,200-11,400	11,401-19,000	above 19,000	under 7,200	7,200-11,400	11,401-19,000	above 19,000
	percent							
Cereals	47.1	36.4	29.1	20.5	42.2	32.2	24.3	16.8
Rice	42.8	34.8	27.6	19.2	41.2	31.7	23.7	16.2
Corn	4.0	1.3	0.9	0.4	0.8	0.2	0.2	0.2
Wheat	0.2	0.3	0.6	0.8	0.2	0.3	0.4	0.4
Root and Tubers	3.3	2.6	2.4	2.5	1.8	1.4	1.3	1.3
Cassava	2.2	1.3	1.1	1.0	1.1	0.5	0.3	0.2
Sweet potatoes	0.4	0.5	0.4	0.4	0.4	0.3	0.2	0.1
Potatoes	0.2	0.4	0.7	0.8	0.3	0.6	0.7	0.9
Beans	3.1	2.9	2.8	3.9	4.9	4.4	4.4	4.3
Soybeans	2.3	1.6	1.4	1.3	3.9	3.2	2.9	2.5
Fruits	3.2	4.3	5.1	6.5	2.9	3.8	4.8	6.7
Vegetables	7.8	8.2	7.7	8.0	8.8	9.2	8.9	7.5
Fish	8.3	11.4	12.7	12.0	7.8	11.3	11.6	10.8
Meat and Poultry	1.7	3.9	7.5	11.2	1.8	3.8	7.2	11.0
Eggs	1.0	1.7	2.1	2.7	1.7	2.6	3.5	3.9
Dairy products	0.3	1.1	1.5	2.1	1.2	2.1	3.3	4.4
Fats and Oils	4.8	4.7	4.6	4.1	4.7	4.5	4.2	3.8
Beverages & Tobacco	9.2	11.0	12.0	12.2	9.5	11.1	11.4	10.3
Prepared foods	3.6	4.6	5.2	6.7	6.1	7.2	8.9	13.4
Sugar	4.0	4.3	4.1	4.0	4.0	3.7	3.3	2.0
Other foods	2.5	2.6	2.7	3.1	2.6	2.6	2.6	2.6
Food Expenditure	79.0	76.8	72.6	62.8	74.0	70.2	63.8	53.6

SOURCE: 1980 SURGASAR Data

Table 3.9. Weekly per Capita Food Consumption (kg) for Reporting Households by Region, Location, and Expenditure Group--Indonesia

Food Groups	Java	outer Java	Rural	Urban	Under 7,200	7,200-11,400	11,401-19,000	above 19,000	Indonesia
Rice									
Rice	2.11	2.43	2.39	2.19	1.98	2.47	2.59	2.63	2.30
Rice products	0.54	0.60	0.53	0.58	0.44	0.52	0.68	0.76	0.56
Corn									
Fresh corn/ husks	0.67	0.90	1.04	0.50	0.75	0.69	1.21	0.81	0.82
Dried corn with husks	0.80	1.55	1.58	0.81	1.45	0.84	1.53	0.37	1.37
Corn grain and flour	1.38	1.12	1.43	0.59	1.30	1.07	0.81	0.69	1.26
Wheat	0.12	0.21	0.18	0.17	0.11	0.16	0.22	0.59	0.18
Cassava									
Fresh cassava	0.70	0.80	0.94	0.46	0.77	0.69	0.71	0.88	0.75
Dried cassava	1.07	1.33	1.34	0.79	1.22	0.97	1.67	1.59	1.20
Sweet potatoes	0.55	0.60	0.75	0.36	0.56	0.58	0.58	0.59	0.57
Potatoes	0.19	0.18	0.22	0.16	0.13	0.18	0.21	0.30	0.19
Fish									
Fresh fish	0.19	0.41	0.35	0.35	0.23	0.36	0.43	0.54	0.35
Dried fish	0.09	0.13	0.13	0.10	0.10	0.13	0.14	0.14	0.12
Canned fish	0.11	0.10	0.09	0.10	0.06	0.09	0.10	0.16	0.10
Fruits	0.59	0.66	0.68	0.57	0.43	0.60	0.77	1.18	0.63
Vegetables	0.62	0.70	0.63	0.69	0.48	0.67	0.85	1.14	0.66
Meats & poultry	0.19	0.23	0.26	0.18	0.14	0.17	0.25	0.36	0.22
Dairy products	0.22	0.16	0.14	0.19	0.10	0.13	0.16	0.37	0.18
Beans									
Soybeans	0.36	0.26	0.27	0.34	0.23	0.32	0.40	0.57	0.32
Other	0.12	0.14	0.15	0.11	0.11	0.12	0.15	0.18	0.13
Household size	4.8	5.3	4.8	5.4	5.4	5.1	4.7	4.1	5.1

SOURCE: 1980 SURGASAR Data

Table 3.10. Per Capita Daily Availability of Nutrients--Indonesia

Nutrients	Unit	Java	outer Java	Rural	Urban	Indonesia	GNAR
Calories	Kcal	1740	2059	2029	1767	1912	1.01
		(675)	(819)	(833)	(662)	(773)	
Protein	gm	43	51	48	45	47	1.09
		(19)	(22)	(22)	(20)	(21)	
Carbohydrates	gm	331	389	391	327	363	
		(128)	(160)	(161)	(122)	(149)	
Calcium	mg	299	264	296	261	280	
		(240)	(199)	(248)	(174)	(219)	
Iron	mg	12.1	10.4	12.4	9.7	11.2	0.78
		(10.0)	(7.6)	(10.6)	(5.7)	(8.8)	
Vitamin A	i.u.	4223	4194	4593	3724	4207	
		(4886)	(5620)	(6275)	(3688)	(5294)	
Thiamine	mg	0.97	0.90	1.12	0.69	0.93	
		(1.05)	(0.79)	(1.15)	(0.41)	(0.92)	
Vitamin C	mg	68	78	81	62	73	
		(71)	(92)	(94)	(64)	(83)	

SOURCE: 1980 SURGASAR Data

NOTE: (a) Estimated Minimum Per Capita Daily Requirements

Nutrients	Unit	Rural	Urban	Indonesia
Calories	kcal	1939	1929	1900
Protein	gm	40.43	40.41	43.04
Iron	mg	13.75	13.78	14.33
Thiamine	mg	0.79	0.78	--

SOURCE: Don Chernichovsky and Deg Astra Meesook. Urban-Rural Food and Nutrition Consumption Patterns in Indonesia. PHN Technical Note 85-5. World Bank. July 1985; LIPI. Lapran Umum dan Kesimpulan Subtema Gizi Widyakarya Nasionil Pangan dan Gizi. Buku I. Jakarta: March 1979.

(b) Gross Nutrient Adequacy Ratio (GNAR) is a measure of a ratio of daily nutrient availability to estimated minimum daily requirement.

Table 3.11. Per Capita Daily Availability of Nutrients for Reporting Households by Expenditure Group--Indonesia

Nutrients	Unit	Expenditures (Rp/person/month) Under 7200	7200-11400	11401-19000	above 19000
Calories	kcal	1545 (487)[a]	1951 (577)	2250 (797)	2567 (1223)
Protein	gm	35 (12)	48 (15)	58 (21)	69 (32)
Fat	gm	20 (12)	29 (15)	39 (19)	53 (29)
Carbohydrates	gm	305 (101)	373 (119)	415 (162)	454 (237)
Calcium	mg	237 (220)	258 (180)	321 (208)	430 (256)
Iron	mg	10.3 (9.9)	10.5 (7.7)	12.2 (7.8)	14.8 (8.6)
Vitamin A	iu	3438 (4548)	4279 (5241)	4799 (5673)	5824 (6670)
Thiamine	mg	0.95 (1.12)	0.86 (0.77)	0.93 (0.73)	1.06 (0.72)
Vitamin C	mg	59 (68)	73 (77)	86 (91)	106 (112)

SOURCE: 1980 SURGASAR Data

[a]The numbers in parentheses are standard deviations.

Table 3.12. Daily Per Capita Availability of Nutrients by Calorie Consumption Group--Indonesia

Nutrients	Unit	Calorie Consumption Group 822-1651	1652-1949	1950-2372	2373-4118
Protein	gm				
Rural		31.8	42.7	50.6	69.2
Urban		33.6	46.0	56.3	74.1
Calcium	mg				
Rural		208.2	244.9	296.4	426.0
Urban		188.5	259.0	326.4	437.4
Iron	mg				
Rural		8.8	10.4	12.6	17.7
Urban		7.1	9.7	12.0	15.9
Vitamin A	iu				
Rural		3047.8	3897.7	4708.6	6691.2
Urban		2757.6	3828.5	4666.3	5916.1
Thiamine	mg				
Rural		0.8	0.9	1.1	1.6
Urban		0.5	0.7	0.8	1.2
Vitamin C	mg				
Rural		55.0	69.9	84.4	118.2
Urban		44.9	64.3	80.4	102.5

SOURCE: 1980 SURGASAR Data

Table 3.13. Distribution of Households by Calorie Group--Indonesia

Calorie Group (Percentile)	Mean (Calorie/Person)	Range (Calorie/Person)
20	1170	822-1372
40	1519	1373-1651
60	1797	1652-1949
80	2143	1950-2372
100	2864	2373-4118

SOURCE: 1980 SURGASAR Data

Table 3.14. Percentage Distribution of Reporting Households by Region and Calorie Consumption Group--Indonesia

Region	Number of Households	Calorie Consumption Group			
		822-1651	1652-1949	1950-2372	2373-4118
		percent			
Java					
Rural	1997	43.04	19.88	18.54	14.79
Urban	1655	54.74	17.40	14.98	9.73
Sumatra					
Rural	1429	21.06	20.50	23.72	31.42
Urban	1207	37.86	24.11	19.72	16.82
Bali/Nusa Tenggara					
Rural	305	38.69	14.10	14.43	24.26
Urban	152	39.47	17.11	22.37	17.11
Kalimantan					
Rural	348	23.85	16.95	22.13	33.33
Urban	230	35.65	16.09	23.04	23.04
Sulawesi					
Rural	406	27.83	15.02	19.46	30.79
Urban	291	41.58	20.27	19.59	16.84
Maluku/Irian Jaya					
Rural	45	26.67	24.44	24.44	17.78
Urban	32	53.13	9.38	18.75	9.38

SOURCE: 1980 SURGASAR Data

Table 3.15 Distribution of Reporting Household Heads by Education, Age, and Calorie Consumption Group (in percentage)

	Calorie Group							
	Rural				Urban			
	822-1651	1652-1949	1950-2372	2373-4118	822-1651	1652-1949	1950-2372	2373-4118
	percent							
Education								
No schooling or partly primary school	35.70	28.69	31.82	29.62	17.53	14.49	16.19	15.76
Primary school	33.52	37.82	33.48	32.17	24.35	19.18	17.30	18.99
Junior high school	28.87	29.27	31.61	34.62	41.94	40.34	39.47	38.59
Senior high school	1.91	4.22	3.07	3.58	16.19	25.99	27.04	26.67
Age								
Under 30	14.68	15.11	17.45	18.02	15.03	15.77	17.61	24.85
30-49	58.63	55.27	50.16	50.28	57.33	55.97	54.40	42.83
50-59	15.77	18.27	18.66	17.74	17.04	16.19	19.18	17.37
60 and over	10.92	11.36	13.72	13.96	10.59	12.07	8.81	14.95
Headship								
Male	88.67	91.10	88.14	88.11	90.08	90.48	88.68	84.65
Female	11.63	8.90	11.86	11.89	9.92	9.52	11.32	15.35

SOURCE: 1980 SURGASAR Data

Table 3.16. Percentage Distribution of Reporting Household Heads by Main Occupation and Calorie Group

Main Occupation	Calorie Group							
	Rural				Urban			
	822-1651	1652-1949	1950-2372	2373-4118	822-1651	1652-1949	1950-2372	2373-4118
	percent							
Professionals and Administrators	1.77	2.46	1.65	2.36	3.41	4.97	6.92	4.24
Clerical	1.64	2.58	2.41	1.98	11.44	16.90	14.31	14.55
Sales/Service	9.56	7.26	8.12	6.89	28.97	27.56	24.06	25.86
Production Workers/ laborer	12.97	10.30	10.21	6.51	31.83	27.13	26.89	23.67
Agriculture (Farming, Fishery & Forestry)	69.22	72.83	72.01	77.45	9.31	8.66	8.02	12.53
Others	4.85	4.57	5.60	4.81	15.03	14.77	19.81	19.19

SOURCE: 1980 SURGASAR Data

Table 3.17. Percentage Distribution of Reporting Households by Expenditure and Calorie Group

Expenditure Group (1000/RP/Person/Month)	Calorie Group							
	Rural				Urban			
	822-1651	1652-1949	1950-2372	2373-4118	822-1651	1652-1949	1950-2372	2373-4118
	percent							
Under 3.0	12.63	0.70	0.33	0.28	1.58	0.28	0.00	0.00
3.0-3.9	21.84	5.39	2.74	0.75	5.78	0.28	0.16	0.00
4.0-4.9	22.18	13.23	6.59	1.32	9.80	1.70	0.63	0.40
5.0-5.9	15.43	19.91	12.84	4.91	11.93	3.84	1.89	0.61
6.0-7.9	16.79	29.63	26.78	15.85	22.22	18.47	8.49	2.63
8.0-9.9	5.67	15.81	20.64	19.34	16.92	19.32	13.21	7.47
10.0-14.9	4.57	12.53	21.95	33.30	20.27	34.09	33.65	27.07
15.0-19.9	0.61	1.76	5.82	13.68	6.57	12.78	20.28	20.00
20.0-29.9	0.14	0.70	1.98	8.49	3.83	7.81	16.67	27.88
30.0-39.9	0.07	0.23	0.33	1.79	0.79	0.99	3.77	10.10
40.0 and over	0.07	0.12	8.00	0.28	0.30	0.43	1.26	3.84

SOURCE: 1980 SURGASAR Data

Table 3.18. Food Expenditure Shares by Calorie Consumption Group (Cal/person/week)

	Calorie Group							
	Rural				Urban			
Expenditure Group	822-1651	1652-1949	1950-2372	2373-4118	822-1651	1652-1949	1950-2372	2373-4118
Cereals								
Rice	28.2	27.3	25.8	24.1	18.0	18.0	15.9	15.9
Others	2.2	1.7	1.7	2.3	0.4	0.5	00.6	1.0
Roots and Tubers	1.7	1.8	2.1	2.3	0.8	0.9	01.0	1.2
Beans	2.3	2.1	2.1	2.4	2.7	2.8	03.1	3.3
Fruits	2.6	2.8	3.4	3.7	2.5	2.9	03.5	3.8
Vegetables	6.1	5.9	6.0	6.0	5.4	5.7	05.5	5.7
Fish	7.2	8.0	8.3	8.4	6.2	7.1	07.2	8.0
Meat and poultry	1.2	2.9	3.6	4.8	3.0	4.1	05.4	5.3
Dairy products	1.6	1.8	2.1	2.3	3.3	4.0	04.4	4.4
Fats and oils	3.4	3.5	3.5	3.6	2.6	2.8	02.8	2.9
Sugar and Sweetner	3.0	3.1	3.1	3.1	2.2	2.5	02.1	2.5
FEXP	67.2	67.1	67.7	69.1	55.5	5.78	57.3	60.2
HH Size	5.34	5.08	4.68	4.04	6.05	5.54	4.97	3.85

SOURCE: 1980 SURGASAR Data

References

Chernichovsky, D. and D.A. Meesook. Rural Food and Nutrition Consumption Patterns in Indonesia. PHN Technical Note 85-5. World Bank. July 1985.

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CHAPTER 4

FOOD DEMAND AND THE AIDS

The consumer demand model applied to study the behavior of Indonesian households has important implications for the resulting demand parameters. If these parameters are in turn used to evaluate food policy alternatives, it is important that the implications of the assumed demand structure be taken into consideration. The objective of this chapter is to describe one of the models selected for the empirical application, and examine the associated set of consumer demand parameters. A complete review of consumer demand theory positioning this particular model structure in the available literature is provided in Appendix C.

Among the empirical demand systems applied for Indonesia, the Almost Ideal Demand System (AIDS) yielded the most robust estimates. The estimates from the alternative systems, a multinomial linear logit model, and a local stochastic approximation are included for comparison in Appendices D and E.

Food consumption behavior was evaluated in several ways. In each case, urban and rural households were examined separately. First Engel curve parameter estimates for 13 commodity groups were estimated. (Also, household size effects were evaluated, holding constant the expenditure level.) Finally, a complete food demand system was estimated using a linear version of the AIDS model. The resulting parameter estimates can be used to derive expenditure, own price and cross price elasticities, as well as a household size elasticity.

Empirical Model

An estimable variant of the Almost Ideal Demand System (Deaton and Muellbauer, 1980) with the addition of a household size variable (Ray 1980) can be specified as

$$(4.1) \qquad \omega_i = \alpha_i + \sum_j \gamma_{ij} \ln P_j + \beta_i \ln (Y/P) + \Theta_i \ln HHS + U_i$$

where ω_i is the average budget share of the ith commodity, P_j is the jth commodity price, Y is per cpaita expenditure, P is an aggregate price index, and HHS is household size. Of course, α, γ, β, and Θ are parameters to be estimated.

Average budget share, the regressand of the model (4.1), is the fraction of total household weekly expenditure allocated to the ith commodity. The aggregate price (P), used to normalize nominal per capita expenditure (Y), is approximated by applying Stone's (1953) price index, $\ln P = \Sigma W_K \ln P_k$. This is an approximation to the true price index,

$$(4.2) \qquad \ln P = \alpha_o + \Sigma \alpha_j \ln P_j + 1/2 \Sigma \Sigma \gamma_{ij} \ln P_i \ln P_j$$

and its use makes the model in Equation (4.1) linear in the parameters. Thus, in model (4.1) average budget shares are related linearly to the prices of composite commodities, income, and household size.

The error terms for each equation in the demand system, U_i, are assumed to satisfy the standard assumptions of normality, zero mean, and constant variance. Because of possible interactions of expenditures among commodities within the system, the error terms across equations are assumed to be contemporaneously correlated:

$$(4.3) \qquad E(U) = 0$$

$$(4.4) \qquad V(U) = \Sigma \times I$$

where U is the error vector for all equations in the system and Σ is a symmetric covariance matrix with nonzero off-diagonal elements. With these cross-equation relationships, the demand system can be estimated as a set of "seemingly unrelated regressions" (Zellner 1962). The seemingly unrelated regression procedure was applied to estimate the structural parameters of the AIDS.

For the demand system in Equation (4.1) to conform to consumer demand theory, the structural parameters are further constrained to satisfy:

(4.5) adding up condition (Engel aggregation): $\Sigma\ \alpha_i = 1,\ \Sigma\ \beta_i = 0,\ \sum_i \gamma_{ij} = 0;$

(4.6) Homogeneity : $\sum_j \gamma_{ij} = \Theta_i = 0;$

(4.7) Symmetry : $\gamma_{ij} = \gamma_{ji}$.

No attempt was made to test the validity of these restrictions. It was assumed throughout that the model as restricted represented the demand structure of the Indonesian households. Hence, the estimation was undertaken with a direct imposition of parametric restrictions (4.5) through (4.7).

A nonprice "Engel curve" version of the AIDS demand model

(4.8) $$\omega_i = \alpha_i + \beta_i \ln Y + \Theta_i \ln HHS + \gamma_i DRE + U_i$$

was estimated as a prelude to the estimation of the full system (Equation 4.1). A regional dummy variable (DRE = 1 for Java and DRE = 0 otherwise) was used instead of the composite of commodity prices to proxy variations in budget shares due to differences in prices, availability of commodities, customs, habits, etc. The intent was primarily to isolate the effects of nonprice variables on household expenditure patterns.

Engel Curves

Assuming prices constant across households except as reflected in DRE, the semilog model in Equation (4.8) was estimated. That is, mean budget shares (ω_i's) were linearly related to the logarithm of per capita weekly expenditure, the logarithm of family size, and the binary regional variable. The objective of this exercise was to establish relationships among the budget share and the nonprice variables.

The structural parameters were estimated equation by equation, using ordinary least squares (OLS). These estimates are given in Table 4.1 for urban households and in Table 4.2 for rural households. The variables in each equation jointly explained statistically significant systematic variations in household-specific budget shares, i.e., the F-values were significant at the one percent level. The Engel curve for fruits in the case of rural households was the only exception. A large number of the estimated structural coefficients of the Engel curves were significant (t-values are equal or greater than 2). The most notable exceptions were the income coefficients for beans, fruits, and fish and the household size coefficients for palawija, fruits, and prepared foods in the rural area. For the urban area, the income coefficients for fish and prepared foods, and the household size coefficient for fish were not statistically significant. Based on simple counts of numbers of statistically significant coefficients, the models fit better for the urban than for the rural households.

Commodities with negative income coefficients were rice, palawija crops, beans (for urban households in particular), vegetables, oils, beverages, and sugar. The shares for these commodities declined with increased household income. For fruits, fish, meats and dairy products,

prepared foods and nonfoods, the income coefficients were positive. A rise in the level of income was accompanied by increases in the shares of these commodities. The signs of these coefficients suggest that the staple food crops, rice and palawija in particular, were necessities. Fruits, fish, animal products, and nonfoods fell into the category of "luxuries".

The expenditure elasticities calculated and reported in Tables 4.3 and 4.4 support the assertions regarding income induced behavior from the structural parameters in Tables 4.1 and 4.2. Commodities with negative income coefficients had expenditure elasticities of less than unity. That is, the percentage increase in demand for these commodities was less than the percentage increase in income. On the other hand, commodities like animal products, prepared foods, and nonfoods had expenditure elasticities greater than one. The proportional increase in demand for these commodities exceeded the proportional increase in income. Households allocated an increasing share of their budgets to these income elastic commodities as their income levels increased.

Variations in expenditure elasticities between rural and urban households were more in differences of magnitude. Similar commodities fell in the categories of necessities and luxuries. But, as reflected in the values of the expenditure elasticities, rural households were more sensitive to changes in income than urban households. This strong responsiveness to income could be related to the relatively lower average income in rural areas.

For household size, the estimated coefficients in Tables 4.1 and 4.2 measure marginal effects of household size, given a constant per capita expenditure, or budget shares. The parameter estimates for all commodity groups for both rural and urban households were negative. Thus, for a given

level of per capita expenditure, an increase in household size resulted in a corresponding decline in the budget share. Alternatively, if the size effects are evaluated at a constant level of household expenditure, the marginal effects follow from the expression:

$$\frac{\partial \ln \omega_i}{\partial \ln HHS} = (\Theta_i - \beta_i)/\omega_i. \tag{4.9}$$

Household size elasticities based on Equation (4.9) are given in Table 4.3 for urban and Table 4.4 for rural households. Household size had a positive effect on the budget shares of the income inelastic commodities. It had the opposite effect on the budget shares of the "luxury" commodities. According to these results, an increase in family size (given a constant level of household expenditure) led to reallocation within the consumption bundle, with increased consumption of necessities, rice and palawija crops. The concentration on rice was more marked among the urban (.7022) than among the rural households (.3720).

The parameter estimates for the regional binary variable (DRE = 1 for Java and DRE= 0 for outer Java) show that there were variations in household budget allocation patterns. The mean budget shares of the staple crops (rice and palawija) were higher in outer Java than in Java. Fish also had a higher share among the households in outer Java. The income elastic commodities (fruits, meats, dairy products, and nonfood) had relatively higher budget shares in Java compared with outer Java. These patterns suggest that in Java there was a shift in budget allocations toward the more income elastic commodities.

Food Demand System

A linear version of the AIDS model (Equation (4.1)) was used to estimate the food demand system for rural and urban households. The variables in Equation (4.1) were defined to concur with total food expenditure. That is, average food budget shares were used as dependent variables instead of average shares of total expenditure. Per capita food expenditure was substituted for per capita total expenditure as the income proxy. The associated aggregate price index (P) was constructed exclusively using food commodity prices. Within the food subsystem, the average food budget shares were then related to composite food prices, real per capita food expenditure, and household size.

Recall that the estimation was completed with aggregation, homogeneity, and symmetry restrictions imposed. Furthermore, the estimates were constrained by adding consistency restrictions. That is, parameter estimates from the more aggregate four-commodity level were used to restrict the parameter estimates for the disaggregated seven-commodity level. These restrictions were used to constrain the estimates to behave consistently among the different aggregation levels (Hassan and Johnson 1986). Final estimates for urban and rural household's respectively, are given in Tables (4.5) and (4.6).

Most of the estimated demand coefficients had t-values that were equal to or greater than 2.0. That is, the food budget shares were responsive to composite food prices, income and household size. The food budget shares were strongly responsive, in particular, to own prices and real per capita food expenditure. Among the cross prices, the rice price had the most significant influence on the food budget shares. There were more significant and larger cross price coefficients for urban than

rural households, suggesting that the urban households are more sensitive to prices and income, or that the model was less representative of the demand structure of the rural households.

Except for rice and palawija, the estimated parameters for the income variable were positive. Increased real per capita food expenditure led to increased budget shares of beans, vegetables and fruits, fish, meats and dairy products, and decreased shares for rice and palawija crops. The negative relationships of the budget shares of rice and palawija crops indicated that these food crops were basics or necessities.

Own prices had largely positive marginal effects on the food budget shares. For the shares to increase with own price, the proportionate change in quantity demanded had to be less than the proportionate change in own price, given the level of income. Own price elasticities for these food commodities were expected to be less than unity.

The signs of the cross price elasticities were mixed. The only exception was in the responses of nonrice food budgets to a change in price of rice, where all cross price effects were negative. An increase in the price of rice resulted in a reduction in food budget shares of other foods.

The demand elasticities were computed using the formulae:

(4.10) expenditure elasticity: $\eta_{iY} = \frac{\beta_i}{\omega_i} + 1$

(4.11) own price elasticity : $\varepsilon_{ii} = \frac{\gamma_{ii}}{\omega_i} - (1 + \beta_i)$ and,

(4.12) cross price elasticity: $\varepsilon_{ij} = \frac{\gamma_{ij}}{\omega_i} - \beta_i \frac{\omega_j}{\omega_i}$.

Equation (4.9) was used to evaluate household size elasticities, for constant household expenditure. These estimated elasticities are reported in Table 4.7 for urban households and in Table 4.8 for rural households. The mean budget shares of the full sample were applied in evaluating the elasticities. Variations of these elasticities for low and high income household groups are given in Table 4.9.

The uncompensated own price elasticities were negative for all the food groups. Changes in own prices had an inverse effect on quantities demanded of these commodities. A 10 percent increase in the price of rice, for example, would lead to a 5.8 percent decrease in quantity demanded for rice among urban households. For most commodities, values of the elasticities were less than unity (Tables 4.7 and 4.8). Rice, the basic staple crop, was the least responsive to changed own price. Because most of these commodities were price inelastic, increased own price would increase the expenditure on these commodities. Also, for a given level of income, the budget shares responded positively to income (Tables 4.5 and 4.6). The impact was stronger for commodities less sensitive to own prices.

There are important variations in the estimated own price elasticities by region and income level (Table 4.9). With the exception of vegetables and fruits, the demand responses to own prices were smaller in rural than in urban areas. Low income households were most sensitive to changes in prices of the staple crops. A 10 percent increase in the price of rice, for example, led urban low income households to cut their demand for rice demand by 6.4 percent while high income households demand decreased rice demand by only 5 percent. The responsiveness of the low income households reflected the presence of more diversified staple crops and/or the higher fraction of

income these households allocated to rice. High income households, on the other hand, were more responsive to changed prices for income elastic food commodities (i.e., meats and dairy products, vegetables and fruits).

The uncompensated cross price elasticities measuring the ratio of the percent change in quantity demanded of one commodity, say rice, to the percentage change in price of other commodity, say fish, are given in Tables 4.7 and 4.8 for urban and rural households, respectively. Food consumption was, in general, responsive to changes in relative prices. Compared to own price elasticities, the cross price elasticities had lower absolute values, suggesting that consumers were more sensitive to change in own prices.

The signs of the uncompensated cross price elasticities were not symmetric for all food commodities. In Table 4.7, for example, the demand for meats and dairy products was negative with respect to the prices of rice, beans, fruits and vegetables, but the demands for rice, beans, and fruits were positive with respect to price of meat and dairy products. This asymmetry of price responses is due to income effects. Income compensated cross price elasticities were computed to estimate effects of changes in relative prices with constant real income. These elasticities (Table 4.10 for urban and Table 4.11 for rural households) can be used to identify commodities that were net substitutes and complements. A comparison of the demand equations for rice, palawija crops, and beans suggests that these commodities were net complements. Beans, fish, and dairy products, the main protein sources, were net substitutes. Similarly, rice, fish, meats and dairy products, and fruits and vegetables were net substitutes. These results were invariant to household location (urban vs. rural).

The food expenditure elasticities were less than unity for the staple crops (rice and palawija crops). The income inelastic nature of these commodities was consistent with the negative responses of the share elasticities to income. A change in income had less impact on the marginal expenditures than on average expenditures for these commodities. The opposite was true for commodities having a positive budget share impact for income. Beans, fruits and vegetables, fish, meats and dairy products had income elasticities greater than one. As income levels increased, households responded by increasing food budget shares for these food commodities.

Expenditure elasticities declined with increased income levels. This was true for rural and urban areas and by income level. Elasticity values were higher in rural than in urban areas. Low income households were more sensitive to change in income than high income households. Households with low food budgets faced tighter income constraints and hence were more sensitive to changed income.

Household size had the opposite effect of income on food demand. The size elasticities (Tables 4.7 and 4.8) were negative for income elastic food commodities. For the staple crops, the elasticities were positive. Increased family size with constant household expenditures lead to increased the demand for staples at the expense of the income elastic foods. A 10 percent increase in family size (unadjusted), for example, increased the demand for rice by 5.6 percent. Simultaneously, the demand for beans, fruits, fish, and meats and dairy products decreased by 0.6, 2.2, 0.4 and 5.6 percent, respectively (Table 4.7).

Evaluation

The AIDS based demand estimates provide additional information to existing knowledge on consumer expenditure patterns in Indonesia. Consumers adjust their expenditure patterns to change in income, relative prices, and household size. A change in level of income induces a systematic shift in expenditure patterns. Increased income, for example, brings about a greater increase in demand for animal and manufactured food products. Proportionate adjustments to income changes are higher among low income and rural households. Opposite to an income effect, increases in household size induce consumers to reallocate their expenditures away from 'luxury' to staple foods. The AIDS based estimates also revealed plausible price responses. Food demands are relatively responsive to own price, and less to cross prices. Among the cross prices, the price of rice had the most influence on food demand.

As evident from the survey of the other studies on Indonesia (Appendix B, table 1) and our demand estimates (from the AIDS in this chapter and the multinomial linear logit model in Appendix D), there is a great deal of uncertainty about the magnitude of the demand elasticities. Comparisons of estimates from the AIDS to those from the study by Timmer and Alderman (1979), for example, reveal similar patterns of price response but there are substantial differences in magnitudes of the elasticities. In Timmer and Alderman (1979), own price elasticities of rice ranged between -.84 and -.81 for rural and urban areas, respectively. For the respective areas, the AIDS based elasticities ranged between -.24 and -.59. The income-specific own price elasticities for rice were also much higher in the Timmer and Alderman (1979) study. The diversity of these values suggests continuing effort to improve the precision of these key demand elasticity estimates.

Evaluating and improving demand parameter estimates requires an understanding of key assumptions embodied in the specification and estimation of empirical models. In estimating the AIDS, a number of assumptions were made. First, a weak form of separability was assumed to exist between food and nonfoods. Food was estimated as a subsystem of a more complete demand structure. Second, the presence of a large number of zero observations posed problems in concept and for estimation. Avoiding the interpretation of the zero values, we chose a simple solution, i.e., aggregating the commodities into composite food groups. Aside from the technical issue of the homogeneity of these groups, the aggregation of commodities into broad categories limits the potential use of the results for policy. The presence of large zero numbers among the observations also limited our capacity to provide separate demand parameters for different socioeconomic groups (region, income group, etc.). Third, the prices were implicit prices and constructed at the district level. Even though an effort was made to minimize the potential influence of household socioeconomic characteristics, quality effects were not purged from the price series. Interpretation of these constructed prices remains problematic. Finally, no effort was made to test the maintained hypotheses or the restrictions from the demand theory. As well, a similar demand structure for different regions was applied. Notwithstanding these shortcomings, we believe that improvements have been made in the stock of demand parameters available for policy analyses and in demonstrating the value of studying demand using systems based parameters like AIDS.

Table 4.1. Engel curve parameter estimates for the 13 commodity groups—urban households

Expenditure Share of	Intercept	LTEXP	LHHS	DRE	$\bar{R}^2$	
Rice	1.2341 (43.578)[a]	-.1299 (-40.042)	-.0106 (-2.956)	-.0104 (-3.225)	.5929	548.559
Palawija Crops	.0993 (10.140)	-.0083 (-7.399)	-.0067 (-5.434)	-.0038 (-3.381)	.0597	24.881
Beans	.1150 (9.437)	-.0098 (-7.029)	-.0048 (-3.108)	.0132 (9.538)	.1256	54.997
Vegetables	0.2127 (15.641)	-.0166 (-10.682)	-.0081 (-4.703)	-.0202 (-13.089)	.1834	85.445
Fruits	.0179 (1.233)	.0041 (2.441)	-.0081 (-4.393)	.0024 (1.444)	.0265	11.241
Fish	.0826 (3.847)	.00094 (.383)	-.00091 (-.337)	-.0468 (-19.152)	.2483	125.173
Meats, Poultry, and Dairy Products	-.2354 (-7.549)	.0384 (10.765)	.0080 (2.037)	.0050 (1.406)	.0911	38.682
Fats and Oils	.1204 17.908)	-.0101 (-13.084)	-.0058 (-6.843)	-.0035 (-4.584)	.1450	64.778
Prepared Foods	.0393 (1.540)	.0018 (.631)	-.0052 (-1.622)	.0165 (5.672)	.0289	12.209
Beverages	.0534 (9.107)	-.0041 (-6.175)	-.0032 (-4.306)	.0007 (.984)	.0407	16.961
Sugar and Sweeteners	.1232 (16.745)	-.0112 (-13.258)	-.0047 (-5.096)	-.0045 (-5.417)	.1444	64.483
Other Foods	.0512 (6.462)	-.0032 (-3.522)	-.0035 (-3.524)	.0047 (5.290)	.0444	18.474
Nonfoods	-.9078 (-17.104)	.1471 (24.193)	.0534 (7.954)	.0477 (7.900)	.3512	204.508

SOURCE: 1980 SURGASAR Data

[a]t-ratios in parentheses.

Table 4.2. Engel curve parameter estimates for the 13 commodity groups—rural households

Expenditure Share of	Intercept	LTEXP	LHHS	DRE	$\bar{R}^2$	F
Rice	1.0948 (18.162)[a]	-.1084 (-15.668)	-.0122 (-1.685)	-.0292 (-4.162)	.2684	89.898
Palawija Crops	.2286 (7.875)	-.0239 (-7.184)	-.00004 (-.011)	-.0031 (-.912)	.0778	21.432
Beans	.0487 (2.894)	-.0014 (-.747)	-.0050 (-2.498)	.0140 (7.142)	.0974	27.155
Vegetables	.1455 (7.374)	-.0089 (-3.922)	-.0074 (-3.145)	-.0155 (-6.765)	.0591	16.235
Fruits	.0158 (.703)	.0034 (1.311)	-.0008 (-.312)	.0032 (1.215)	.0001	.980
Fish	.0740 (2.367)	.0029 (.819)	-.0057 (-1.525)	-.0391 (-10.744)	.1759	52.736
Meats, Poultry, and Dairy Products	-.2756 (-6.308)	.0422 (8.409)	.0147 (2.813)	-.0006 (-.115)	.1076	30.326
Fats and Oils	.1293 (9.825)	-.0096 (-6.343)	-.0115 (-7.280)	-.0044 (-2.860)	.0848	23.455
Prepared Foods	-.0009 (-.036)	.0054 (1.797)	-.0025 (-.787)	.0108 (3.511)	.0168	5.145
Beverages	.0519 (4.854)	-.0034 (-2.803)	-.0029 (-2.261)	-.0003 (-.206)	.0117	3.877
Sugar and Sweeteners	.0930 (7.678)	-.0067 (-4.826)	-.0050 (-3.415)	-.0090 (-6.367)	.0575	15.782
Other Foods	.0052 (.485)	.0029 (2.325)	-.0041 (-3.209)	.0040 (3.154)	.0369	10.281
Nonfoods	-.6117 (-8.570)	.1057 (12.901)	.0415 (4.852)	.0710 (8.557)	.1915	58.414

SOURCE: 1980 SURGASAR Data

[a]t-ratios in parentheses.

Table 4.3. Average budget shares, expenditure, and household size elasticities computed at average budget shares--urban households

Commodity Group	Average Budget Share	Expenditure Elasticity	Household Size Elasticity
Rice	.1699	.2354	.7022
Palawija Crops	.0132	.3712	.1212
Beans	.0285	.6561	.1754
Vegetables	.0547	.6965	.1554
Fruits	.0310	1.1323	-.3935
Fish	.0684	xx	xx
Animal Products	.0789	1.4867	-.3853
Fats and Oils	.0270	.6259	.1593
Prepared Foods	.0554	1.0325	-.1264
Beverages	.0144	.7153	.0625
Sugar and Sweeteners	.0128	.4862	.2982
Other Foods	.0192	.8333	-.0156
Nonfoods	.4175	1.3523	-.2244

SOURCE: 1980 SURGASAR Data

Table 4.4. Average budget shares, expenditure, and household size elasticities computed at average budget shares--rural households

Commodity Group	Average Budget Share	Expenditure Elasticity	Household Size Elasticity
Rice	.2586	.5808	.3720
Palawija Crops	.0398	.3995	.5905
Beans	.0228	xx[a]	-.1579
Vegetables	.0596	.8507	.0252
Fruits	.0320	xx	xx
Fish	.0796	xx	-.1080
Meats, Poultry & Dairy Products	.0546	1.7729	-.5037
Fats and Oils	.0349	.7249	-.0544
Prepared Foods	.0329	1.1641	xx
Beverages	.0200	.8300	.0250
Sugar and Sweeteners	.0305	.7803	.0557
Other Foods	.0211	1.1374	-.3318
Nonfoods	.3112	1.3397	-.2063

SOURCE: 1980 SURGASAR Data

[a]estimated coefficient not significant.

Table 4.5. Parameter estimates for the AIDS model with aggregation, homogeneity, symmetry, and consistency restrictions--urban households

		Price								
Commodity	Intercept	Rice	Palawija	Beans	Fruits/ Veg.	Fish	Meats and Dairy Prod.	Others	LFEXP	LHHS
Rice	1.2686	.0729	-.0145	-.0319	-.0401	-.0308	-.0148	-.0630	-.1701	-.0090
	(30.7245)[a]	(8.4038)	(-5.2476)	(-4.5941)	(-6.9760)	(-13.6564)	(-6.8084)	(-18.0054)	(36.6658)	(-1.9745)
Palawija	.1348	-.0145	-.0017	.0036	-.00004	-.0075	.0032	-.00004	-.00006	-.00004
	(8.8246)	(-5.2476)	(-1.4633)	(2.7645)	(-21.4386)	(-3.7988)	(3.9088)	(-37.5547)	(-40.0798)	(-29.4324)
Beans	.1092	-.0319	.0036	-.0070	-.0227	.0237	.0020	.0035	.0043	.0013
	(5.0043)	(-4.5941)	(2.7645)	(-1.7611)	(-8.2161)	(7.4584)	(1.9898)	(2.1598)	(2.0953)	(.6317)
Fruits/Veg.	-.0724	-.0401	-.0004	-.0227	.0467	.0353	.0041	.0144	.0182	-.0158
	(-2.0027)	(-6.9760)	(-21.4386)	(-8.2161)	(10.2622)	(9.5758)	(2.7042)	(6.2010)	(5.7469)	(-5.0999)
Fish	-.1413	-.0308	-.0075	.0237	.0353	.0170	-.0088	.0155	.0077	.0030
	(-3.1498)	(-3.7988)	(7.4584)	(7.4584)	(9.5758)	(2.8157)	(-4.7912)	(5.3088)	(1.9855)	(.7786)
Meats and Dairy Products	-.3146	-.0148	.0032	.0020	.0041	-.0088	.0120	.0491	.1161	.0348
	(-11.6256)	(-6.8084)	(3.9088)	(1.9898)	(2.7042)	(-4.7912)	(5.0625)	(14.2966)	(24.1421	(7.3260)

SOURCE: 1980 SURGASAR Data

[a]t-ratios in parentheses.

Table 4.6. Parameter estimates based on AIDS model with aggregation, homogeneity, symmetry, and consistency restrictions--rural households

Commodity	Intercept	Price							LFEXP	LHHS
		Rice	Palawija	Beans	Fruits/ Veg.	Fish	Meats and Dairy Prod.	Others		
Rice	.1410 (1.1556)[a]	.2363 (8.5823)	.0013 (.2741)	-.0361 (-4.8613)	-.0389 (-5.1724)	-.0059 (-.6585)	-.0143 (-4.5566)	-.0659 (-12.2215)	-.1396 (-17.2259)	-.0024 (-.3270)
Palawija	.0994 (3.6843)	.0013 (.2741)	-.0062 (-2.1705)	.0001 (.0581)	.0009 (.3662)	-.0080 (-2.8702)	.0040 (2.3985)	.0156 (5.2348)	-.0144 (-3.1708)	-.0032 (-.7711)
Beans	.1953 (5.4660)	-.0361 (-4.8613)	.0001 (.0581)	.0085 (2.1100)	-.0122 (-4.0331)	.0074 (2.0492)	.0015 (1.3187)	-.0019 (-1.3187)	.0097 (3.4500)	-.0029 (-1.1132)
Fruits/Veg.	.0604 (1.6070)	-.0389 (-5.1724)	.0009 (.3662)	-.0122 (-4.0331)	.0288 (5.8222)	.0157 (3.6954)	.0024 (1.4140)	.0063 (2.2277)	.0239 (5.5856)	.0059 (1.4931)
Fish	-.2266 (-4.8706)	-.0059 (-.6585)	-.0080 (-2.8702)	.0074 (2.0492)	.0157 (3.6954)	.0308 (4.3469)	-.0008 (-.4456)	.0211 (6.5552)	.0108 (2.2213)	-.0045 (-1.0241)
Meats and Dairy Products	-.1912 (-6.4056)	-.0143 (-4.5566)	.0040 (2.3985)	.0015 (1.3187)	.0024 (1.4140)	-.0008 (-.4456)	.0074 (3.0048)	.0226 (5.6088)	.0816 (13.2317	.0247 (4.3552)

SOURCE: 1980 SURGASAR Data

[a] t-ratios in parentheses.

Table 4.7. Matrix of food demand elasticities--urban households

Food Group	Uncompensated Elasticities with respect to price of							Elasticity	
	Rice	Palawija	Beans	Fruits and Vegetables	Fish	Meats and Dairy Prod.	Others	Food Expenditure	Household Size
Rice	-.5785	-.0290	-.0754	-.0480	-.0415	.0349	-.0974	.4133	.5556
Palawija	-.4035	-1.0473	.1004	-.0109	-.2088	.0894	-.0008	.9983	.0001
Beans	-.5626	.0586	-1.1231	-.3965	.3942	.0232	.0449	1.0730	-.0509
Fruits and vegetables	-.2262	-.0045	-.1544	-.7148	.2163	.0093	.0694	1.1182	-.2209
Fish	-.2993	-.0705	.2106	.3091	-.8537	-.0900	.1262	1.0698	-.0399
Meats, poultry, and dairy products	-.3307	-.0066	-.0330	-.0940	-.1475	-1.0342	.1731	1.7922	-.5548

SOURCE: 1980 SURGASAR Data

Table 4.8. A matrix of food demand elasticities--rural households

Food Groups	Uncompensated Elasticities with respect to price of							Elasticity	
	Rice	Palawija	Beans	Fruits and Vegetables	Fish	Meats and Dairy Prod.	Others	Per Capita Expenditure	Household Size
Rice	-.2408	--	-.0823	-.0525	--	-.0080	-.1030	.6339	.3597
Palawija	--	-1.0867	--	--	-.1028	.0840	.2988	.7655	.1824
Beans	-1.1810	--	-.7575	-.4009	.1807	.0213	--	1.2878	-.3739
Fruits and vegetables	-.3554	--	-.0966	-.8107	.0955	.0016	.0129	1.1769	-.1332
Fish		-.0739	.0600	.1214	-.7482	--	.1623	1.0921	-.1304
Meats, poultry, and dairy products	-.5643	-.0125	-.0155	-.1071	--	-.9897	.0875	2.0137	-.7068

SOURCE: 1980 SURGASAR Data

Table 4.9. Average food budget shares, expenditure, and own price elasticities by region and expenditure class--Indonesia

	Food Commodity Group				
	Rice	Beans	Fruits and Vegetables	Fish	Meats and Dairy Prod.
1. Average Food Budget Shares					
Rural					
Low	.4230	.0326	.1284	.1081	.0534
High	.2750	.0366	.1522	.1409	.1498
Urban					
Low	.3800	.0504	.1391	.1122	.0817
High	.2225	.0493	.1568	.1268	.1896
2. Expenditure Elasticities					
Rural					
Low	.6700	1.2975	1.1861	1.0841	2.5281
High	.4924	1.2650	1.1570	1.0767	1.5447
Urban					
Low	.5524	1.0853	1.1308	1.0686	2.4211
High	.2355	1.0872	1.1161	1.0607	1.6123
3. Own Price Elasticities					
Rural					
Low	-.3018	-.7490	-.7996	-.7259	-.9430
High	-.0011	-.7775	-.8347	-.7922	-1.0322
Urban					
Low	-.6381	-1.1432	-.6825	-.8562	-.9692
High	-.5023	-1.1463	-.7204	-.8736	-1.0528

SOURCE: 1980 SURGASAR Data

Table 4.10. Matrix of compensated price elasticities--urban households

	Uncompensated Elasticities with respect to price of						
Food Group	Rice	Palawija	Beans	Fruits and Vegetables	Fish	Meats and Dairy Prod.	Others
Rice	-.4587	-.0142	-.0510	.0156	.0041	.0955	-.0129
Palawija	-.1140	-1.0115	.1592	.1428	-.0986	.2357	.2032
Beans	-.2500	.0970	-1.0599	-.2313	.5126	.1804	.2642
Fruits & vegetables	.0975	.0356	-.0885	-.5427	.3397	.1732	.2979
Fish	.0098	-.0321	.2736	.4738	-.7356	.0668	.3448
Meats, poultry & dairy products	.1890	.0577	.0726	.1819	.0503	-.7716	.5394
Others							

SOURCE: 1980 SURGASAR Data

Table 4.11. Matrix of compensated price elasticities--rural households

	Compensated Elasticities with respect to price of						
Food Group	Rice	Palawija	Beans	Fruits and Vegetables	Fish	Meats and Dairy Prod.	Others
Rice	-.0010	xx[a]	-.0609	.0331	xx	.0430	.0178
Palawija	xx	-1.0397	xx	xx	-.0130	.1456	.4447
Beans	-.6898	xx	-.7141	-.2269	.3318	.1250	xx
Fruits & vegetables	.0935	xx	-.0569	-.6517	.2336	.0963	.2372
Fish	xx	-.0068	.0968	.2689	-.6201	xx	.3705
Meats, poultry & dairy products	.2037	.1111	.0524	.1650	xx	-.8276	.4713
Others							

SOURCE: 1980 SURGASAR Data

[a]estimated coefficient not significant.

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CHAPTER 5

FOOD COST AND NUTRIENT AVAILABILITY

The dietary choices of households have obvious nutritional implications. Thus, nutritional outcomes from government interventions in markets for agricultural products are important indicators of food and agricultural policy impacts. Because of the significance of evaluating the availability of nutrients to households and impacts of prices and income, the descriptive analysis of Chapter 3 was extended to assess household level availability of nutrients. The general theory of household production is utilized as a framework in developing and estimating the relationships used for the analysis.

Model Specification and Estimation

The analysis examines the household level availability of nutrients, conditioned on household food cost, food prices, family size and composition, and location of residence. The empirical model is:

(5.1) $$FEXP = F(P, TEXP, K1) + U_0$$

and

(5.2) $$NA_j = NA_j\ (P, FEXP, K2) + U_j, \quad j=1, \ldots ,5.$$

Food cost ((FEXP) in Equation 5.1) was related to household income (TEXP) a vector of food prices (P), and a set of household specific shift variables (K1). Household nutrient availability ((NA$_j$) in Equation 5.2) was specified for each of five (j) nutrients (calories, protein, iron, vitamin A, and thiamine), conditional on food cost (FEXP), the vector of food prices (P), and a set of efficiency variables (K2) which were presumed to influence household diets. Thus, income, prices, and household size (in both K1 and K2) were

assumed to have direct as well as indirect (through the food cost equation) influences on availability of nutrients in the household food supply.

The two equations are interrelated through the presence of the endogenous variable FEXP, and contemporaneously correlated additive error terms. Preliminary evaluation of the model in the sample data showed that there was little gain in efficiency for the parameter reliability for the equations estimated jointly to account for the contemporaneously correlated errors. The absence of a gain in efficiency from generalized least squares estimation was related to (i) low error correlations across equations, (ii) presence of a near identical exogenous variables in the equations, and (iii) absence of cross equation restrictions. Based on results from this preliminary assessment, two-stage least squares was used to estimate the model, equations (5.1) and (5.2) in double log functional form.

Results

Results for Equation (5.1) relate directly to the demand parameter estimates in Chapter 4, however, the functional form and the inclusion of scaling and translating variables may have changed the elasticity estimates. Equation (5.2) is motivated by a household production hypothesis, indicating that food expenditure is transformed into nutrient availability by a set of variables reflecting household efficiency and the opportunity cost of time.

Engel Curves for Nutrient Consumption

Directly specified (abstracting from simultaneity) nutrient consumption functions (5.2) were estimated for the five nutrients or food components, i.e., calories, protein, iron, vitamin A, and thiamine. From Table 5.1, each consumption function was related in the log of household income (LTEXP), the log of household size (LHHS), and three binary variables--region (DRE),

education (DEDU), and main occupation (DMOC). The estimation was equation by equation, using ordinary least squares. Results are presented in Table 5.1 for rural households and in Table 5.2 for urban households.

The income coefficients of the nutrient consumption equations were statistically significant and positive. The estimated ratios reported in Table 5.1 support this hypothesis. Increased household income was associated with increased household food supply, and the nutrient availability.

Variations in nutrient income elasticities between rural and urban areas were mixed. Calories, protein, and vitamin A had higher income elasticities in rural areas. Iron and thiamine, on the other hand, had higher elasticities in urban areas. Such regional variations reflect the diversity in mix of items in the household food supplies, food availability in the markets and from home production, household resources, and relative prices.

Household size measured in adult male calorie equivalents had a large positive impact on the availability of nutrients. Comparisons between rural and urban show that the proportional adjustments to changes in household size were relatively higher among urban than rural households, for calories, protein, and vitamin A, and higher among rural than urban households for iron and thiamine.

Place of residence had a significant influence on availability of nutrients. Within urban areas, households in Java (DRE=1) had a lower average consumption of calories and iron than households in other areas (Table 5.2). Among the rural households, the Javanese had higher average consumption of all nutrients except calories (Table 5.1).

The effect of education on nutrient availability was consistent across all nutrients, and significant for all except vitamin A. Those with at least

an elementary school education had lower levels of available nutrients. This runs counter to expectations but could perhaps be explained based on activity levels. Recall that the equations are already conditioned by expenditure, so that the results reflect the nutrients received from a given expenditure. Finally, in rural areas those in agricultural or related work (DMOC) had higher levels of available nutrients. This was expected with the rural households having higher activity levels and relatively easier access (lower effective prices) to food. In urban areas, those households in production or other related occupations (DMOC3) had consistently higher levels of available nutrients.

Food Cost and Availability of Nutrients

The two-stage least squares parameter estimates are given in Table 5.3 for rural and in Table 5.4 for urban samples. A large proportion of the structural coefficients are significant with t-ratios equal to or greater than 2. Food prices, food cost, and household size had strong direct influences on households' apparent nutrient consumption. The influence of household income on nutrient consumption is indirect through its impact on household food expenditure. The effect of income will be more apparent from the reduced form of the equation system.

The coefficients for the food cost equation show that, in general, food prices, household income, and size had a positive impact on household food expenditure. Moreover, food demands were inelastic with respect to the same variables. The prices (in logs) included were for rice (LPRC), for beans (LPBN), vegetables (LPVG), and fish (LPFS). For these conditioning variables, food cost was, in particular, sensitive to the price of rice (LPRC) and income (LTEXP).

There is no clear a priori basis for predicting the signs of the nutrient demand elasticities. The short-run elasticities can be read directly as the coefficients presented in Tables 5.3 and 5.4 and are weighted sums of the demand elasticities of corresponding food commodities. That is,

$$\varepsilon_{NA_{jX}} = \sum_i \alpha_{ji} \, \varepsilon_{F_{iX}} \tag{5.3}$$

where $\varepsilon_{NA_{jX}}$ is the observed elasticity of the jth nutrient with respect to a variable X, α_{ji} is the share contributed by the ith commodity to total availability of the jth nutrient, and $\varepsilon_{F_{iX}}$ is the demand elasticity of the ith commodity with respect to the variable X. When the simultaneity of food cost and nutrient demands are taken into account, the elasticities are expressed as

$$\eta_{NA_{jX}} = \varepsilon_{NA_{jX}} + \varepsilon_{N_{jC}} \cdot \varepsilon_{CX}$$

where $\eta_{NA_{jX}}$ is the long-run elasticity of the jth nutrient with respect to a varible X, $\varepsilon_{N_{jC}}$ is the demand elasticity of the jth nutrient with respect to food cost, and ε_{CX} is the food cost elasticity with respect to variable X. These elasticities are presented in Table 5.5. Food commodities that have high nutrient shares and large demand elasticities will have greater influence on the levels and signs of the nutrient demand elasticities than other commodities.

The estimated price elasticities in Tables 5.3 and 5.4 suggest that nutrient demands were responsive to food commodity prices. In most cases nutrients elasticities were negative and less than one in absolute value. Prices of rice, vegetables and fish, in particular, had significant influences on household nutrient consumption levels. These price elasticities in Tables 5.3 and 5.4 suggest that the demands for calories, protein, iron, and thiamine

were more responsive to the price of rice in urban than in rural areas. This is partly a reflection of the importance of rice and rice products in urban diets.

Increased household food expenditures increased availability of all nutrients. This positive association was related to the fact that all the food items had nonnegative nutrient shares and positive food expenditure elasticities. Moreover, all nutrient demands were inelastic with respect to total household food expenditure. Nutrients from relatively more of low income sensitive food items had lower expenditure elasticities than nutrients from primarily from high income sensitive foods. The low calorie expenditure elasticity is a reflection of a large share for rice which itself was the least income responsive food item.

The elasticities from the reduced form of the system (5.1) and (5.2) are given in Table 5.5. Unlike the direct structural parameter estimates in Tables 5.3 and 5.4, the elasticities in Table 5.5 incorporate direct and indirect effects of the conditioning variables. For instance, the price elasticities in Table 5.5 reflect the combined direct and indirect, from Equation (5.1), effects of food price changes on the consumption of nutrients through their effects on food cost. For most of the nutrients, the direct effects were negative and the indirect effects, through food cost, were positive. The balancing of the direct and indirect effects, however, resulted in inconsistent sign patterns for the nutrient elasticities. This was most apparent for rice in rural households. It appeared that the positive price effect of rice price on food cost more than compensated for the direct negative effect of the rice price on consumption of calories. Hence, from these preliminary estimates, the uncompensated rice price elasticity for calories and other nutrients appeared close to zero.

For total household expenditures, the reduced form elasticities in Table 5.5 capture the indirect influence of income on nutrients through household food cost. The nutrient demand patterns due to income were similar to those observed for food expenditure; i.e., the income elasticities were positive, less than unity, and their sensitivity dependent on the demand characteristics of food commodities contributing the major shares to total nutrient availability.

Similar to the income elasticities, household size elasticities for nutrients were positive and less than one. The rankings of the elasticities were, however, opposite to those for the income effects. This can be largely attributed to the fact that food commodities were insensitive to income and highly responsive to changes in household size. The elasticities in Table 5.5 show that the rice-dominated nutrients, like calories and thiamine, were relatively more sensitive to increased household size. These results are consistent with the findings on the demand structure of food commodities in Indonesia (Chapter 4).

Evaluation

Demand parameters for selected nutrients were estimated in single and simultaneous equations frameworks. The results suggested that nutrient demands were responsive to changes in income, food prices and selected socioeconomic and demographic variables. Income and household size elasticities were positive and less than unity. Nutrient demands were also responsive to food prices, particularly the price of rice. The nutrient elasticities were largely determined by the demand characteristics of the foods contributing most significantly to total nutrient availability. Among the socioeconomic and demographic conditioning variables, location of households had a significant impact on variations in nutrient availability.

Comparisons of our results with those from other studies on Indonesia (Timmer and Alderman, 1979 and Chernichovsky and Meesoosk, 1984) showed that the price of rice and income continue to have an important influence on consumption of nutrients. Timmer and Alderman, using 1976 survey data, found calorie income elasticities of 0.26 and 0.47 for urban and rural areas, respectively. Our estimates ranged between 0.31 and 0.40 for the two areas, respectively. The 1978 study of calorie deficient households (Chernichovsky and Meesook, 1984) showed that demand elasticities for calories with respect to the price of rice ranged between -.20 and -.35 for outer Java and Java, respectively. For protein, the elasticities were -.17 and -.27 for the two respective regions. Our study showed that these elasticities ranged between -.30 and -.04 for calories, and -.27 and -.14 for protein in urban and rural areas, respectively. Calorie price elasticities reported by Timmer and Alderman were quite large by comparison. As evident in these studies, policy reforms affecting income or the price of rice would have significant influence on availability of nutrients at the household level.

Table 5.1 Unrestricted Reduced Form Parameters for Nutrient Availability; Double-Log Functional Form--Rural Households

	Food Energy	Protein	Iron	Vitamin A	Thiamine
Intercept	6.92 (105.95)[a]	2.35 (31.15)	2.14 (13.09)	5.00 (14.61)	0.72 (4.18)
LTEXP	0.38 (48.28)	0.48 (53.34)	0.30 (15.42)	0.64 (15.57)	0.17 (8.26)
LHHS	0.55 (61.66)	0.46 (44.85)	0.61 (24.27)	0.26 (5.67)	0.76 (32.28)
DEDU	-0.03 (-3.70)	-0.05 (-5.03)	-0.11 (-5.41)	-0.03 (-0.64)	-0.14 (-6.52)
DMOC	0.10 (12.84)	0.09 (9.30)	0.16 (7.70)	0.10 (2.42)	0.20 (9.24)
DRE	-0.03 (-4.07)	0.01 (0.70)	0.26 (13.14)	0.38 (9.27)	0.11 (5.06)

SOURCE: 1980 SURGASAR Data
[a]t-ratios in parentheses

Table 5.2 Unrestricted Reduced Form Parameters for Nutrient Availability; Double-Log Functional Form--Urban Households

	Food Energy	Protein	Iron	Vitamin A	Thiamine
Intercept	7.54 (107.63)[a]	2.96 (35.92)	1.05 (8.87)	7.00 (25.91)	-0.54 (-5.17)
LTEXP	0.29 (35.46)	0.40 (41.45)	0.43 (31.36)	0.41 (12.96)	0.31 (25.74)
LHHS	0.60 (62.48)	0.60 (45.52)	0.45 (27.88)	0.45 (12.33)	0.59 (41.65)
DEDU	-0.06 (-4.82)	-0.06 (-4.56)	-0.09 (-4.86)	-0.05 (-1.03)	-0.09 (-5.58)
DMOC2	0.01 (0.56)	0.03 (2.26)	0.02 (1.26)	0.00 (0.11)	-0.00 (-0.05)
DMOC3	0.05 (4.63)	0.06 (4.89)	0.09 (5.17)	0.13 (3.42)	0.07 (4.76)
DRE	-0.07 (-8.19)	-0.07 (-0.24)	-0.13 (-3.41)	-0.04 (-1.27)	-0.01 (-1.09)

SOURCE: 1980 SURGASAR Data
[a]t-ratios in parentheses

Table 5.3 Two Stage Least Squares Parameter Estimates of Food Cost and Weekly Nutrient Availability; Double Log Functional Form--Rural Households

	Food Cost	Food Energy	Protein	Iron	Vitamin A	Thiamine
Intercept	-1.61 (-12.06)[a]	7.14 (43.83)	3.50 (19.17)	6.87 (15.63)	14.09 (14.92)	2.81 (5.95)
LPRC	0.40 (14.25)	-0.04 (-1.22)	-0.14 (-3.55)	-0.30 (-3.14)	-0.99 (-4.84)	-0.04 (-0.36)
LPBN	-0.03 (2.80)	-0.03 (-2.82)	-0.04 (-3.35)	-0.04 (-1.36)	-0.23 (-3.57)	0.12 (3.67)
LPVG	0.03 (4.27)	-0.05 (-5.44)	-0.07 (-7.43)	-0.26 (-11.49)	-0.28 (-5.73)	-0.19 (-7.86)
LPFS	0.04 (4.95)	-0.05 (-4.52)	-0.12 (-9.69)	-0.39 (-13.50)	-0.42 (-6.81)	-0.36 (-11.46)
LTEXP	0.81 (141.18)					
LFEXP		0.49 (55.42)	0.63 (63.35)	0.45 (19.07)	0.90 (17.51)	0.28 (10.91)
LHHS	-0.16 (23.71)	0.46 (51.04)	0.34 (33.94)	0.47 (19.46)	0.04 (0.84)	0.67 (25.70)
DEDU		-0.03 (-3.77)	-0.04 (-4.96)	-0.08 (-4.35)	-0.01 (-0.14)	-0.11 (-5.50)
DMOC		0.11 (14.76)	0.09 (10.78)	0.14 (7.12)	0.08 (1.95)	0.19 (9.07)

SOURCE: 1980 SURGASAR Data
[a]t-ratios in parentheses

Table 5.4 Two Stage Least Squares Parameter Estimates of Food Cost and Weekly Nutrient Availability; Double Log Functional Form--Urban Households

	Food Cost	Food Energy	Protein	Iron	Vitamin A	Thiamine
Intercept	0.11 (0.42)[a]	8.78 (32.43)	4.49 (14.87)	6.17 (13.22)	9.24 (7.82)	3.06 (7.52)
LPRC	0.19 (3.59)	-0.30 (-5.42)	-0.27 (-4.31)	-0.66 (-6.81)	0.08 (0.32)	-0.59 (-7.01)
LPBN	0.07 (5.28)	0.02 (1.19)	-0.02 (-1.12)	-0.22 (-9.29)	-0.13 (-2.26)	-0.02 (-1.09)
LPVG	0.04 (3.86)	-0.00 (-0.30)	-0.05 (-4.29)	-0.19 (-11.13)	-0.21 (-4.95)	-0.07 (-4.65)
LPFS	-0.03 (-2.48)	-0.09 (-7.40)	-0.16 (-11.47)	-0.14 (-6.48)	-0.37 (-7.05)	-0.19 (-10.45)
LTEXP	0.76 (112.68)					
LREXP		0.41 (42.35)	0.58 (52.94)	0.66 (39.15)	0.64 (15.06)	0.49 (33.47)
LHHS	0.18 (22.23)	0.50 (51.93)	0.37 (34.82)	0.27 (16.48)	0.37 (6.46)	0.45 (31.21)
DEDU		-0.04 (-4.48)	-0.05 (-4.31)	-0.08 (-4.45)	-0.01 (-0.30)	-0.08 (-5.16)
DMOC2		0.01 (1.40)	0.03 (3.42)	0.03 (1.81)	0.01 (0.15)	0.01 (0.66)
DMOC3		0.05 (5.45)	0.06 (6.04)	0.08 (5.70)	0.13 (3.47)	0.07 (5.27)

SOURCE: 1980 SURGASAR Data

[a]t-ratios in parentheses

Table 5.5 Selected Nutrient Uncompensate Price and Income Elasticities Based on Derived Reduced Form Coefficients--Indonesia

	Food Energy	Protein	Iron	Vitamin A	Thiamine
Rural					
Price of					
Rice	0.00[a]	0.11	-0.12	-0.63	0.00[a]
Vegetables	0.03	-0.05	-0.25	-0.25	-0.18
Fish	-0.03	-0.09	-0.37	-0.38	-0.34
Income	0.40	0.51	0.37	0.73	0.23
Household Size	0.54	0.44	0.54	0.19	0.71
Urban					
Price of					
Rice	-0.22	-0.16	-0.53	0.00[a]	-0.49
Vegetables	0.00[a]	-0.03	-0.17	-0.19	-0.05
Fish	-0.10	-0.17	-0.16	-0.39	-0.21
Income	0.31	0.44	0.50	0.49	0.37
Household Size	0.58	0.48	0.40	0.40	0.54

SOURCE:. 1980 SURGASAR Data
[a]Due to rounding.

References

Chernichovsky, D. and D.A. Meesook. "Patterns of Food Consumption and Nutrition in Indonesia." World Bank Staff Working Paper #670. September 1984.

Timmer, P.C. and H. Alderman. "Estimating Consumption Parameters for Food Policy Analysis." Amer. Journal of Ag. Econ. 61 (Dec. 1979).

CHAPTER 6

CONCLUSIONS AND POLICY IMPLICATIONS

Policy implications of the estimated structural relationships can be evaluated from two perspectives. First, the parameters have implications as descriptive estimates of the structure of the consumer demand and food consumption-nutrition conditions. For example, the direct, cross-price, and income elasticities from the estimated demand system along with the nutritional linkages provide a framework for evaluating impacts of price and income changes on food consumption and nutritional status. Changes over time and among household types can be compared using parameters estimated using this framework.

A second source of policy implications of the estimated demand structure and nutritional linkage is the potential for supporting more specialized policy models. Accurate estimation of the structure of consumer demand are important components in many food agricultural policy analyses. Thus, from this perspective, the results of the estimated demand system and nutritional linkages represent improved tools for policy analysis. The demand systems allow policy makers to consider programs with improved and more consistently estimated direct and secondary effects of price and quantity change.

The demand systems feature income and price induced interrelationships between food and nonfood and within food group demands. The increased precision afforded for the development of policy models should reduce program outcome uncertainties. The nutritional linkages provide possibilities for more fully assessing policy impacts. The demand parameters of Chapter 4 are behavioral relationships. Thus, they are components of the structures of models typically formulated for agricultural price policy analysis.

An example of changing rice prices illustrates the usefulness of these basic parameter estimates. As a result of domestic and international rice market conditions, rice prices have declined in Indonesia. These changes in relative prices have affected real income levels for both producers and consumers. For consumers, the change in real income is expected to be relatively large, since in Indonesia the bulk of the population has low income levels, and the commodity with the price change (i.e., rice) is the dominant staple food. Of course, the price change will have differential impacts on real income levels, depending on the distribution of income. A systematic approach to estimating the effects of income and price changes can be taken using a complete demand system.

Assuming no production by the household, the price induced adjustments in total expenditure per household reflect both substitution and income effects. Assume that there are $i = 1, 2, \ldots, n$ foods. The demand for commodity i, expressed in expenditure form, is

$$C_i = P_i(P_1, \ldots, P_n, Y, S) \tag{1}$$

where C_i is expenditure on commodity i, P_i is price of commodity i, Y is total expenditure, and S is household size.

The complete demand system can be expressed in percentage terms as

$$\% \Delta C = E(\% \Delta P) + \eta(\% \Delta Y) + \Theta(\% \Delta S)$$

where C is a$(n \times 1)$ vector of expenditures on η commodities, E is a matrix of price elasticities, η is a column vector of income elasticities and Θ is a column vector of household size elasticities. The variables P, Y, and S

are prices, income, and household size respectively. The impact of a percentage change in the price of j, on the expenditures of n commodities ceteris paribus, can be derived as

$$\% \Delta C_i = e_{ij}(\% \Delta P_j) \quad \text{for} \quad i = 1,\ldots,n$$

where e_{ij} is an element of the matrix E. If the price effect were to be only through real income (that is, there was no substitution effect), then the change in expenditure on commodity i due to a price change in j can be written as

$$\% \Delta C_i = - \alpha' \eta(\% \Delta P_j)$$

where α is a row vector of budget shares of n commodities and η is the column vector of income elasticities.

To illustrate, simulated impacts of a 10 percent decrease in price of rice on food expenditures are given in Table 6.1 for urban households. Since the demand for rice is price inelastic, consumers would decrease their budgets for rice. The decrease is much larger among high-income consumers because of their relatively low sensitivity to change in rice prices. Expenditures on all other food groups would increase as well, but at different rates. In the case of fruits and vegetables, and meats, which are net substitutes for rice, the increases in expenditures reflect the larger real income effects. These results show the proportionate change to be greater for meats among low income households, and for beans among high income households. Finally, comparisons of changes in food expenditures by income groups show that the proportionate allocations are higher among the

lower income consumers. The greater adjustments of these consumers compared to others are consistent with the larger share of rice in their food budgets and their greater sensitivity to change in the relative price of rice.

The change in the relative price of rice also has a differential impact on the distribution of income. Consumers experience a real income gain from the decline in the rice price. The low-income consumers are more likely to benefit because of the importance of rice in their budgets. These differential impacts can be simulated using change in total food expenditure due to the real income effect of a price change as a measure of income gain. The results, appearing in the last row of Table 6.1 show that the low income consumers' income increases by an average of 3.6 percent, while that of the high-income consumers increases by 2.3 percent.

The precision that better estimates of the demand structure brings to policy analysis is also illustrated by their use in representing the economic structure for the government planning. Projections of consumption and production levels depend on good estimates of price and income elasticities. Because these parameters may change over time, estimates from relatively recent data provide better information for such projections. And, these projections form the basis of the planning process.

Changes in consumption patterns over time can result from changes to many factors, including changes to relative prices, income, tastes and preferences, new products, quality change, and the age composition of the population. However, within a relatively short planning horizon, it is possible to abstract from these sources and focus on the effects of prices and income. Thus, the policy analysis aids the planning process by incorporating the consumption effects of price and income changes suggested

by alternative actions. The price changes can result from changes in the conditions of supply, brought about by government policy, world market conditions, or other factors, or changes in demand through altered pricing policy. Short-run forecasts of changes in consumption levels can be based on these basic demand parameters.

Table 6.1 Effect of a 10 percent decrease in rice price on food commodity expenditures and total food expenditures using AIDS based price elasticities--urban Indonesia

Food Group	Low Income	High Income
	----------Percent----------	
Rice	-3.6	-5.0
Palawija	5.4	5.7
Beans	6.7	6.7
Fruits and vegetables	3.4	2.8
Fish	3.0	2.6
Other meats	7.2	2.1
Miscellanous	3.2	3.3
Food Expenditure		
Total price effect	1.2	1.3
Real income effect	3.6	2.3

SOURCE: SURGASAR Data

APPENDIX A

Studies on Food Consumption and Nutrient Availability in Indonesia

Food Availability and Consumption

Food and agricultural policies have major impacts in the availability of food for consumption from domestic sources. Total food available for human consumption is estimated from net available domestic production (i.e., gross domestic production adjusted for seed and feed requirements, processing losses, waste and other nonfood uses), net import trade, and net stock changes. Such food balance sheet estimates provide a gross measure of per capita food availability. In general, total food available for consumption in Indonesia has increased over time, due both to increased domestic production and increased imports, using government reserves to cover production shortfalls.

There are marked variations in the growth rates of per capita availability of staple crops, in Indonesia, i.e., rice, corn, wheat, cassava and potatoes. Per capita annual consumption of rice grew from an average of 103.7 kg to 128.7 kg in the years between 1968 and 1981, an average rate of 2.5 percent per annum. Wheat, an import crop, grew in availability at a comparable rate of 2.2 percent. Per capita availability of cassava increased from 57.4 kg to 71.6 kg in the period between 1968 and 1978, an annual growth of 1.4 percent. For corn, the availability growth was relatively small, only 0.4 percent per annum. Per capita consumption of sweet potatoes declined in the 1968-1978 period, at annual rate of -3.5 percent. Thus, except for sweet potatoes, the growth trends of the staple crops suggest an increased availability of food for consumption.

The food crops contribute two-thirds of the value added in agriculture. Over 50 percent of the contribution of food crops comes from the production of rice. Cassava and corn are the other important food crops.

Contributions of these crops, and rice, in particular, determine the overall availability of food for consumption.

Since 1968, rice production has progressed in three phases. Between 1968 and 1971, the annual rate of growth in production was 5.5 percent. The growth rate averaged 4.7 percent per annum in the period of 1972 to 1976. The slow growth in this period has been associated with the occurrence of droughts. Since 1977, rice production has grown at annual rate of 8.7 percent.

The recent rising trend in production has been related to the combined effects of the increased levels of yield and area harvested. The increase in area harvested has been due mainly to increased cropping cycles in Java, reflecting a combination of three factors: expansion of irrigated lands which permitting farming all year round; an increased utilization of short maturing seed varieties; and improved crop management and cultivation practices. Expansion of new lands and, to some degree, increases in crop intensity, have contributed to an increase in land utilization in off-Java islands. The increase in production due to the yield effect has been associated with improved quality of irrigation lands, the use of improved seeds and fertilizers, and better crop management practices. No conclusive results have yet been established on the precise magnitude of the separate and joint contributions of these factors. Table A.2, however, suggests that the effects of improved technical inputs and irrigation had stronger impacts on yields and total production than area.

Despite the rapid growth in production, the amount of rice available for consumption has not been sufficient to meet the consumption needs of the people. Since rice prices in Indonesia vary in narrow fixed margins, the government has had to use imports in addition to reserve stocks to make up

the production shortfalls (Table A.3). The level of rice imports, for example, jumped from 0.5 million in 1971 to 1.66 million tons in 1973 as a result of a drop in domestic production and a decline in domestic reserves. Since then, import levels have remained on a higher plateau with a rising trend. Mears (1981) attributes this rising trend to the availability of oil revenues which permitted the Indonesian government to increase imports of rice in order to hold domestic prices and build up reserve stock to reduce risks of shortages.

Notwithstanding such rising trends in imports, however, the contribution of imported rice to total available consumption has been marginal. The import share increased from 6 percent in 1968/1971 to 10 percent in 1977/81. Even when combined with government open stock reserves, the joint contribution of the imports and government reserves was only 15 percent of the total available consumption in 1977/81. Despite their relatively low share in the rice available for consumption, however, imports and open stock reserves are likely to remain important sources of rice in periods of poor harvest.

The production performance of the other food crops has been mixed. Despite the decline in harvested areas, corn and cassava experienced positive growth rates of 3.7 and 2.0 percent, respectively, during the period between 1968 and 1981 (Table A.4). For sweet potatoes, the positive yield effect was much weaker than the negative area effect and overall production declined. Various factors have been attributed to the slow growth in production of secondary crops. First, farmers prefer to produce rice, the most profitable crop. Second, the location of production of these crops shows that farmers grow them in areas unsuitable or less favorable

for rice. Third, the government's priority in the intensification program has been on improving the technical and financial capacity of the farmers to increase rice production. Nonetheless, these other crops, corn and cassava in particular, continue to contribute significantly to the overall availability of food for consumption.

Food Consumption in Practice

The estimates from food balance sheets, in general, are upper bounds for actual food consumption. For Indonesia, the household expenditure and consumption surveys (SUSENAS) provide information on a regular basis on actual food consumption patterns.

According to Chernichovsky and Meesook (1984), Indonesians spent 68 percent of their average income on food in 1978. The rural population spent more of its average income on food (69.6 percent) than the urban population (59.7 percent). The share allocated to food declined as the average income level increased; the lower income group allocated 73 percent of income while the upper income group allocated 59.1 percent to foods (Table A.5).

The allocation of the food budgets to the different food groups varied depending on location and income of the population. Average Indonesians allocated 41 percent of their food budget to the consumption of the staple crops, i.e., rice, corn, wheat, cassava, and potatoes, with rice being dominant. The rural population allocated relatively more than the urban population to these staple crops: 43.04 and 29.53 percent, respectively. The share of the staples in the food budget declined as the average income level increased; and, rice represented a relatively larger share of the total, as shown in Table A.5. Fish, meat, poultry, eggs and dairy products--essential sources of protein--constituted 11 percent of the

average food budget. Those in high income groups consumed more of these food products. Of course, these consumption patterns affect available nutrient intakes.

Rice accounted for 34 percent of the average food budget. The average rice share within the staple foods rises was 83 percent (Table A.6). Even though the share of the urban food budget allocated to rice (28%) was less than the rural population (35%), the urban population spent more on rice within the staples than the rural population. Compared to the total expenditures on staple crops, the individual shares of the other staples, i.e., corn cassava, potatoes and wheat were higher in rural areas.

There are noticeable variations across by region in the budget shares within the staple foods. The average individual in all regions allocated at least two-thirds of the staple food budget to rice (Table A.6). Above this minimum commitment, the range varied in Java between 69 percent for East Java to 96 percent for Jakarta. For the islands off-Java, this share varied between 64 percent in Maluku and Irian Jaya and 93 percent in Sumatra. Among the other staples, corn had a relatively greater share in Central and East Java, Bali, Nusatenggara, and Sulawesi. Cassava was important in Yogyakarta, East Java, Central Java, Maluku and Irian Jaya. These regional variations suggest that rice was still a dominant food, but maize and cassava were also important foods in Central Java, Yogyakarta, East Java, Bali, Nusatenggara, Sulawesi, Makulu and Irian Java.

The share of rice in the food budget declined (Table A.5) as the average income increased. For example, the lower income groups spent 36.3 percent while the high income groups spent 28 percent of their food budgets on rice. Within the staple crops, however, the upper income groups (Table A.6) spent about 90 percent on rice alone. The poor households spent

77 percent on rice. The share of the other staple crops fell as incomes increased. That is, the higher income group tended to concentrate on rice in allocating their food budget among the staple crops.

The average intake of the staples, measured in quantity per capita, followed closely the budget shares for the staple food groups. The per capita intake of rice was highest (Table A.7) compared to other staples. Corn and cassava were next in the ranking followed by potatoes and wheat, which was consumed by 8 percent of the population and with the lowest per capita intake level.

The available estimates are not conclusive (see, for example, Tables A.7 and A.8) on differences in per capita consumption of rice between rural and urban areas. Dixon (1982a), however, suggests (Table A.8) that there is a growing tendency to move away from the other staples toward rice in rural areas. This pattern was stronger in urban areas where the average diet was centered on rice. For the other staples, the average intake levels were lower in urban than in rural areas.

Average consumption levels also varied by region. Rice was the leading crop in all provinces except Yogyakarta, Maluku and Irian Jaya. The consumption of corn in Yogyakarta, and cassava in Maluku and Irian Java was higher than the consumption of rice, on per capita basis. Per capita consumption of rice was highest in Sumatra and West Java. The lowest per capita rice consumption was in Maluku and Irian Jaya. For corn, the highest per capita consumption was in Central Java, East Java, Bali and Nusatenggara. Potatoes were consumed more in Bali, Nusatenggara and Sulawesi. Jakarta, the main urban center, had the lowest per capita consumption of all the staples except rice.

Similarly, the consumption patterns varied by income level. Rice consumption increased consistently with the levels of income (Table A.7). Alternatively, the consumption of the other staples declined steadily with income. The dependency on rice, therefore, increased with increasing levels of income. It is worth noting that the consumption of wheat, like corn and cassava, appeared to be declining with rising income levels.

Dixon (1982a and 1982b) and Mears (1981), in addition, suggest that consumers in rural areas adjust their composition of staples to crop harvesting cycles. The main rice harvest occurs during the months March to May. During this period, when harvested stocks peak and market prices are low, the consumption of rice rises. Corn, which is usually harvested in the months that precede the main rice harvest, is used as a substitute when rice reserves are low. Cassava and fresh roots, in particular, play a similar role in the lean months prior to rice harvest.

The food consumption patterns, in short, exhibited variations by region, season and socioeconomic group. Food was the main component of total household expenditures, and within the food group, the share of the staple crops, i.e., rice, corn, cassava, potatoes and wheat accounted for no less than one-third of the food budget. Urban consumption was more diversified, which explains the lower share of the staple crops in urban food budget. Among the staples, rice was the dominant food. Compared with the other staples, rice was relatively more important in the average diets of households in urban areas. Even where the diet was more diversified (e.g., rural Java), the trend was toward a more concentration on rice. High income groups consumed relatively more rice compared to the low income groups. The consumption of staples for the poor, especially in rural areas, was more varied, i.e., included a mixture of rice and other staples.

Finally, in general, the secondary crops appeared to play a stabilizing role in maintaining food consumption in rural areas.

Nutrient Availability and Consumption

Nutrient Availability

Nutrients of plant origin are the main sources of energy and protein in the Indonesian diet. In the years between 1974 and 1978, plants contributed about 98 percent of the available calorie and 90 percent of the available protein consumption (Table A.9). The cereal crops, i.e., rice, corn and wheat, as a group, contributed over 65 percent of both calorie and protein consumption. Rice alone accounted for 54 percent of the calories and 51 percent of the protein availability. Corn, the next important cereal crop, contributed 9 and 12 percent to calorie and protein consumption. The other food crops, i.e., root crops (cassava, potatoes and sago) and pulses and nuts (ground nuts, soybeans, and coconuts) were less important separately, but, as a group, were a supplement to overall diets.

Over the period between 1968 and 1977, the per capita availability of calories increased at an annual rate of 1.3 percent (Table A.10). The main source of growth was the rising trend of rice calorie consumption. Daily per capita availability of rice increased from 981 kcalories in 1968 to 1233 kcalories in 1977; an average growth rate of 2.6 percent per annum. Like rice, the available calories from wheat consumption increased steadily. But, because of the relative low share of wheat in total food availability, this impact was not as significant to overall growth. The other crops showed mixed results; cassava available for consumption fluctuated but on average increased, corn fluctuated with a negative trend, and potatoes declined steadily. It is noteworthy that the staple foods provided

three-fourths of the potential calorie consumption. Growth trends in calories from these sources were frequently associated with their production performance.

Nutrient Consumption

The Susenas data on food consumption are often used to assess the nutritional situation in Indonesia. This is the data source Chernichovsky and Meesook (1984) used to identify the segments of the Indonesian population with nutrient deficiencies. According to their study, the diet of an average Indonesian already surpassed minimum calorie and protein requirements.[1] That is, the Indonesian diet, on average, supplied the minimum energy and growth requirements.

Despite this average adequacy, however, nutrient consumption was uneven among socioeconomic groups. Chernichovsky and Meesook (1984) found that the average calorie and protein availabilities in three provinces of Java (Central, East and Yogyakarta) were lower than the regional-based minimum requirements (Table A.11). These provinces exhibited the highest proportions of households with calorie and protein deficiencies. The other provinces that met the minimum basic calorie and protein requirements had lower proportions of households with nutritional deficiencies.

Based on a 1976 Susenas V study, Dixon (1982b) reports Hutabarat's estimates that link expenditure levels to calorie and protein consumption. Table A.12 provides a condensed version of this original table. According to the minimum calorie and protein requirements adopted in the study, i.e.,

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[1]Chernichovsky and Meesook (1984) adopted a minimum threshold of 1933 calories and 40.43 gms of protein per day. These figures are lower than the daily requirements that have been used in the other studies, i.e., 2100 calories and 45 gms of energy and protein intake, respectively.

2100 kcalories and 45 gms of protein, the threshold was surpassed at an average expenditure of more than Rp 5,000 per month. The lower three expenditure groups had an average a daily consumption of 1851 kcalories of energy and 35.1 gms of protein. These groups, according to the income distribution in the population estimates, constituted 72 percent of the Indonesian population.

The study by Chernichovsky and Meesook (1984), which is based on 1978 Susenas, reveals that those in the lower 40 percent of the income distribution consumed on average 81 percent of the required minimum calorie level. Moreover, it points out that nutritional deficiency prevailed for all income levels, declining with rising income. For example, the proportions of the population with calorie deficiency fell from 69 percent in the lower income stratum to 37 percent in upper stratum (Table A.13). Similarly, the proportions with protein deficiency declined from 58 to 19 percent for these same stratum comparisons, respectively. Nutritional deficiency is, therefore, related to income level but, there are other additional factors that explain the variations in nutritional status.

Chernichovsky and Meesook (1984) identify the key attributes of nutrition deficient population. They considered, in particular, the variations in nutrient consumption due to differences in income levels, family size, education, and sources of income. The level of income, according to their findings, is the key factor that discriminates between the nutrition deficient and nondeficient populations. Larger family size appears to be a characteristic of households with nutrition deficiencies. Education is useful in discriminating among households with caloric adequacy and deficiency in Java only.

Expenditure patterns are a key discriminating factor for nutritional status. According to the 1978 Susenas based study, three-fourths of the calories came from the staple foods. Rice, the predominant staple, was the primary source of calories. The other sources were cassava, corn, vegetable and fruits, and legume crops. The staples also contributed over half of the protein intake. Again, rice was the most important source. Legume crops, fish, vegetables and fruit were the other important contributors to protein.

Cassava and corn, in addition to rice, were important sources of calories for the low income groups. Rice, vegetables and fruits, and legumes contributed largely to protein intake. The upper income groups depended heavily on rice for calorie consumption. Rice, legumes, meat, poultry, eggs and dairy products were the important sources for their protein consumption. Fish, an important source of protein, was consumed in relatively equal proportions across income groups.

In fact, the contributions of these foods to calorie and protein nutrient levels were consistent, by and large, with the food consumption patterns of the populations in the different income groups. Rice consumption steadily increased with income while the consumption of the other staples declined. The lower income groups thus obtained calories from a more diversified staple diet. By region, cassava and corn were particularly important sources of calories where their consumption was more prevalent. Similarly, the food budget shares and the per capita consumption of legumes, meat and poultry, eggs and dairy products increased with income. Variations in calorie and protein consumption were associated with shifts in food composition which in turn were related to the distribution of income.

Table A.1. Annual Per Capita Availability by Crop, 1968-78.
(kilograms)

Year	Rice[a]	Corn[b]	Wheat	Cassava[c]	Sweet Potatoes
1968/70	103.7	21.5	3.1	57.4	18.0
1971/74	112.5	20.7	4.1	52.9	16.7
1975/78	118.7	21.9	4.3	71.6	15.6
1968/78	112.3	21.3	3.9	60.9	16.6
(% P.A.)	(2.5)	(0.4)	(2.2)	(1.4)	(-3.5)

SOURCE: John A. Dixon. Food Consumption Patterns and Related Demand Patterns in Indonesia. June, 1982. (Note: The data are based on Food Balance Sheet Estimates.)

a: Rice includes milled rice only.

b: This does not include fresh corn.

c: This does not include cassava starch; cassava is given fresh root equivalent.

Table A.2. Annual Average Rates of Growth of Rice: Area Harvested and Yield by Region, 1955-1981.

	Java		Off-Java		Indonesia	
Period	Area	Yield	Area	Yield	Area	Yield
1955/1967	-0.2	0.9	3.0	-0.4	--	--
1968/1971[b]	1.2	4.7	1.3	3.4	1.2	4.3
1972/76[b]	0.7	3.5	2.2	3.2	1.5	3.2
1977/81[b]	3.6	6.7	2.1	4.0	2.9	5.8
1968/81	1.0	3.4	1.1	3.2	1.1	3.2

SOURCES: 1. L.A. Mears. The New Rice Economy of Indonesia. Jakarta: Gadjah Mada University Press, 1981.

2. World Bank. Indonesia: Policy Options and Strategies for Major Food Crops. Report No. 36865-IND. April 4, 1983.

Table A.3. Rice Production, Consumption, Imports and Procurement, 1965/81.

Year	Available Production	Consumption	Balance	Imports	Net Change in Stock Government	Private
			(million tons)			
1965	9.22	9.52	-0.30	0.20	-0.10	*
1966	9.67	9.89	-0.22	0.31	0.10	*
1967	9.36	9.74	-0.38	0.35	-0.03	*
1968	10.50	10.78	-0.28	0.63	0.35	*
1969	11.02	11.98	-0.96	0.60	-0.23	*
1970	11.83	12.43	-0.61	0.96	0.27	0.08
1971	12.35	12.96	-0.61	0.50	0.00	-0.11
1972	11.87	13.51	-1.64	0.75	-0.36	-0.53
1973	13.15	13.94	-0.80	1.66	0.41	0.45
1974	13.75	14.36	-0.61	1.07	0.27	-0.19
1975	13.67	14.93	-1.27	0.67	-0.46	-0.14
1976	14.26	15.45	-1.19	1.29	0.15	-0.04
1977	14.29	16.09	-1.80	1.99	-0.15	0.33
1978	15.72	16.87	-1.16	1.85	0.69	0.05
1979	16.09	17.54	-1.46	1.95	-0.29	0.79
1980	18.15	18.67	-0.52	2.07	0.74	0.83
1981	20.06	19.58	0.42	0.55	0.72	0.32

SOURCES: 1. L.A. Mears. The New Rice Economy of Indonesia. Jakarta: Gadjah Mada University Press, 1981.

2. World Bank. Indonesia: Policy Options and Strategies for Major Food Crops. Report No. 36865-IND. April 4, 1983.

NOTE: The production figures for 1965 to 1976 were adjusted to make them comparable to the World Bank estimates.

* Data not available at the time of writing this report.

Table A.4. Annual Average Rates of Growth of Secondary Food Crops: Area Harvested and Yield by Region, 1968-81.

Crop	Java		Off-Java		Indonesia	
	Area	Yield	Area	Yield	Area	Yield
Cassava						
68/71	-1.8	-1.1	-4.0	4.5	-2.0	0.2
72/76	-3.0	6.1	0.7	6.5	-2.1	6.3
77/81	0.0	1.9	2.0	-0.3	0.6	1.1
68/81	-1.2	2.8	1.9	1.5	-0.5	2.5
Corn						
68/71	-6.9	-0.3	-5.4	1.5	-6.5	0.3
72/76	-1.4	3.9	0.4	4.9	-0.7	4.3
77/81	4.1	6.1	2.5	4.7	3.6	5.9
68/81	-0.4	4.1	0.4	3.3	-0.2	3.9
Sweet potatoes						
68/71	-10.4	-0.6	4.0	2.8	-3.5	1.9
72/76	-3.4	9.0	-2.9	4.7	-3.1	6.8
77/81	-7.5	0.3	-1.5	0.0	-4.9	0.3
68/81	-5.1	3.1	-0.7	1.3	-2.7	2.2

SOURCE: World Bank. Indonesia: Policy Options and Strategies for Major Food Crops. Report No. 36865-IND. April 4, 1983.

Table A.5. Proportions of the Food Budget Allocated to Different Food Crops, 1978.

Food Group	Location		Income Group			Indonesia
	Rural	Urban	Low	Medium	High	
	Percent					
Cereals						
Rice[a]	35.11	27.89	36.29	36.86	28.01	33.90
Corn[b]	4.31	0.40	6.41	2.68	1.15	3.65
Wheat	0.68	0.25	0.82	0.48	0.47	0.61
Roots & Tubers						
Cassava[c]	2.16	0.50	2.80	1.65	0.96	1.88
Potatoes[d]	0.78	0.53	0.77	0.69	0.74	0.74
Vegetables	7.32	7.20	8.04	7.05	6.62	7.30
Legumes	3.02	3.85	2.75	3.14	3.68	3.16
Fruits	2.36	3.39	1.67	2.42	3.71	2.53
Fish	6.50	6.90	5.88	6.75	7.24	6.56
Meat & Poultry	2.19	3.91	0.86	2.04	4.94	2.48
Eggs	0.87	2.03	0.59	0.96	1.77	1.07
Dairy Products	0.45	2.03	0.14	0.49	1.66	0.72
Other Foods	34.25	41.12	32.99	34.78	39.04	35.40
% of Total Expenditures	69.63	59.72	72.70	69.91	59.07	68.00

SOURCE: Dov Chernichovsky and Dey Astra Meesook. Patterns of Food Consumption and Nutrition in Indonesia. World Bank Staff Working Papers No. 670. September, 1984.

NOTE:
a. Rice includes glutinous rice as well as rice by-products.
b. Corn includes both fresh and dried corn on the husk, shelled corn, and corn meal.
c. Cassava refers to fresh and dried cassava and cassava meal.
d. Potatoes cover sweet potatoes, potatoes, taro and sago.

Table A.6. Proportions of the Staple Food Budget Allocated to Staple Crops, 1978.

	Rice	Corn	Wheat	Cassava	Potatoes
Region					
DKI Jakarta	95.7	0.4	0.6	1.3	2.1
West Java	94.5	1.5	0.4	2.3	1.2
Central Java	75.7	16.6	1.1	5.5	1.1
DI Yogyakarta	82.5	6.7	0.9	9.2	0.6
East Java	69.2	18.3	3.2	8.3	1.1
Sumatra	93.2	0.4	0.9	2.9	2.6
Bali & Nusatenggara	77.8	12.4	2.2	3.5	4.1
Kalimantan	92.7	0.7	1.6	3.5	1.6
Sulawesi	82.2	7.6	2.4	3.5	4.3
Maluku & Irian Jaya	63.8	0.5	2.6	18.4	14.8
INDONESIA	83.4	9.0	1.5	4.6	1.8
Income Group					
Low	77.1	13.6	1.7	6.0	1.6
Medium	87.0	6.3	1.1	3.9	1.6
High	89.4	3.7	1.5	3.1	1.4
Location					
Rural	81.6	10.0	1.6	5.0	1.8
Urban	94.5	1.4	0.9	1.7	1.8

SOURCE: Computed from Table 4 in Dov Chernichovsky and Dey Astra Meesook. Patterns of Food Consumption and Nutrition in Indonesia. World Bank Staff Working Paper, No. 670, September 1984.

Table A.7. Per Capita Daily Consumption of Foods for Households, Representative Consumers, 1978 (in grams, except for eggs)

Food Crop	Rural	Urban	Low	Med	High	Indonesia
Cereals						
Rice	344.5	324.2	310.7	346.3	369.3	340.9
Corn	224.6	91.7	261.6	194.6	155.2	215.5
Wheat	78.4	35.2	110.1	73.1	49.8	67.6
Roots & Tubers						
Cassava	190.2	78.4	215.2	170.2	139.5	176.8
Potatoes	125.4	46.0	157.7	117.4	76.6	107.3
Vegetables	150.1	136.4	143.4	142.0	158.8	147.8
Legumes	46.1	63.6	41.2	43.3	62.1	49.7
Fruits	101.2	97.2	88.1	92.8	113.0	100.4
Fish	42.2	49.5	34.2	41.4	54.8	43.4
Meat & Poultry	34.8	27.3	32.2	30.2	33.1	32.3
Eggs	0.16	0.21	0.16	0.15	0.20	0.18
Dairy Products	17.7	23.0	24.6	18.2	20.2	20.1
Other	223.4	237.3	181.0	211.5	295.5	225.8

SOURCE: Dov Chernichovsky and Dey Astra Meesook. Patterns of Food Consumption and Nutrition in Indonesia. World Bank Staff Working Papers, No. 670. September 1984.

Table A.8. Annual Rural and Urban Consumption Per Capita By Crop, 1969/70, 1976, and 1978

Region/Crop	1969/70			1976			1978		
	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
	(kilograms)								
Indonesia									
Rice	103.2	101.3	113.8	111.2	110.5	114.3	109.2	109.2	109.2
Corn	22.0	25.4	3.2	9.9	11.9	0.7	11.4	14.0	1.0
Cassava, fresh	21.9	23.7	12.3	26.2	29.9	9.5	20.2	22.9	8.8
Cassava, gaplek	7.7	8.9	1.4	6.4	7.9	0.2	7.3	8.8	0.0
Sweet potatoes	8.8	9.6	4.3	10.8	12.3	4.1	5.7	6.2	2.6
Java									
Rice	92.7	89.8	108.5	103.3	102.4	107.3	99.8	98.8	104.0
Corn	28.2	33.3	2.9	11.5	14.0	0.5	15.1	17.7	1.0
Cassava, fresh	21.4	23.3	11.5	21.6	24.9	6.7	20.3	22.9	7.8
Cassava, gaplek	9.5	11.1	1.7	8,0	9.7	0.1	9.4	11.4	0.0
Sweet potatoes	7.9	8.6	4.2	7.5	8.4	3.4	3.6	4.2	2.6
Off-Java									
Rice	123.1	12.7	126.6	124.8	124.4	126.6	130.0	130.0	119.6
Corn	10.2	11.2	3.8	7.0	8.3	1.1	5.7	6.8	1.6
Cassava, fresh	22.9	24.3	14.0	34.2	36.5	14.4	20.2	22.4	10.4
Cassava, gaplek	4.3	4.9	0.5	3.8	4.6	0.3	3.1	3.6	0.0
Sweet potatoes	10.5	11.3	4.7	16.4	18.8	5.3	8.8	10.4	2.6

SOURCE: John A. Dixon. Food Consumption Patterns and Related Demand Parameters in Indonesia: A Review of Available Evidence, June 1982 (the figures are based on Susenas Surveys).

Table A.9. Percentage Distributions of Calories and Protein by Food Group, for all of Indonesia, 1974-1978.

	Calories	Protein
Per Capita Daily Availability, 1974-1978	2,272	45.4 gm
Food Group	Percent of total	Percent of total
Cereals[a]	66.5	67.4
Rice, corn	(53.5)	(49.4)
	(10.7)	(14.4)
Roots and tubers[b]	11.5	4.5
Cassava	(9.0)	(3.6)
Sugar	5.0	0.1
Pulses, nuts, and oilseeds[c]	7.3	14.8
Fruits	1.9	1.1
Vegetables	0.4	1.3
Meat	0.8	2.7
Eggs	0.1	0.4
Milk	0.2	0.5
Fish	0.8	7.0
Oils and fats[d]	5.5	0.0

Source: P. Timmer, W.P. Falcon and S.R. Pearson. Food Policy Analysis. Baltimore: The John Hopkins University Press, 1983.

[a]Cereals include rice, corn, and wheat.

[b]Roots and tubers include sweet potatoes, cassava, and sago.

[c]Pulses, nuts, and oilseeds include groundnuts, soyabeans, and coconuts/copra.

[d]Oils and fats include groundnut oil, copra oil, palm oil, and animal fats.

Table A.10: Average Daily Availability of Calories Per Capita by Food Type, 1968-77.

Food	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	68/77 (% P.A.)
					(K Calories)						
Starchy staples	1503	1471	1523	1518	1456	1690	1638	1638	1658	1734	1.6
Rice	(980.9)	(1063)	(1093)	(1104)	(1079)	(1183.4)	(1164.4)	(1170)	(1180)	(1233)	(2.6)
Corn	(270.5)	(183.6)	(222)	(202.7)	(183.1)	(271.2)	(221.9)	(222)	(175)	(214)	(-2.6)
Sweet potatoes	(49.2)	(46.6)	(43.8)	(43.8)	(38.3)	(43.8)	(43.8)	(4.4)	(41)	(41)	(-2.0)
Cassava	(174.9)	(150.7)	(137)	(128.8)	(128.4)	(153.4)	(158.9)	(164)	(213)	(208)	(1.9)
Wheat flour	(27.3)	(27.4)	(27.4)	(38.4)	(27.3)	(38.4)	(49.3)	(38)	(49)	(38)	(3.7)
Sugar	112	124	124	134	123	113	135	104	118	115	0.3
Other foods	419	424	457	437	456	406	454	400	461	429	0.3
TOTAL	2,035	2,019	2,014	2,089	2,035	2,209	2,227	2,142	2,237	2,278	1.3

SOURCE: Mears Table 3.2, p. 56.

Table A.11. Per Capita Daily Requirements and Actual Consumption of Nutrients, 1978

	Calories		Protein	
	Actual	Minimum	Actual	Minimum
Region				
DKI Jakarta	1946	1926	56.03	40.35
West Java	2097	1935	53.97	40.51
Central Java	1605	1937	38.53	40.56
DI Yogyakarta	1584	1978	35.09	41.60
East Java	1664	1958	41.81	41.04
Sumatra	2408	1909	62.20	39.82
Bali & Nusatenggara	2229	1917	55.44	40.01
Kalimantan	2431	1914	67.30	39.94
Sulawesi	2253	1907	62.21	39.76
Maluku & Irian Jaya	2010	1913	57.14	39.97
Indonesia	1987	1933	50.94	40.43
Location				
Rural	2002	1939	50.34	40.43
Urban	1912	1929	53.91	40.41
Expenditure Group				
Low	1747	1961	41.97	41.19
Middle	1988	1913	49.95	39.91
High	2279	1916	62.90	39.97

SOURCE: Dov Chernichovsky and Dey Astra Meesook. Patterns of Food Consumption and Nutrition in Indonesia. World Bank Staff Working Papers, No. 670. September, 1984.

Table A.12. Total Calorie and Protein Intake Estimated from the Susenas V Survey, 1976.

Monthly Expenditure Per Capita (RP)	Share of the Total Population (%)	PER CAPITA DAILY Calories (Kcalories)	Protein (grms)
below 2,000	15.3	1,381	22.2
2,000-3,000	23.8	1,870	32.3
3,000-5,000	33.1	2,055	43.0
5,000 & above	27.8	2,611	64.0
Average	--	2,064	43.3
Min. Reqt.	--	2,100	45.0

SOURCE: John A. Dixon. Food Consumption Patterns and Related Demand Patterns in Indonesia. June, 1982.

Table A.13. Proportions of the Population With Nutrient Deficiencies, 1978 (Percent)

	Calories	Protein
Indonesia	54.32	39.75
Rural	53.59	41.09
Urban	57.90	33.05
Expenditure Group		
Low	68.83	58.09
Middle	53.04	36.71
High	37.37	19.27

SOURCE: Dov Chernichovsky and Dey Astra Meesook. Patterns of Food Consumption and Nutrition in Indonesia. World Bank Staff Working Papers, No. 670. September, 1984.

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APPENDIX B

Earlier Food Demand Studies for Indonesia

Food Demand Studies for Indonesia

The food consumption patterns in Indonesia exhibit distinct features and variations by region, season, and socioeconomic characteristics.

1. Food is the main share of total household expenditure. An average Indonesian household has a food budget share of 68 percent (Chernichovsky and Meesook, 1984).
2. The shares for the staple crops, that is, rice, corn, cassava, potatoes, and wheat, account for no less than one-third of the food budget.
3. Among the staples, rice is dominant. Households in every region spend, on average, at least two-thirds of their staple food budgets on rice. The share of rice above this minimum varies depending on the availability of the other staples. Next to rice, for example, maize and cassava are important crops in Central Java, Yogyakarta, Maluku, and Irian Jaya.
4. Compared with the other staples, the diet is centered more on rice in urban than in rural areas.
5. The share of the staple crops in the food budget declines as the average income rises. At the same time, the high income groups tend to consume a realtively larger portion of rice among staples, when compared to low income groups.
6. Except in urban areas where nonrice staple crops are less important, the secondary crops play more of a stabilizing role in maintaining the food consumption level in rural areas.

Several studies have estimated the demand elasticities for the staple crops of Indonesia. This appendix contains a review of these studies including data source, demand system specification, and the regional and

income breakdowns for the estimated elasticities in order to provide a point of reference for the analysis of the 1980 SURGASAR data. Among the studies reviewed, Timmer (1971), using the 1967 Susenas Survey, estimated the expenditure elasticities for rice in rural and urban Java. Boedino (1978) estimated price and income elasticities for forty-one commodity groups using the 1969/70 and 1976 Susenas Surveys. Hedley (1978), Timmer and Alderman (1979), the World Bank [in Dixon (1982)], and Dixon, in collaboration with Anwar and Mears [in Mears (1981)], also estimated separately demand elasticities based on the 1976 Susenas Survey. Further, Chernichovsky and Meesook (1984), using a more recent Susenas, have estimated demand elasticities for fourteen food groups. The World Bank report (1983) also contains demand elasticity estimates from time series data. All elasticity estimates, except those from the World Bank (1983) are from cross section data.

Selected demand elasticity estimates from these studies are presented in Table B.1, which shows the data source, the demand system specification, and the regional and income breakdowns for the estimated elasticities. The studies vary greatly in time, commodities covered, commodity aggregation, classification of income groups, demand systems specifications, and estimation procedures.

Hedley (1978) used data collected in the second round of the 1976 Susenas Survey. He specified ten commodity groups and disaggregated by region (Java/outer Java) and by location (rural/urban). Rice and other staple crops were aggregated in a cereals category. A linear expenditure system was used to estimate expenditure elasticities for all of the commodity groups. The World Bank study of 1978 [in Dixon (1982)] used all of the 1976 Susenas expenditure survey. Following Hedley (1978), the data were partitioned by

island group and location. Each partition of the data was further divided by income group, based on per capita monthly expenditures (Table C.1, Column 7).

The approach of Timmer and Alderman (1979) used a similar classification system to that adopted by the World Bank (1978) [in Dixon (1982)]. The difference was the cut-off points for partitioning the sample by income group. Two staple crops, (rice and fresh cassava) and one diet component (calories) were included. A double-log-quadratic function was used to estimate price and expenditure elasticities. A covariance analysis was applied, in addition, to isolate the effects of spatial and seasonal variations in consumption responses.

Chernichovsky and Meesoo' (1984) extended the work of Timmer and Alderman (1979) by estimating demand elasticities for fourteen food groups and eleven diet components. The estimates include expenditure elasticities for the staple crops and calories and protein. Separate elasticities were estimated for populations deficient in calories. A log-linear procedure was applied in the three-round 1978 Susenas Survey to generate these results.

Dixon (1982) estimated price and expenditure elasticities for rice, fresh cassava, dried cassava (gaplek), and sweet potatoes. The 1976 Susenas expenditure survey was the data base. Like most of the previous studies, the data were partitioned by island, rural and urban areas, and income (consumption) groups. But unlike the other studies, the grouping of the population was by caloric consumption level. Three calorie consumption population groups were identified using daily totals: less than 1755 k calories, 1755 to 2300 k calories, and over 2300 k calories. The objective was to group the population by equivalent calorie consumption, regardless of income. The estimation procedures then applied were, by and large, similar to Timmer and Alderman (1979).

The results of these studies are not, in general, directly comparable technically. However, they are comparable in the sense of their potential application in food and agriculture policy issues. Still, caution should be exercised in jointly applying and interpreting consequences these coefficients for food and nutrition policy. Notwithstanding these qualifications, however, useful structural and policy inferences can be drawn from these studies. It is emphasized that these studies represent the present empirical basis for food policy analysis; and while not directly comparable theoretically, they do have the same policy focus.

Rice: The cross-section based expenditure elasticities for rice for all Indonesia range between 0.47 and 0.69. These estimates are higher than those estimated from time series data (0.20). Despite the variations in the elasticities, all the coefficients suggest that the consumption of rice increases with income, but not proportionally.

The expenditure elasticities for rice are, in general, lower in urban areas. For example, according to Timmer and Alderman (1979), the coefficients were 0.58 and 0.27 for rural and urban areas, respectively. The coefficients appear to fall much faster as income rises within Java than for the off-Java islands. This pattern is consistent with the increased diversity of foods in urban areas.

The estimated expenditure elasticities for rice give a general view of the income-consumption relation. The income elasticities are positive for all income groups. The income-specific expenditure elasticities for all Indonesia range between 0.98 and 1.16 for the poor, and 0.19 and 0.28 for the higher income groups. The urban expenditure elasticities are low for all income groups. These estimates range between 0.83 and 1.52 for the rural poor and 0.36 and 0.96 for the urban poor. Among the upper income groups, the

coefficients vary between 0.13 and 0.29 in rural areas and -0.12 and 0.03 in urban areas.

Rice is a superior food among the poor in rural areas. Because of the increasing diversity of foods and a declining share of rice in the food budget with rising income levels, the expenditure elasticities are lower for higher income groups. Across regions, the studies suggest (except Chernichovsky and Meesook 1984) that the income elasticities for Java are lower than for the off-Java islands (World Bank 1978, in Dixon 1982; and Dixon 1982).

Over the years, these elasticities have shown a pattern of decline with time. In the years between 1967 and 1976, for example, the rice expenditure elasticities fell from 0.44 (Timmer 1971) to 0.15 (World Bank 1978) for urban Java, and from 0.74 (Timmer 1971) to 0.56 (World Bank 1978) for rural Java. For Indonesia as a whole, the elasticities declined from 0.69 (Boedino 1978) to 0.47 (World Bank 1978) for the period between 1976 and 1978. Such a trend is likely to continue as the country experiences a rising level of per capita income.

The estimated own-price elasticities present a less conclusive picture of consumption behavior, however, the studies provide noticeable patterns. First, rice consumption responds to changes in relative prices. Second, the own-price elasticities are all negative regardless of location and income partition. Third, the own-price elasticities decline in absolute terms as the average income level rises. This pattern is possibly associated with the rice-centered staple food consumption of high income groups. Finally, the absolute-price elasticities based on cross-section data are higher than those from time series data.

Cassava: The expenditure elasticities for fresh cassava range between 0.26 and 0.29. For dried cassava, consumed largely by the rural population,

the elasticity is -0.62 (Dixon 1982). The expenditure elasticities for cassava are positive for the low and medium groups, but, regardless of the location, negative for high income groups. On a regional basis, the elasticities are larger in off-Java than Java (see Chernichovsky and Meesook 1984). Cassava, in short, appears to be consumed mainly by the low-income, rural population. The general pattern of elasticities suggests that cassava is an inferior good.

Other staples: According to the World Bank (1984), the expenditure elasticity for sweet potatoes is on average, -0.02. This estimate, from time series data, implies that consumers reduce their consumption of sweet potatoes as their incomes rise. Dixon (1982), using 1976 Susenas data for Java, found expenditure elasticities of 0.64 and 0.09 for rural and urban Java, respectively. Across income groups, however, the elasticities are negative for upper income groups. Dixon (1982), therefore, suggests that sweet potatoes are the inferior crop only among the wealthier groups.

Chernichovsky and Meesook (1984) combine sweet potatoes with potatoes, targo, and sago and enter all as "potatoes" in their model. They find the elasticities to be positive both in Java and on off-Java islands regardless of income levels. And, contrary to the case of sweet potatoes, the expenditure elasticities increase with income.

What is to be learned from these demand elasticity estimates?

(1) The majority of the studies have centered on the principal food crop--rice.

(2) Expenditure elasticities, for rice in particular, appear to decline with time.

(3) Price elasticity estimates are largely limited to own-price effects. Cross-price elasticity estimates are absent or highly erratic in value.

(4) The double-log demand system has been widely used in estimating demand parameters. This specification, despite its convenience, imposes restrictive assumptions on preference structure and is not consistent except under highly specialized assumptions, with demand theory and unnecessary in analyses of survey data.

(5) The studies have abstracted from the interdependency of consumption and production decisions. This may be particularly restrictive for farm households that retain part of their output for own consumption.

(6) No systematic linkages have been developed between food consumption and nutritional status.

Table B.1: Selected Own-Price and Expenditure Elasticities for Staple Crops - Indonesia

Study	Data Source	Demand System	Country/ Region	Location	Crop	Income Group ('000 Rp/Pop/month)	Elasticity Price	Elasticity Expenditure
Timmer (1971)	Susenas-III(1967)	*	Java		Rice			0.69
				Rural		LN. 0.3		0.92
						0.3-1.0		0.63
						GR. 1.0		0.34
						AV.		0.74
				Urban				
						LN. 0.3		0.75
						0.3-1.0		0.44
						GR. 1.0		0.13
						AV.		0.44
Boedino (1978)	Susenas-IV(1969-1970)	LES	Indonesia		Cereals			
				Rural			-0.68	0.71
				Urban			-0.51	0.50
Boedino (1978)	Susenas-IV/V (1976)	log linear	Indonesia		Rice		-.63	0.69
					Corn, tuber & root crops		-.26	0.30
Hedley (1978)	Susenas-V(1976)	LES	Java		Cereals			
				Rural				0.56
				Urban				0.24
			Outer-Java					
				Rural				0.69
				Urban				0.39
World Bank (1978)	Susenas-V(1976)	*	Indonesia		Rice			
						LN. 2.0		0.98
						2.0-3.999		0.61
						4.0-7.999		0.33
						GE. 8.0		0.19
						AV.		0.47

Table B.1 (continued)

Study	Data Source	Demand System	Country/ Region	Location	Crop	Income Group ('000 Rp/Pop/month)	Elasticity Price	Elasticity Expenditure
			Java			LN. 2.0		0.96
						2.0-3.999		0.58
						4.0-7.999		0.32
						GE. 8.0		0.16
						AV.		0.49
				Rural				
						LN. 2.0		0.99
						2.0-3.999		0.62
						4.0-7.999		0.38
						GR. 8.0		0.24
						AV.		0.56
				Urban				
						LN. 2.0		0.46
						2.0-3.999		0.25
						4.0-7.999		0.12
						GR. 8.0		0.07
						AV.		0.15
			Off-Java			LN. 2.0		1.04
						2.0-3.999		0.67
						4.0-7.999		0.34
						GR. 8.0		0.22
						AV.		0.44
				Rural				
						LN. 2.0		1.15
						2.0-3.999		0.68
						4.0-7.999		0.33
						GR. 8.0		0.29
						AV.		0.49
				Urban				
						LN. 2.0		0.90
						2.0-3.999		0.55
						4.0-7.999		0.42
						GR. 8.0		0.03
						AV.		0.32

Table B.1 (continued)

Study	Data Source	Demand System	Country/ Region	Location	Crop	Income Group ('000 Rp/Pop/month)	Elasticity Price	Elasticity Expenditure
Timmer & Alderman (1979)	Susenas-V(1976)	log linear	Indonesia		Rice			
						LN. 2.0	-1.92	1.16
						2.0-3.0	-1.48	0.92
						3.0-5.0	-1.16	0.68
						GE. 5.0	-0.74	0.28
						AV.	-1.11	0.53
					Fresh Cassava			
						LN. 2.0	1.28	0.99
						2.0-3.0	-0.82	0.68
						3.0-5.0	-0.94	0.39
						GE. 5.0	-0.78	-0.08
						AV.	-0.80	0.39
				Rural	Rice			
						LN. 2.0	-1.33	1.17
						2.0-3.0	-0.99	0.92
						3.0-5.0	-0.82	0.70
						GE. 5.0	-0.61	0.36
						AV.	-0.84	0.58
					Fresh Cassava			
						LN. 2.0	-1.26	0.99
						2.0-3.0	-0.81	0.68
						3.0-5.0	-0.94	0.39
						GE. 5.0	-0.78	-0.05
						AV.	-0.91	0.41
				Urban	Rice			
						LN. 2.0	-1.32	0.997
						2.0-3.0	-1.06	0.76
						3.0-5.0	-0.92	0.53
						GE. 5.0	-0.72	0.07
						AV.	-0.81	0.27
					Fresh Cassava			
						LN. 2.0	-1.27	0.84
						2.0-3.0	-0.81	0.52
						3.0-5.0	-0.94	0.23
						GE. 5.0	-0.78	-0.37
						AV.	-0.86	-0.05

Table B.1 (continued)

Study	Data Source	Demand System	Country/ Region	Location	Crop	Income Group ('000 Rp/Pop/month)	Elasticity Price	Elasticity Expenditure
World Bank (1984)	*	*	Indonesia					
					Rice		-0.15	0.20
					Corn		-2.27	-0.21
					Wheat		-0.53	0.99
					Cassava		-0.19	0.20
					Sweet Potatoes		-0.47	-0.02

Table B.1 (continued)

Study	Data Source	Demand System	Country/ Region	Location	Crop	Income Group ('000 Rp/month)	Elasticity Price	Elasticity Expenditure
D. Cherni-chovsky & Meesook (1984)	Susenas-VI(1978)	log linear	Java		Rice			
						LE. 12.999		3.02
						13.0-23.999		0.91
						GE. 24.00		0.03
					Corn			
						LE. 12.999		-0.62
						13.0-23.999		-0.43
						GE. 24.00		0.20
					Wheat			
						LE. 12.999		0.06
						13.0-23.999		-0.03
						GE. 24.00		0.94
					Cassava			
						LE. 12.999		0.24
						13.0-23.999		0.79
						GE. 24.00		-0.07
					Potatoes			
						LE. 12.999		0.54
						13.0-23.999		1.24
						GE. 24.00		1.67
			Off-Java		Rice			
						LE. 22.999		1.15
						23.0-35.999		0.40
						GE. 36.000		0.05
					Corn			
						LE. 22.999		-0.29
						23.0-35.999		-0.13
						GE. 36.000		0.57

Table B.1 (continued)

Study	Data Source	Demand System	Country/ Region	Location	Crop	Income Group ('000 Rp/month)	Elasticity Price	Elasticity Expenditure
					Wheat			
						LE. 22.999		0.42
						23.0-35.999		1.22
						GE. 36.000		1.67
					Cassava			
						LE. 22.999		0.37
						23.0-35.999		0.72
						GE. 36.000		0.11
					Potatoes			
						LE. 22.999		0.67
						23.0-35.999		1.67
						GE. 36.000		1.63

Table B.1 (continued)

Study	Data Source	Demand System	Country/ Region	Location	Crop	Calorie Level ('000 kcalories/day)	Elasticity Price	Elasticity Expenditure
Dixon, Anwar, & Mears in Mears (1981)	Susenas-V(1976)		Java		Rice			
				Rural		LN. 1.755		0.97
						1.755-2.300		0.36
						GR. 2.300		
				Urban				
						LN. 1.755		0.37
						1.755-2.300		
						GR. 2.300		
			Off-Java					
				Rural		LN. 1.755	-1.9	1.52
						1.755-2.300	-1.58	0.58
						GR. 2.300	-0.88	0.28
				Urban				
						LN. 1.755	-2.05	0.96
						1.755-2.300	-0.81	0.35
						GR. 2.300	-0.80	
Dixon (1982)	Susenas-V(1976)	log linear	Java	Rural	Fresh Cassava			
						LN. 1.755		0.85
						1.755-2.300		0.12
						GR. 2.300		-0.63
						AV.	-0.81	0.28
					Gaplek			
						LN. 1.755		0.83
						1.755-2.300		-1.02
						GR. 2.300		-2.90
						AV.	-1.86	-0.62
					Sweet Potatoes	LN. 1.755		1.56
						1.755-2.300		0.39
						GR. 2.300		-0.80
						AV.		0.64
				Urban	Fresh Cassava			
						LN. 1.755		0.09
						1.755-2.300		-0.26
						GR. 2.300		-0.65
						AV.		-0.13

Table B.1 (continued)

Study	Data Source	Demand System	Country/ Region	Location	Crop	Calorie Level ('000 kcalories/day)	Elasticity Price	Elasticity Expenditure
					Sweet Potatoes	LN. 1.755		0.46
						1.755-2.300		-0.15
						GR. 2.300		-0.78
						AV.	-2.69	0.09

Key:
*: unidentified
LN: <
LE: ≤
GR: >
GE: ≥

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APPENDIX C

Consumer Demand Theory--A Review

A REVIEW OF CONSUMER DEMAND THEORY

Overview

This appendix has two main parts: first, a review of basic consumer demand theory, and second, a discussion of extensions of the theory.

Part one reviews alternative approaches to consumer demand theory. Aspects discussed are the basic demand restrictions of the theory and their implications for estimation of demand systems. Also surveyed are the commonly used empirical demand models and their implications for demand structure and parameters.

Part two presents three extensions of the basic consumer demand theory. Included is a discussion of the share analysis model that incorporates commodity consumption interactions. This is followed by a survey of techniques for introducing demographic variables in estimated demand systems. Part two concludes by reviewing "new" approaches to consumer demand theory that allow production as an integral component of the demand system. These approaches are than specialized for farm household production and nutritional analyses.

Basic Consumer Demand Theory

This section presents a review of basic consumer demand theory. It is organized in three parts. Part one utilizes the direct approach to the utility maximization problem. The dual version of the consumer allocation problem is presented in part two. The common empirical demand models are surveyed in part three.

Utility Maximization

Assume that a consumer can make a complete and consistent order of preferences within a closed choice set. The choices that can be made are limited by an income opportunity set. The consumer's choice problem is then to find an optimum commodity bundle within the opportunity set.

This allocation problem can be formulated in a utility maximization framework (for example, see Deaton and Muellbauer 1980a; Phlips 1983; and Johnson, Hassan, and Green 1984). Suppose there exists a utility function, $U(Q)$, that represents the consumer's preference ordering. The function is defined over an exhaustive vector of commodities Q where $Q' = (Q_1, \ldots, Q_n)$. It is assumed that $U(Q)$ is an increasing function (that is, $U'(Q) > 0$), continuous, twice differentiable and strictly quasi-concave. The consumer choice problem is completed by the addition of a linear budget constraint, $P'Q = Y$ where P is an n-element column vector of prices.

The utility maximization problem is to find an optimal vector $Q^*(P,Y)$ at which, subject to the linear budget constraint, the consumer attains maximum utility $U^*(Q)$. That is,

(1)
$$\text{Max } U = U(Q)$$
$$\text{St.} \quad P'Q = Y.$$

The maximization procedure can be viewed as involving four steps. First, formulate the Lagrangian:

(2)
$$L(Q, \lambda) = U(Q) - \lambda(P'Q - Y).$$

Second, differentiate the equation (2) with respect to the choice variables, Q and λ, that is,

(3)
$$U_Q - P\lambda = 0$$
$$P'Q - Y = 0,$$

where $U_Q = \frac{\partial U}{\partial Q} = [U_1, U_2, \ldots, U_n]$ is the vector of the derivatives of the utility function with respect to the vector Q. Third, solve the system of n + 1 equations for

(4)
$$Q^* = \Phi(P, Y) \text{ and}$$
$$\lambda^* = \lambda(P, Y),$$

where Q^* is an n-element vector of optimal quantities expressed as functions of the prices of goods and income. The last equation, $\lambda(P, Y)$, denotes the optimal value for the Lagrangian multiplier. The regularity conditions on the utility function, in particular its strict quasi-concavity, ensure that the

solutions are unique. The final step is to test the second order conditions to verify that the first order conditions yield a maximum.

Applications of the consumer theory are centered on the estimation of the parameters of the system $Q^* = \Phi(P, Y)$. For n commodities, there are a total of $n^2 + n$ elasticities to be estimated, n^2 price elasticities and n income elasticities. The actual number of elasticities to be estimated can be reduced by imposing on the elasticities restrictions following from the consumer optimization problem and the properties of the utility function. Moreover, by assuming a specific functional form for the utility and/or demand functions, the number of elasticities to be estimated can be further reduced.

The restrictions on the demand parameters are generated from the properties of the utility function (consistency and symmetry) and the linear budget constraint. Solutions of the fundamental matrix equation of consumer demand theory (Barten 1964) expressed in terms of partial derivatives show:

(5) $$\frac{\partial Q}{\partial P} = \lambda U^{-1} - \lambda(\partial\lambda/\partial y)^{-1} \left(\frac{\partial Q}{\partial y}\right)\left(\frac{\partial Q}{\partial y}\right)' - \left(\frac{\partial Q}{\partial y}\right) Q',$$

(6) $$\frac{\partial Q}{\partial Y} = \left(\frac{\partial \lambda}{\partial Y}\right) U^{-1} P,$$

(7) $$\frac{\partial \lambda}{\partial P} = -\lambda\left(\frac{\partial Q}{\partial Y}\right) - \left(\frac{\partial \lambda}{\partial Y}\right) Q, \text{ and}$$

(8) $$\frac{\partial \lambda}{\partial Y} = (P'U^{-1}P)^{-1},$$

where $\frac{\partial Q}{\partial P}$, $\frac{\partial Q}{\partial Y}$, $\frac{\partial \lambda}{\partial P}$, and $\frac{\partial \lambda}{\partial Y}$ are the derivatives of the demand equation (4) with respect to the prices, P_i, and income, Y, and U^{-1} is the inverse of the Hessian

matrix, U. Because of the continuity and differentiability assumptions, the Hessian matrix, U, is symmetric. Also, the strict quasi-concavity assumption implies U is negative definite.

The symmetry and the negative definite properties of the Hessian matrix U imply that the substitution matrix of equation (5),

$$K = \lambda U^{-1} - \lambda\left(\frac{\partial\lambda}{\partial Y}\right)^{-1}\left(\frac{\partial Q}{\partial Y}\right)\left(\frac{\partial Q}{\partial Y}\right)' \tag{9}$$

is symmetric, and that the diagonal elements are negative. The latter result assumes that the income compensated own price elasticities are always negative.

Demand Restrictions

Expressing equations (5) through (8) in elasticities, the consumer demand theory implies that demand functions must satisfy three types of restrictions:

(A) Engel aggregation--

$$\sum_i w_i \eta_{iy} = 1, \tag{10}$$

where $w_i = P_i Q_i / Y$ is the average budget share for the ith commodity. Budget exhaustion for given income, $P'Q = Y$, implies that the sum of the weighted income elasticities adds to unity. Thus, only $n - 1$ of the income elasticities are independent.

(B) Homogeneity--

$$\sum_j \varepsilon_{ij} + \eta_{iY} = 0, \qquad \text{for all } i \tag{11}$$

which means that the demand functions are homogenous of degree zero in prices and income. That is, an equal proportional change in P and

Y will leave commodity demands unaffected. For each demand function, there is therefore one redundant elasticity, and for n functions there are n elasticities.

(C) Slutsky Symmetry--using equation (9), the well-known Slutsky equation (5) is obtained by rewriting as

$$\frac{\partial Q}{\partial P} = K - \left(\frac{\partial Q}{\partial y}\right) Q', \tag{12}$$

where K is again the substitution effect and $\left(\frac{\partial Q}{\partial y}\right) Q'$ is the income effect of a price change. From equation (12) the substitution matrix can be expressed as,

$$K = \left(\frac{\partial Q}{\partial P}\right) + \left(\frac{\partial Q}{\partial y}\right) Q' \tag{13}$$

and, because it is symmetric, $K_{ij} = K_{ji}$. In elasticities, equation (13) corresponds to

$$\varepsilon_{ij} = \frac{w_j}{w_i} \varepsilon_{ji} - w_j(\eta_{iy} - \eta_{jy}). \tag{14}$$

Equation (14) reduces the number of independent elasticities to $1/2(n^2 - n)$.

These three types of restrictions, i.e., Engel aggregation (10), homogeneity (11), and symmetry (14), reduce the number of parameters to be estimated for the demand system to $1/2\ (n^2 + n - 2)$. Additional reductions of the parameters to be estimated can be made through direct imposition of restrictions on the demand parameters or a choice of a specialized utility function.

Specialized Utility Structures

The choice of a specific form for the utility function depends on prior knowledge of the consumer's preference structure. Common behavioral

assumptions embedded in specifications of utility functions are separability and additivity. The restrictions that these concepts imply for the demand parameters along with their behavioral consequences are summarized below.

Separability: One specialized utility structure often used in applied demand analysis is a partitioning of commodities into groups. The question is under what conditions do decisions involving these aggregates give a utility level that is equivalent to the one that would be articulated in terms of the individual commodities? An assumption of separability of preferences is required to assure this equivalence relationship.

In the case of a weak separability, the utility function is written as

$$U(Q) = F[U_1(Q_1), \ldots, U_r(Q_r), \ldots, U_m(Q_m)], \tag{15}$$

where $F' > 0$. The n commodities are partitioned into $m < n$ groups and each group has n_r commodities. Then, $U_r(Q_r)$ represents a branch utility function. The necessary and sufficient conditions for $U(Q)$ to be weakly separable with respect to the m groups is that the marginal rate of substitution between two commodities from the same branch is independent of the quantities of all commodities not in the branch (Phlips 1983). That is,

$$\partial[U_i(Q_r)/U_j(Q_r)]/\partial Q_k = 0, \tag{16}$$

where $i \in R$, $j \in R$, $k \in K$, and $(R \neq K)$.

Equation (16) has important implications for the demand functions. Specifically, the cross-substitution terms become

(17) $$K_{ij} = \Theta_{IJ} \frac{\partial Q_i}{\partial Y} \frac{\partial Q_j}{\partial Y},$$

where $i \in I$, $j \in J$, and $(I \neq J)$. In equation (17), Θ_{IJ} is a parameter summarizing the pattern of substitution between the branches I and J. Note that no restrictions are imposed on the substitution relationships within each branch or commodity group.

Rewriting the Slutsky equation (12), the associated uncompensated cross-price elasticities are shown to be (Johnson, Hassan, and Green 1984)

(18) $$\varepsilon_{ij} = w_j \Theta_{IJ} \eta_i \eta_j - w_j \eta_i .$$

Equation (18) implies that all elements of the matrix of demand elasticities are identified $[1/2(m^2 - m)]$, if the income elasticities (n) and the general (branch) substitution terms θ_{IJ}'s, are known. Thus, under this separability assumption, the number of independent estimates of elasticities required to determine the system of demand functions is reduced to $n + 1/2\ (m^2 - m)$.

<u>Strong separability</u> is the case, where the branch utilities in (15) are combined:

(19) $$U(Q) = F[U_1(Q_1) + \ldots + U_r(Q_r) + \ldots + U_m(Q_m)],$$

where F is now increasing in only one variable, that is, the sum of the m branch utilities. Equation (19) defines strong separability with respect to m groups if the marginal rate of substitution between two commodities, i and j, from different subsets does not depend upon the quantities of commodities outside I and J. That is,

(20) $$\partial[U_i(Q_i)/U_j(Q_j)]/\partial Q_k = 0$$

164

for all $i \in I$, $j \in J$, $k \in K$, $K \notin I$ and J, and $I \neq J$.

Because of additivity, the commodity groups are not interconnected, that is, there are no unique utility branches. Any combination of commodity groups is admissible. Additivity implies a Slutsky term of the form

$$K_{ij} = \Theta \frac{\partial Q_i}{\partial Y} \frac{\partial Q_j}{\partial Y}, \tag{21}$$

where Θ is independent of the commodity groups to which i and j belong. With strong separability, the Slutsky equation for cross-price effects is (Johnson, Hassan, and Green 1984)

$$\varepsilon_{ij} = w_j \Theta \eta_i \eta_j - w_j \eta_i, \tag{22}$$

where Θ is the same for all groups. Notice the relationship between strong and weak separability by comparing equations (22) and (18). Hence, for the complete demand system, only n + 1 parameters are required--n income elasticities and a value for Θ.

<u>Block Additivity</u>: This is a special case of strong separability where F in Equation (19) is set to unity. Since under the foregoing assumptions on the consumer allocation problem, any monotonic transformation of a utility function represents the same underlying preference ordering, the implied restrictions on demand functions are similar to those expressed in equations (21) and (22).

<u>Direct additivity</u>: (point-wise separability) This is again a special case of Equation (19), where F is defined as an identity function and each component utility function, $U_r(Q_r)$, contains only one element. The condition on the cross-partial derivatives of the utility function becomes

(23) $$\partial U_i / \partial U_j = 0 \quad \text{for all } i \text{ and } j.$$

The Slutsky term, K_{ij}, reduces to a general substitution relation,

(24) $$K_{ij} = \tilde{\Theta} \frac{\partial Q_i}{\partial Y} \frac{\partial Q_j}{\partial Y},$$

where $\tilde{\Theta} = -\lambda \left(\frac{\partial \lambda}{\partial Y}\right)'$. The expression for the uncompensated cross-price elasticities is, in this case,

(25) $$\varepsilon_{ij} = w_j \phi \eta_i \eta_j - w_j \eta_i,$$

where $\omega = -Y/\tilde{\Theta} = 1/\phi$; this is known as the "income flexibility" parameter (Frisch 1959).

This simple preference structure requires only estimates of n income elasticities and the income flexibility parameter ($\tilde{\theta}$) for a complete characterization of the demand system. Also, the substitution matrix K_{ij} is positive (the matrix being negative semidefinite) if $\tilde{\theta} > 0$ and the income elasticities are all positive. Thus, inferior and complement goods are ruled out by the direct additivity assumption. These behavioral implications suggest that direct additivity, if applicable at all, should be used only for broad groups of commodities.

Duality

An alternative approach for obtaining a Marshallian demand system is to start from an <u>indirect</u> utility function,

(26) $$V(P, Y) = \text{Max } [U(Q) : P'Q = Y],$$

where V(P, Y) is the maximum attainable utility level for a given vector of prices and income. Applying Roy's identity to expression (26) produces

(27) $$Q_i^*(P, Y) = V_{P_i}/V_Y \qquad \text{for all } i,$$

where $V_{P_i} = \frac{\partial V}{\partial P_i}$ and $V_Y = \frac{\partial V}{\partial Y}$ are partial derivatives of the indirect utility function with respect to price of commodity i, P_i, and income Y, respectively.

An indirect utility function representing an underlying preference ordering consistent with U = U(Q) has the following properties (Varian 1978):

a. V(P, Y) Continuous at all P > 0, Y > 0,

b. V(P, Y) nonincreasing in P ($V_P \leq 0$),

c. V(P, Y) nondecreasing in Y ($V_Y \geq 0$),

d. V(P, Y) homogeneous of degree zero in (P, Y), and

e. V(P, Y) quasi-convex in P.

The first property (a) is a direct result of the regularity assumptions on the direct utility function U. According to property (b), a price change has a nonpositive effect on consumer's utility level if a nominal income is held fixed. Property (c) follows from the assumption of nonsatiation. Property (d) is a consequence of the absence of the no-money illusion that is, $Q^*(tP, tY) = Q^*(P, Y)$, and hence $V(Q^*(P, Y)) = V(Q^*(tP, tY))$ where t is a positive constant. The last property (e) implies that the matrix of second order partial derivatives of V, defined as $V_{ij}(P, Y)$, is positive semidefinite.

Alternatively, suppose a target level of utility, U^*, is given. The minimum income level required to reach U^* is

(28) $$E(P, U^*) = \text{Min } [PQ : U(Q) = U^*],$$

where $E(P, U^*)$ is expressed as a function of fixed prices and a given utility level. Expression (28) is known as an <u>expenditure</u> (cost) function.

Shephard's lemma can be applied to the cost function to obtain

$$\frac{\partial E(P, U^*)}{\partial P_i} = Q_i^c(P, U) \tag{29}$$

where $Q_i^c(P, U)$ is a Hicksian demand function, expressed as a function of prices and target utility level, U^*.

The expenditure function satisfies the properties:

a. $E(P, U^*)$ continuous in P ($P > 0$),

b. $E(P, U^*)$ nondecreasing in P ($E_P > 0$),

c. $E(P, U^*)$ homogeneous of degree 1 in P, and

d. $E(P, U^*)$ concave in P.

Property (b) implies that increases in P require at least as much expenditure as the initial expenditure to remain at U^*. Property (c) states that if prices increase in some proportion, $Q^c(P, U)$ remains unaffected, and hence $E(P, U)$ increases in the same proportion. Property (d) follows from cost minimization, where as the price of a commodity increases, cost will rise to maintain the same U^* but at a decreasing rate as the consumer substitutes other commodities. Provided that property (a) holds, that is, that the derivatives exist, Shephard's lemma can be used in general to obtain the Hicksian (compensated) demand functions.

When U^* is the level that represents the maximum utility in the primal problem, that is, $V(P, Y) = U^*$, both the indirect utility and cost functions yield the same demand functions. That is, the Marshallian and Hicksian demand functions, $Q_i(P, Y) = Q_i^c(P, E)$, are equal. Moreover, the cost function, $E(P, U^*)$, can be obtained by inverting the indirect utility function, $V(P, Y)$. This is possible since $V(P, Y)$ is nondecreasing in Y. Similarly, the indirect utility function can be derived from the cost function by setting $E(P, U^*) = Y$ and solving for $V = U^*(P, Y)$. These results are consistent for a utility-maximizing consumer where cost minimization is dual to the utility maximization

problem. An underlying preference ordering can thus be represented by a direct utility function, U(Q), an indirect utility function, V(P, Y), or a cost function, $E(P, U^*)$.

If we redefine the problem in equation (28) as

$$D(Q, U) = \text{Min } [PQ : V(P, Y) = U^*] \tag{30}$$

then D(Q, U) represents the <u>distance</u> function, expressing the minimum cost of achieving a utility level U^* at a given vector Q^*. The distance function yields the vector of prices that will give the amount (proportion) that Q^* must be divided to achieve U^*.

Like the indirect and cost functions, the distance function maps to the same preference structure if it is:

a. continuous in Q,

b. nonincreasing in utility, and

c. nondecreasing, concave, and homogeneous of degree 1 in Q.

Empirical Demand Systems

Among demand systems used in empirical analysis, the linear expenditure system is reviewed first, as it is based on a simple and widely applied utility structure. It has also been used in previous work with Indonesia data (Hedley 1978). This is followed by a discussion on the Indirect Addilog demand model. This model, like the linear expenditure system, is based on a simplified utility function, but overcomes some of the restrictions on the parameters implied by the linear expenditure system. For example, all income elasticities need not be positive. The next two demand models--the Almost Ideal Demand System and the Indirect Translog Model--are derived using duality theorems. An alternative approach to derive a demand system is to start with

demand restrictions to construct a theoretically plausible demand system. The Rotterdam demand model exemplifies this approach. Finally, a more ad hoc local approximation method more consistent with the past work in agricultural economics is reviewed.

Linear Expenditure System (LES): The demand function for commodity i is given by

$$Q_i = \gamma_i + \beta_i/P_i \ (Y - \sum_j P_j \gamma_j), \tag{31}$$

where γ_i is interpreted as the committed quantity of commodity i and $Y - \Sigma P_j \gamma_j$ as supernumerary income, which the consumer allocates in fixed proportions, β_i/P_i. The demand system can be derived from a translated version of the family of the Bergson utility functions (Pollak 1971), known as the Stone-Gary utility function,

$$U(Q) = \Sigma\beta_i \ln(Q_i - \gamma_i), \tag{32}$$

where $\Sigma\beta_i = 1$, $0 < \beta_i < 1$, and $(Q_i - \gamma_i) > 0$. With these restrictions on the parameters of the utility function, the demand system satisfies the adding up ($\Sigma\beta_i = 1$) and symmetry ($0 < \beta_i < 1$ and $Q_i > \gamma_i$) conditions.

The income elasticity for commodity i is

$$\eta_i = \beta_i/w_i, \tag{33}$$

where $w_i = P_i Q_i/Y$ is again the average budget share. Note from (33) that the marginal budget share is $\beta_i = \eta_i w_i$.

The own-price elasticity for commodity i is

$$\epsilon_{ii} = -1 + (1 - \beta_i) \ \gamma_i/Q_i, \tag{34}$$

where to make the previous statement of conditions more explicit, $K_{ii} < 0$

requires $0 < \beta_i < 1$ and $(Q_i - \gamma_i) > 0$.

The cross-price elasticity for good i is

$$\varepsilon_{ij} = -\beta_i(P_j\gamma_j/P_iQ_i) \qquad \text{for all } i \neq j, \tag{35}$$

so that for the linear expenditure system, all goods are gross complements.

The LES incorporates the restrictions implied by an additive utility structure. The restriction $0 < \beta_i < 1$ implies income elasticities (33) are positive. The fact that the cross-substitution terms are positive ($K_{ij} > 0$) implies that all pairs of goods are net substitutes. Also, for the LES specified for a large number of commodities, the price elasticities are approximately proportional to expenditure elasticities (Deaton and Muellbauer 1980a). Despite these limitations, however, experience with the demand system (Phlips 1983) shows that it is a reasonable model if the goods are broadly grouped and price variations within these groups are restricted.

<u>Indirect Addilog Demand Model (Houthakker 1960)</u>: The addilog demand system is derived from the additive, indirect utility function,

$$V(P, Y) = \Sigma\alpha_i(Y/P_i)^{b_i}, \tag{36}$$

with parameter restrictions $\alpha_i < 0$, $\Sigma\alpha_i = -1$, and $-1 < b_i < 0$. The corresponding demand function for the ith commodity, in log form, is

$$\ln Q_i = \ln\alpha_i b_i + (1 + b_i)\ln(Y/P_i) - \ln \Sigma\alpha_j b_j (Y/P_j)^{b_j}. \tag{37}$$

The demand function (37) satisfies the general restrictions from consumer demand theory. Differentiating equation (37), the income and price elasticities of this demand system are (Johnson, Hassan, and Green 1984):

(38) $$\eta_{iY} = (1 + b_i) - \Sigma\, b_j w_j \quad \text{for all } i; \text{ (income elasticity)}$$

where $\eta_{iY} \lesseqgtr \Sigma\, b_j w_j$:

(39) $$\varepsilon_{ii} = -(1 + b_i) + b_i w_i \quad \text{for all } i; \text{ (own-price elasticity)}$$

where $-1 < \varepsilon_{ii} < 0$ with $-1 < b_i < 0$ and $w_i > 0$; and

(40) $$\varepsilon_{ij} = b_j w_j \quad \text{for all } i \neq j; \text{ (cross-price elasticity).}$$

<u>Almost Ideal Demand System (AIDS)</u>: Using the dual formulation of the consumer allocation problem, Deaton and Muellbauer (1980b) specified the cost function

(41) $$\ln C = \alpha_o + \Sigma_j \alpha_j \ln P_j + 1/2\ \Sigma\Sigma \hat{\gamma}_{jk} \ln P_j \ln P_k + U\beta_o \Pi P_j^{\beta_j}$$

where for the function to be linearly homogeneous in prices, the parameters must satisfy $\Sigma_i \alpha_i = 1$, $\Sigma_j \hat{\gamma}_{jk} = \Sigma_k \hat{\gamma}_{kj} = \Sigma_j \beta_j = 0$. Applying Shephard's lemma to equation (41), the Hicksian demand function for commodity i in share form, becomes

(42) $$w_i = \alpha_i + \Sigma \gamma_{ij} \ln P_j + \beta_i U \beta_o \Pi P_k^{\beta_k}$$

where $\gamma_{ij} = 1/2(\hat{\gamma}_{ij} + \hat{\gamma}_{ji})$ is required to satisfy the symmetry conditions. From the duality relation that $Y = C(P, U)$, the indirect utility function, $U(P, Y)$, corresponding to equation (41) can be expressed as

(43) $$U = \ln Y - (\alpha_o + \Sigma_j \alpha_j \ln P_j + 1/2\ \Sigma\Sigma \hat{\gamma}_{jk} \ln P_j \ln P_k)/\beta_o \Pi P_j^{\beta_j}.$$

Substituting equation (43) into equation (42), the Marshallian demand function for commodity i in share form is

172

(44) $$w_i = \alpha_i + \Sigma_j \gamma_{ij} \ln P_j + \beta_i \ln \bar{Y},$$

where $\bar{Y} = Y/P^*$ is nominal income deflated by the price index, P^*. The price index P^* is defined by

(45) $$\ln P^* = \alpha_o + \Sigma\, \alpha_j \ln P_j + 1/2\ \Sigma\Sigma \gamma_{jk} \ln P_j \ln P_k.$$

Equation (44) represents a consistent system of demand functions if,

(46) $$\Sigma_i \alpha_i = 1, \quad \Sigma_i \gamma_{ij} = 0, \quad \Sigma_i \beta_i = 0$$

(47) $$\Sigma_j \gamma_{ij} = 0, \text{ and}$$

(48) $$\gamma_{ij} = \gamma_{ji},$$

where equations (46), (47), and (48) are restrictions assuring the Engel aggregation, homogeneity, and Slutsky symmetry conditions, respectively. Note that the adding-up and homogeneity restrictions simply repeat the restrictions imposed on the parameters of the cost function. These restrictions can be applied to equations (44) and (45) to test the consistency of the demand system with demand theory (Brown, Green, and Johnson 1986).

The share elasticity with respect to income for equation (44) is

(49) $$\frac{\partial \ln w_i}{\partial \ln Y} = \beta_i / w,$$

implying the goods are necessities if $\beta_i < 0$ and luxuries if $\beta_i > 0$. For the prices P_j, the share elasticity is

(50) $$\frac{\partial \ln w_i}{\partial \ln P_j} = \frac{\gamma_{ij}}{w_j} - \frac{\beta_i}{w_i} (\alpha_j - \Sigma \gamma_{jk} \ln P_k).$$

Expressing these elasticities in terms of the quantity demand for commodity i, the income elasticity is

(51) $$\eta_{iY} = \beta_i/w_i + 1.$$

The own- and cross-price elasticities are, respectively,

(52) $$\varepsilon_{ii} = \frac{\gamma_{ii} - \beta_i\alpha_i - \Sigma\gamma_{ik}\ln P_k}{w_i} - 1$$

$$= \frac{\gamma_{ii} - \beta_i w_i + \beta_i^2 \ln(\bar{Y})}{w_i} - 1, \text{ and}$$

(53) $$\varepsilon_{ij} = \frac{\gamma_{ij} - \beta_i\alpha_j - \Sigma\gamma_{jk}\ln P_k}{w_i}$$

$$= \frac{\gamma_{ij} - \beta_i w_j + \beta_i\beta_j \ln\bar{Y}}{w_i}.$$

For estimation purposes, the price index P^* can be approximated using Stone's index, that is, $\ln P^* = \Sigma\, w_k \ln P_k$. The one application available for evaluating this approximation suggests that it is reasonably accurate (Brown, Green, and Johnson 1986). The advantage of the approximation is that if used, the demand system is linear in the structural parameters.

<u>Indirect Translog Model (ITL)</u>: Instead of starting with a specific indirect utility function, Christensen, Jorgenson, and Lau (1975) approximate the true indirect function with a second order Taylor series expansion. The approximation, $\psi(\hat{P})$, is in the logarithms of income normalized prices, $\hat{P}_j = P_j/Y$;

(54) $$\psi(\hat{P}) = \alpha_o + \Sigma\alpha_i \ln\hat{P}_i - 1/2\ \Sigma\Sigma b_{ij} \ln\hat{P}_i \ln\hat{P}_j,$$

where $\Sigma\alpha_i = -1$, $b_{ij} = b_{ji}\ \forall_{i \text{ and } j}$, and $\Sigma_j b_{ij} = 0\ \forall_i$. Using Roy's identity, the demand function for commodity i in share form is

$$(55) \qquad w_i = \alpha_i + \Sigma_j b_{ij} \ln\hat{P}_j / \Sigma\alpha_k + \Sigma\Sigma\, b_{kj} \ln\hat{P}_j.$$

Writing equation (55) in terms of the quantity demanded for commodity i yields,

$$(56) \qquad Q_i = \hat{P}_i^{-1}(\alpha_i + \sum_j b_{ij} \ln\hat{P}_j)/\Sigma\alpha_k + \Sigma\Sigma b_{kj} \ln\hat{P}_j.$$

The demand system can be estimated subject to the symmetry restrictions ($b_{ij} = b_{ji}$) and an equality restriction $\Sigma_j b_{kj} = 0$ for all k in all the demand equations. The full demand system requires estimation of $1/2(n^2 + 3n - 2)$ parameters. Compared to the other demand systems reviewed, the ITL requires a great deal of variability or information in the sample data, since the number of parameters to be estimated is comparatively large.

The income and price elasticities (own and cross) for equation (56) are, respectively,

$$(57) \qquad \eta_{iY} = 1 + \Sigma_j b_{ij} - w_i \Sigma\Sigma b_{ij}/1 + \sum_{ij}\Sigma b_{ij} \ln\hat{P}_j,$$

$$(58) \qquad \varepsilon_{ii} = (b_{ii} - w_i \Sigma_j b_{ij}/1 + \Sigma\Sigma b_{ij} \ln\hat{P}_j) - 1, \text{ and}$$

$$(59) \qquad \varepsilon_{ij} = b_{ij} - w_i \Sigma_j b_{ij}/1 + \Sigma\Sigma b_{ij} \ln\hat{P}_j.$$

If $b_{ij} = 0$ for all i and j, the indirect utility function (54) reduces to a simple Cobb-Douglas form. These utility functions (both the direct and indirect) are self-duals, that is, they represent the same preferences. This is the case with the linear logarithmic system popularized by Lau and Mitchell

(1975). The imposition of this restrictive homothetic structure reduces the number of parameters to be estimated, but the demand system becomes much less flexible and less behaviorally plausible when applied to food consumption analysis.

The Rotterdam Demand Model (RDM): Unlike the demand systems reviewed, this approach (Theil 1965, Barten 1969) started with a specific algebriac demand system, then the general demand restrictions were imposed to make it consistent with the theory of consumer demand. The relative price version of this system begins with Stone's (1954) logarithmic demand function:

$$\ln Q_i = \alpha_i + \eta_i \ln(Y) + \Sigma_j \varepsilon_{ij} \ln P_j. \tag{60}$$

Writing equation (60) in differentials yields

$$d\ln Q_i = \eta_i d\ln(Y) + \Sigma_j \varepsilon_{ij} \ln P_j, \tag{61}$$

where η_i is the income elasticity of commodity i and ε_{ij} is the cross-price elasticity of the ith commodity with respect to the jth price.

The cross-price elasticity can be decomposed into cross-substitution and income effects as in (12), or in elasticity form

$$\varepsilon_{ij} = K_{ij} - \phi w_j \eta_i \eta_j - w_j \eta_i, \tag{62}$$

where $K_{ij} = \lambda U_{ij} P_j / Q_i$ is the specific substitution term and $\phi w_i \eta_i \eta_j$ is the general substitution term. Substituting these two terms into equation (61) provides

$$d\ln Q_i = \eta_i d\ln Y + \sum_j [K_{ij} - \phi w_j \eta_i \eta_j - w_j \eta_i] \, d\ln P_j. \tag{63}$$

From the solutions of the "fundamental matrix" of the theory of consumer demand, equations (5) through (8), it can be shown (Thiel 1965) that

$$\Sigma_j K_{ij} = \phi\eta_i. \tag{64}$$

Substituting equation (64) into equation (63) and collecting the like terms, the demand equation for the ith commodity can be written as

$$d\ln Q_i = \eta_i(d\ln Y - w_k d\ln P_k) + \Sigma_j K_{ij}(d\ln P_j - \Sigma w_k \eta_k d\ln P_k). \tag{65}$$

To impose the symmetry restriction, that is, $w_i k_{ij} = w_j k_{ji}$ for all i and j, equation (65) is multiplied on both sides by the budget share w_i, that is,

$$w_i d\ln Q_i = \mu_i d\ln\bar{Y} + \Sigma_j b_{ij} d\ln\bar{P}_j, \tag{66}$$

where $\mu_i = P_i \frac{\partial Q_i}{\partial Y}$ is the marginal budget share, $\bar{Y} = d\ln Y - w_k d\ln P_k$ is a measure of real income, $b_{ij} = \lambda U_{ij} P_j P_i / Y$ is the coefficient of the relative price j; and $\bar{P}_j$ is the deflated price of the jth commodity. The demand equation (66) satisfies the restrictions for the consumer allocation problem, that is, adding up ($\Sigma\mu_i = 1$), symmetry ($b_{ij} = b_{ji}$ for all$_{i,j}$) and homogeneity ($\Sigma_i b_j = \phi_i \mu_i$).

The income and price elasticities (Johnson, Hassan, and Green 1984) for commodity i are derived from equation (66). The income elasticity is

$$\eta_i = \mu_i / w_i \qquad \text{for all i,} \tag{67}$$

where $\eta_i \lesseqgtr 1$ according to $\mu_i \lesseqgtr w_i$. The price elasticities for P_i and P_j are, respectively,

$$\varepsilon_{ij} = (b_{ii} - b_{ii}\mu_i - \mu_i w_i)/w_i, \text{ and} \tag{68}$$

(69) $$\varepsilon_{ij} = (b_{ii}\mu_j - \mu_i w_i)/w_i.$$

The parameters of the demand system can be significantly reduced if additivity restrictions are further imposed (Johnson, Hassan, and Green 1984). Then, only n + 1 parameters (η, μ_s, and ϕ) are required to form a complete set of demand elasticities.

The assumption of the constancy of the coefficients (μ_i, b_{ij}) in equation (66) implies a specific structure of the underlying utility function. It has been shown (Goldberger 1969; Yoshihara 1969) that the Rotterdam demand system can be derived from the Cobb-Douglas utility function,

(70) $$U = \Sigma_i \beta_i \ln Q_i.$$

The demand system derived from equation (70) implies that income elasticities are all equal to unity, all own-price elasticities are equal to -1, and all cross-price elasticities are equal to 0. These results show that the Rotterdam demand system is rather restrictive for empirical work.

<u>A Local Box-Cox Approximation</u>: The Box-Cox procedure (1964) and, in fact, other functional forms provide a basis for developing "local" approximations of demand systems. The Box-Cox form utilizes a transformation of variables defined by

(71) $$C_i(\lambda) = Z_i(\lambda)\beta,$$

where $C_i(\lambda) = C_i^{\lambda} - 1/\lambda$ and $Z_i(\lambda) = Z_i^{\lambda} - 1/\lambda$, and λ is a transformation variable. The function can be specified to include a value, λ, for each variable, generalizing equation (71) as well. If one postulates that $C_i(\lambda)$ represents a demand function for a particular commodity i, equation (71) can

178

be viewed as defining a general Box-Cox demand system (Johnson et al. 1985). The original demand system (4) is replaced by

$$Q_i(\lambda) = \phi_i(P_i(\lambda), Y(\lambda)); \quad i = 1, 2, \ldots, n. \tag{72}$$

The corresponding restrictions from the demand theory are derived by Johnson et.al. (1985), who note that the restrictions hold only locally at specified prices, income, and budget proportions. Those expressions can be used to combine, in a mixed estimation context, prior and sample information to estimate local approximations to demand systems.

The most commonly used flexible functional forms also fall out if equation '71) represents a generalized Box-Cox cost function (Berndt and Kahlad 1979). The function expressed as a quadratic in Box-Cox transformations is a translog as $\lambda \to 0$, generalized Leontief if $\lambda = 1$, generalized square-root if $\lambda = 0.5$, and quadratic if $\lambda = 2$. Hence, tests for specific values of λ can be used to select among an extended a family of local flexible approximations.

Extensions of the Demand Theory

Three extensions of the basic demand theory to be utilized in the study for Indonesia are introduced in this section. First, a multinomial logit model is presented as an improved approach basis for food budget analysis with disaggregated commodity groups. This model, which is consistent with consumer demand theory, has two distinct features. One, it allows one to estimate relative food budget shares at disaggregated commodity levels. Two, the elasticities reflect budget substitution across all the food commodity groups. The latter provides a unique advantage over past studies which do not account for commodity interactions in budget share analyses. After the model is presented, available systematic techniques for incorporating demographic

variables in demand systems are discussed. The intent is to present the rationale, the development of these techniques, and their implications for utility and demand structures. The final section introduces basic models that incorporate the idea that consumers do not purchase all they consume. Part of their consumption goods may be produced at home, using production inputs and technology. Production activities should therefore be an integral component of demand systems. The farm household model is presented as a special case of these household production models.

Integrated Food Budget Share Analysis

The multinomial logit model (for example, Theil 1969) forms the basic theoretical framework for analyzing the food budget shares. Suppose expenditure on commodity group i takes an exponential form,

$$C_i = e^{f_i(X)}, \tag{73}$$

where C_i is an expenditure on group i, and X is a vector of conditioning socioeconomic variables. The budget shares for the commodity groups can be defined as

$$w_i = \frac{e^{f_i(X)}}{\Sigma\, e^{f_j(X)}}; \quad i = 1, \ldots, S, \tag{74}$$

where $Y = \Sigma\, e^{f_j(X)}$ is the total expenditure. Equation (74) represents a general logistic form in the budget shares. If the function $f_i(X)$ takes a linear form in the parameters, the model represents a linear logit model.

The model satisfies the adding-up conditions, that is, Engel and Cournot aggregation. It can also be constrained to satisfy the homogeneity and Slutsky symmetry restrictions (Tyrell and Mount 1982). Equation (74)

can therefore be constrained to satisfy the basic restrictions of the consumer demand theory.

Only S-1 relative share equations can be estimated, with S the total number of commodities. But, using the Engel aggregation condition, all the budget shares are uniquely identified. If food group one is used as a reference, the predicted budget shares are

$$w_1 = 1/(1 + \sum_{j=2}^{S} e^{f_j(X)}) \text{ and,} \tag{75}$$

$$w_i = e^{f_i(X)}/(1 + \sum_{j=2}^{S} e^{f_j(X)}); \qquad i = 2, \ldots, S. \tag{76}$$

The predicted budget shares always lie between 0 and 1, and their sum adds to unity.

The budget share elasticities with respect to the conditioning variables, X_i, can be written

$$\varepsilon_{w_i X_i} = X_i\left(\frac{\partial f_i}{\partial X_i} - \sum_j^S W_j \frac{\partial f_j}{\partial X_i}\right). \tag{77}$$

Recall that the X_i are socioeconomic variables (for example, income, prices, and household-specific characteristics).

The budget shares in equation (74) can be expressed alternatively in quantity form as

$$Q_i = \frac{w_i e^{f_i(X) + \ln Y - \ln P_i}}{\sum e^{f_j(X)}} \qquad i = 1, \ldots, S, \tag{78}$$

where Q_i is the quantity of the ith food group, Y is household income, and P_i is the price of the ith food group. Using equation (78), income elasticities (η_{iY}), own-price elasticities (ε_{ii}), cross-price elasticities (ε_{ij}), and

elasticities for specific socioeconomic characteristics (ε_{iX_r}) can be derived for the ith good:

$$\eta_{iY} = Y\left(\frac{\partial f_i}{\partial Y} - \sum_{j=1}^{S} w_j \frac{\partial f_j}{\partial Y}\right) + 1, \tag{79}$$

$$\varepsilon_{ii} = P_i\left(\frac{\partial f_i}{\partial P_i} - \sum_{j=1}^{S} w_j \frac{\partial f_j}{\partial P_i}\right) - 1, \tag{80}$$

$$\varepsilon_{ij} = P_i\left(\frac{\partial f_i}{\partial P_j} - \sum_{j=1}^{S} w_j \frac{\partial f_j}{\partial P_j}\right) - 1 \qquad \text{for } i \neq j, \text{ and,} \tag{81}$$

$$\varepsilon_{iX_r} = X_r\left(\frac{\partial f_i}{\partial X_r} - \sum_{j=1}^{S} w_j \frac{\partial f_j}{\partial X_r}\right) \qquad \text{for } r = 1, \ldots, R. \tag{82}$$

Note a unique feature of these elasticities. The elasticities incorporate the substitutions that take place across all commodities due to change in exogenous variables. Thus, the multinomial logit model provides an improved capacity to estimate elasticities that account for commodity interrelations, an attractive feature for applications with food commodities specified as disaggregated.

Incorporating Demographic Variables

The utility function $U = U(Q)$ assumes that households with different socioeconomic characteristics have similar preference structures. This assumption likely has, however, little validity in situations where socioeconomic characteristics (family size, age-sex composition, location, etc.) influence consumption behavior of the household unit. A more plausible approach is to respecify the utility function conditioned by these variables, that is , $U = U(Q/\eta)$ where $\eta = (\eta_1, \eta_2, \ldots, \eta_r)$ is a vector of demographic characteristics. This section reviews selected procedures that have been developed to modify utility and demand functions to systematically incorporate household specific demographic variables.

A simple approach is to express quantities demanded and income (equation 4) in per capita terms. This specification, however, fails to incorporate variations due to the age-sex composition of individuals in households. The classical approach is Engel's (1895) work which reflects differences in household composition in income-consumption relationships. The quantities and income in the demand functions are normalized in "adult equivalents,"

$$Q_i/m_o = \bar{Q}_i(Y/m_o), \tag{83}$$

where m_o is the adult equivalent index and a function of characteristics of household members.

Prais and Houthakker (1955) provide a commodity-specific generalization of Engel's specification with adult equivalent scales, m_i's, defined separately for each commodity,

$$Q_i/m_i = \bar{Q}_i(Y/m_o), \tag{84}$$

where m_i is a commodity-specific scale and m_o is a general or income scale. That is, m_o is a weighted average of the individual commodity scales, $m_o = m_o(m_1, m_2, \ldots, m_n, Y)$. Note that these commodity-specific scales incorporate no relative price effects. The Prais-Houthakker specification is, hence, consistent with demand theory where prices are held constant by experimental control, as in cross section data.

Barten (1964) presented a generalization of the Prais-Houthakker work in a modified utility framework. The resulting modified demand function is

$$Q_i = m_i\bar{Q}_i(P_1m_1, P_2m_2, \ldots, P_nm_n, Y) \qquad \text{for all } i, \tag{85}$$

or, in scaled quantities and prices,

$$(86) \qquad \hat{Q}_i = \hat{Q}_i(\hat{P}_1, \hat{P}_2, \ldots, P_n, Y); \quad \text{for all } i,$$

where $\hat{Q}_i = Q_i/m_i$ is a "normalized" quantity of commodity i, m_i is a commodity-specific-adult-equivalent scale, and $\hat{P}_i$ is a normalized price. Changes in family composition therefore modify relative prices and, consequently, substitution among goods.

The Barten approach has been defined by Pollak and Wales (1969, 1978, 1981) as a scaling technique for incorporating household-specific demographic variables in demand systems. The procedure involves first postulating the scaling parameters, $m_1, \ldots, m_n$, which depend only on demographic variables. That is,

$$(87) \qquad m_i = \bar{m}_i(\eta); \quad \text{for all } i,$$

where the modified demand function is as specified in equation (86).

The demand function in equation (86) has an attractive interpretation. The demand for, say, number of kilograms of rice per (rice) equivalent person is expressed as a function of price per kilogram of rice per (rice) equivalent person, and income. Similarly, as shown in Table D.1, the direct and indirect utility functions are expressed in normalized quantities and prices. A problem with the specification is that changes in relative prices are not distinguishable from changes in household composition.

Pollak and Wales (1981) reviewed and/or developed the other four procedures for reflecting nonhomogeneous household effects: demographic translation procedure, the Gorman procedure, the reverse Gorman procedure, and the modified Prais-Houthakker procedure. The <u>translation procedure</u> facilitates the introduction of parameters, $d_1, \ldots, d_n$, linked to the

demographic variables through the functional form

(88) $$d_i = d_i(\eta); \quad \text{for all } i.$$

The modified demand system replacing equation (4) is

(89) $$Q_i = d_i + \bar{Q}_i(P, Y - \Sigma P_k d_k),$$

where only the d's depend on the demographic variables. These translating variables represent characteristics of all household members as opposed to scales, for example, race, region, location, etc. The d's can be interpreted as parameters reflecting "subsistence" or "necessary" consumption levels. Alternatively, the demand function in equation (89) can be viewed as being generated in a two-stage budgeting process. First, the household allocates part of its total expenditure to a vector of necessary quantities, $d_1, d_2, \ldots, d_n$. Then, in the second stage, it allocates the balance, $Y - \Sigma P_k d_k$, among the various commodities. This interpretation is similar to that advanced for the Linear Expenditure System (LES).

The <u>Gorman procedure</u> can be viewed as equivalent to first scaling and then translating the original demand function, $Q_i = Q(P, Y)$. The modified demand system becomes

(90) $$Q_i = d_i + m_i \bar{Q}_i(P_1 m_1, P_2 m_2, \ldots, P_n m_n, Y - \Sigma P_k d_k),$$

where the d's and m's are parameters postulated to depend on sociodemographic variables. If the order is reversed, that is, the demand function is first translated and then scaled, the resulting procedure (<u>reverse Gorman</u>) yields a system

(91) $$Q_i = m_i[d_i + \bar{Q}_i(P_1 m_1, P_2 m_2, \ldots, P_n m_n, Y - \Sigma P_k d_k)].$$

The <u>modified Prais-Houthakker procedure</u> adjusts the original demand system (4) as

$$Q_i = m_i \bar{Q}_i(P, Y/m_o), \tag{92}$$

where the commodity-specific scales, m's, depend on the demographic variables, $m_i = \bar{m}(\eta)$. The income or composite scale, m_o, is defined through the budget constraint,

$$\Sigma P_i m_i \bar{Q}_i(P, Y/m_o) = Y \tag{93}$$

and a function of all prices, income, and demographic variables, $m_o = \bar{m}_o(P, Y, \eta)$.

The main difference among these procedures is in the way the utility functions are modified (Table D.1). All the modified demand functions are, in general, consistent with the theory of consumer demand. The only exception is the demand system in equation (92) which, according to Pollak and Wales (1981), is a theoretically plausible demand system only if the original demand system (4) is derived from an additive direct utility function.

Finally, by incorporating household characteristics, the demand functions can add more realism to empirical studies. These gains are, however, achieved at a cost of estimating additional parameters. Pollak and Wales (1981) have suggested simple and convenient specifications of the functions for relating the d's and m's to observed household characteristics:

$$d_i = \bar{d}_i(\eta) = \gamma \sum_{j=1}^{r} a_{ij}\eta_j, \text{ and} \tag{94}$$

Table C.1. Specifications of Direct and Indirect Utility Functions Under Four Alternative Techniques

Procedure	Direct utiltity function $U = U(Q)$	Indirect Utility Function $V = V(P, Y)$
Scaling	$U = U[Q_1/m_1, Q_2/m_2, \ldots, Q_n/m_n]$	$V = V[P_1m_1, P_2m_2, \ldots, P_nm_n, Y]$
Translating	$U = U[(Q_1-d_1), (Q_2-d_2), \ldots,(Q_n-d_n)]$	$V = V[P, Y-\Sigma P_jd_j]$
Gorman	$U = U[(Q_1-d_1/m_1), (Q_2-d_2/m_2), \ldots, (Q_n-d_n/m_n)]$	$V = V[P_1m_1, P_2m_2, \ldots, P_nm_n, Y-\Sigma P_jd_j]$
Reverse Gorman	$U = U[Q_1/m_1)-d_1, (Q_2/m_2)-d_2), (Q_n-d_n)/m_n]$	$V = V[P_1m_1, P_2m_2, \ldots, P_nm_n, Y - \Sigma P_jm_jd_j$

$$m_i = \bar{m}_i(\eta) = 1 + (1 - \gamma) \sum^{r} b_{ij}\eta_j, \tag{95}$$

where linear translating corresponds to $\gamma = 1$ and linear scaling to $\gamma = 0$.

Household Production Theory

The household production theory, primarily an outgrowth of the traditional consumer theory, has two major themes. First, the classical consumer demand theory assumes that a consumer derives satisfaction from a consumption of a vector of quantities of market goods. The "new" approach hypothesizes that the consumer derives satisfaction from consumption of characteristics, derived in part from market goods. These characteristics are produced in the household from the combination of purchased market goods, labor, and human and physical capital. Second, the explanatory variables in the classical demand functions are vectors of market prices, income, and taste. The classical theory is incapable of either explaining tastes or predicting *a priori* effects of selected proxies for tastes on consumption behavior. The approaches to alter demand models demographically can be interpreted as, for example, attempts to reflect these characteristics, thereby enhancing the explanatory power of demand theory. The household production approach adds this dimension by rationalizing the incorporation of production-related parameters in demand systems.

The household production theory is essentially a combination of theory of the consumer and of the firm. The households, as producers, decide the mix and level of production of the home-produced consumption characteristics (known in the literature as the Z-commodities). Simultaneously, the household decides the amounts of the market purchased goods, labor, and other factors to allocate to the production of these characteristics or commodities.

Efficiency of allocation of resources is guaranteed if the household firm maximizes profit or minimizes the cost of producing a given level of the outputs. As a consumer, the household allocates the income derived from the production activity to the consumption of the "commodities" from which utility is derived. Utility maximization conditions guarantee that the consumer maximizes satisfaction.

The basic structure of the household production theory can be summarized by the relationships:

$$\text{(96)} \qquad \begin{aligned} &\text{Max} \quad U = U(Z) \\ &\text{St.} \quad PQ + W\,T_H = C \\ &\qquad\quad F(Q, T, Z; K) = 0 \end{aligned}$$

where Z is a row vector of home-produced commodities, Q is a row vector of market goods, P is a column vector of prices, T_H is a row vector of home-used labor or other factors, W is a column vector of wages or prices of these home-used factors, C is cost, F is household production function in implicit form, and K is a vector of inputs fixed in the short run.

The optimal choice of the Z-commodities can be determined by two alternative but equivalent approaches: (1) the direct approach, and (2) the two-stage approach. The direct approach is to maximize the utility function in the consumed commodities, subject to a full income constraint. This maximization problem can be represented by the Langrangian equation,

$$\text{(97)} \qquad L = U(Z) + \lambda_1(C - PQ - WT_H) + \lambda_2 F(Q, T, Z; K).$$

The optimal solution is characterized by the condition that the ratio of marginal rate of substitution between any pair of consumed commodities is equal to the ratio of their respective relative shadow prices. These shadow prices, Π,

(98) $$\Pi = \Pi(P, W, Z; K)$$

are endogenously determined as functions of the input prices, the demand for Z-commodities, fixed inputs, and the technology parameters.

In most cases the Z-commodities and their respective shadow prices are not observable. Thus, it is more tractable to optimize through the inputs that go into the production of the basic commodities. The process is accomplished in two stages. Stage one is to determine the minimum cost of producing the Z-commodities at particular output levels (Z^*). That is, to solve the Lagrangian problem,

(99) $$L = PQ + W\,T + \Theta\,F(Q, T, Z; K),$$

such that the cost of production is minimized for a given technology. The solution to this problem gives the short-run cost function,

(100) $$C = C(P, W, Z^*; K),$$

where C is expressed as a function of the vector of the prices of market goods, wage rates or factor prices conditioned upon the output, Z^*, and capital, K^*, vectors. Thus, the cost function characterizes the minimum cost for producing Z^*, given the other parameters. Of course, it has properties similar to the cost function for the firm. Applying Shephard's lemma to the cost function, the derived input demand functions for market goods and labor in household production are

(101) $$\frac{\partial C}{\partial P_i} = Q_i(P, W, Z; K),$$

(102) $$\frac{\partial C}{\partial W} = T_H(P, W, Z; K), \text{ and}$$

(103) $$\frac{\partial C}{\partial Z_i} = \Pi_i(P, W, Z; K)$$

where equation (101) is the demand for market goods, equation (102) is demand for labor in household production, and equation (103) represents the shadow price; which Π_i measures the marginal cost of output Z_i.

Stage two is to maximize the utility function, defined in the Z space, subject to income determined as a solution in equation (6). That is, in the second stage, the Lagrangian equation

(104) $$L = U(Z) + \lambda[C - \bar{C}(P, W, Z; K)]$$

is solved. The solution to this second stage optimization problem yields the demand functions for the commodities, Z:

(105) $$Z_j = Z_j(C, \Pi) \qquad j = 1, 2, \ldots, m.$$

The complete set of the structural equations constitute the derived demand for inputs [equations (101) and (102)], the shadow price function [for example, equation (103)] and the demand functions for Z-commodities [for example, equation (105)]. Note that the shadow prices are determined within the system.

The principal complication with the household production approach is the nonlinearity of the budget constraint in the Z-commodity space. An <u>ad hoc</u> approach that can be used to obtain a linear budget constraint is to impose the assumption of linear homogeneity in Z (constant returns to scale) and to define the shadow prices, Π, conditional on the optimal level of Z^*. Thus, the demand function for the basic commodity, Z_j, is specified as

(106) $$\hat{Z}_j = \hat{Z}_j(C, \Pi^*).$$

The demand functions, $\hat{Z}_j$, satisfy the adding-up condition:

$$\Sigma_j \Pi_j^* Z_j(C,\Pi^*) = C$$

by Eulers theorem, and the Slutsky sign and symmetry conditions (LaFrance 1983). An alternative is to view the technology as nonjoint and linearly homogeneous in Z (Muellbauer 1974). The cost function then becomes

$$C = \Sigma_j C_j(P, W, K)\ Z_j, \tag{107}$$

which is independent of the level of Z. Since C_i is a unit price of commodity j, it is equivalent to $\Pi_i = \Pi_i(P, W, K)$. The shadow price is also independent of the levels of the demand consumption goods for Z. The imposition of the assumption of additive production functions renders the model simple to estimate but restrictive in behavioral implications (Pollak and Watcher 1975).

There are two variants of the household production theory: the commodity characteristics (Lancaster 1966) and the production function approaches (Becker 1965, Muth 1966, and Michael and Becker, 1973). The latter can be specialized to the farm household production-consumption decision problem.

The Characteristics Approach

According to the characteristics approach, the consumed Z-commodities represent objective features of market goods. Consumers buy commodities, not for the commodities per se, but for their characteristics, the primary objects of choice. The decision to allocate income, for example, to food purchases reflects a conscious and rational effort of consumers to purchase a desired mix of nutrients.

The Lancaster model is similar in specification to equation (96). The consumed Z-commodities are characteristics transformed from purchased market goods. A linear transformation function is assumed where

(108) $$Z_j = \Sigma b_{ji} Q_i$$

and b_{ji} represents the quantity of the jth characteristics provided by one unit of market good i. These characteristics are measureable, objective, and the same for all consumers.

The demand for the characteristics can be derived by the linear optimization procedure discussed above (Deaton and Muellbauer 1980a). From the assumption of constant returns to scale,

(109) $$P_i = \Sigma \Pi_j b_{ji},$$

where the price of market good i, P_i, is a weighted linear combination of the characteristics of good i. That is, the prices of market goods reflect the values of the characteristics. Since b_{ji}'s are assumed constant and observable and the P's are known parameters, equation (9) can be solved (for interior solutions) to determine the implicit prices of the characteristics.

The main limitations of the Lancaster model are (1) the assumption of linear consumption technology (Lucas 1975); (2) the assumption that the utility function depends upon the level of characteristics and not on their distribution among commodities; and (3) the nonnegativity of the marginal utility of characteristics (Hendler 1975).

The Production Approach

Like the Lancaster model, the production approach assumes that consumers derive satisfaction from the consumption of Z-commodities or characteristics. The consumed Z-commodities are "nonmarket basic commodities". Leisure time, for example, is an element of the vector of the Z-commodities in Becker's (1965) pure producer model. Nonleisure time used in the production of the

basic commodities is assumed, implicitly, to have no contribution to the utility of the household.

The production technology is usually assumed nonjoint, and the production of the basic commodities depends on the market goods, labor, and a given stock of capital,

$$\bar{Z}_j = \bar{Z}_j(Q, T_H; K). \tag{110}$$

Equation (110) implies that market goods, Q, and time, T_H, can be allocated to a separate production process for the outputs Z_j. Demands for the consumed Z-commodities are then derived in either a two-stage process or directly through maximization in the Z-commodity space. An additional assumption of linear homogeneity of production in the Z-commodities facilitates simpler derived demand functions.

The Farm Production Model: This model is a specialization of the household production approach. First, it recognizes that a farm household integrates, more fully, both consumption and production activities. The nature of the integration depends on the commodity markets and production processes (Tesfaye 1984). Second, the household, as a firm, combines inputs including labor to produce farm output conditioned by a given technology and a stock of human and physical capital stock. The income from these production activities, wage income, sales income, and asset income flow to the households. As a consumer, the household, in turn, allocates income to alternative consumption of goods.

Unlike the simple household model (Becker 1965), the farm household is not treated as a producer of all the goods that it consumes. The household can derive satisfaction from consumption of home-produced as well as purchased

market goods. The household maximizes utility, subject to three constraints, that is,

$$\text{maximize} \quad U = U(Q, T_L; \gamma)$$

(111) $$\text{subject to: } Q = F(T_F, X_F; k_F),$$

(112) $$T = T_L + T_F + T_M, \text{ and}$$

(113) $$Y = \Pi + W_M T_M + V.$$

Equation (111) represents farm technology, where Q and T_F are vectors of farm outputs and inputs, respectively, and X_F is a vector of variable inputs with k_F a matrix of fixed farm inputs. The value T in Equation (112), total available time to the household, is allocated to leisure (T_L), farm inputs (T_F), and off-farm wage-work (T_M). Equation (113) is the income equation, where $\Pi(P, R; k_F)$, $W_M T_M$, and V represent farm net income, wage income, and nonfarm-nonwage income, respectively. Net income, Π, is $P_F'Q - R'X_F - W_M T_F$ where P_F, R, and W_M are vectors of producer prices, variable input prices, and wage rates, repectively.

The resulting demand system is

(114) $$Q = D(P_c, Y(P_F, R, V, k_F); \gamma)$$

where P_c is a vector of consumer prices and γ is a vector of household characteristics. A price-transmission equation can be used in the demand system to connect consumer and producer prices.

The distinctive feature of this farm household demand structure, compared to equation (4), is the presence of production parameters. The income equation serves as a link betwen production and consumption in the model. Full characterization of these farm household demand functions requires all

price elasticities and the elasticities associated with levels on factor endowments, technology, and household specific characteristics.

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APPENDIX D

Food Demand and the Multinomial Linear Logit Model--Indonesia

Multinomial Linear Logit Model

There are several approaches available to estimating the full demand system. One alternative, the multivariate linear logit model, was estimated in addition to the AIDS model to produce a food demand matrix for Indonesian major food commodities. The estimated demand parameters are, by and large, comparable with the linear version of AIDS demand system. The multinomial logit model provides, additional information on understanding commodity characteristics, and the results are included in this appendix.

The structure of the multinomial lineal logit model relies on specifying budget shares as a logistic function. The proportions of income that consumers allocate for various commodity groups take the form

$$(1) \qquad \omega_i = \frac{e^{f_i(X)}}{\Sigma\, e^{f_i(X)}} \qquad i = 1, \ldots, n.$$

ω_i is an average budget share of ith commodity group, which is a fraction of expenditure on i^{th} group ($e^{f_i(X)}$) to total expenditure ($\Sigma\, e^{f_i(X)}$). The vector X represents socioeconomic variables that condition the budget shares.

The function $f_i(X)$ is assumed to take a semilog form,

$$(2) \qquad f_i(X) = \alpha_i + \sum_i \gamma_{ij} \ln P_j + \beta_i \ln Y + \Theta_i \ln Z,$$

where P_j is j^{th} commodity price, Y is total expenditure and Z is a vector of nonprice and nonincome socioeconomic variables. Because the explicit functional form of $f_i(X)$ is linear in the parameters (α_i's, γ_i's, β_i's, and Θ_i's), the model in Equation (1) represents a linear logit model.

Note that the exponential specification of the commodity expenditures guarantees that the shares be positive. The budget shares also sum to unity.

Moreover, the model allows flexibility in a choice of variables that constitute the vector X and specification of functional form for $f_i(X)$.

The share elasticities with respect to income (Y), j^{th} commodity price (P_j), and other conditioning variables (Z) for commodity group i are, respectively,

$$S_{iy} = \beta_i - \sum_{k=1}^{n} \omega_k \beta_k \tag{3}$$

$$S_{ij} = \gamma_{ij} - \sum_{k=1}^{n} \omega_k \gamma_{kj} \tag{4}$$

$$S_{iz} = \Theta_i - \sum_{k=1}^{n} \omega_k \Theta_k \tag{5}$$

Alternatively, the budget shares can be expressed in quantity form as

$$Q_i = \frac{\omega_i e^{f_i(X)+\ln Y-\ln P_i}}{\Sigma e^{f_i(X)}} \qquad i = 1,\ldots, n, \tag{6}$$

where Q_i is the quantity of the ith commodity. Using Equation (6), income elasticities (η_{iy}), own price elasticities (ε_{ii}), cross price elasticities (ε_{ij}) and size elasticities (ε_{iz}) are defined, respectively, as

$$\eta_{iy} = S_{iy} + 1, \tag{7}$$

$$\varepsilon_{ii} = S_{ii} - 1, \tag{8}$$

$$\varepsilon_{ij} = S_{ij}, \tag{9}$$

$$\varepsilon_{iz} = S_{iz} \quad . \tag{10}$$

The expressions of these elasticities show that the effect of change in any of the exogenous variables on a particular commodity group is net of all adjustments across all commodities. That is, the elasticities take into

account commodity interrelations. In addition, the values of these elasticities are sensitive to a choice of budget shares.

For the model to be consistent with consumer demand theory, the Slutsky restrictions can be imposed linearly on the parameters (Tyrell and Mount 1982). The shares add to unity by construction and, hence, the model satisfies the adding-up conditions. The parameters can be constrained to satisfy

(11) Homogeneity: $\Sigma_j \gamma_{ij} + \beta_i = 0,$

(12) Symmetry: $\frac{1}{\omega_j}(\gamma_{ij} - \Sigma\, \omega_k \gamma_{kj}) = \frac{1}{\omega_i}(\gamma_{ji} - \Sigma\, \omega_k \gamma_{ki}).$

Note that evaluation of the symmetry restrictions is conditional on the choice of a set of budget shares. The sensitivity of these restrictions to values of selected shares poses a problem of stability in the structural coefficient.

The Empirical Model

The empirical model is based on a logarithm transformation of the ratio of the budget shares. With additive error terms, the equations are expressed as

(13) $\ln(\omega_i/\omega_n)=(\alpha_i-\alpha_n)+\sum_j(\gamma_{ij}-\gamma_{nj})\ln P_j+(\beta_i-\beta_n)\ln Y+(\Theta_i-\Theta_n)\ln HHS+(U_i-U_n)$ $i = 1, \ldots, n-1$

where HHS is household size. The relative share equations are normalized to the base commodity (n^{th} commodity group). The structural parameters measure the differential impact of socioeconomic variables on budget shares between the base and the other commodities.

The error terms of the relative share equations are assumed to have zero mean on average, and a covariance matrix, Σ, with nonzero off diagonal elements. That is,

$$E(U_i - U_n) = 0 \qquad i = 1, \ldots, n-1 , \tag{14}$$

$$V(U_i - U_n) = \Sigma \times I \qquad i = 1, \ldots, n-1 . \tag{15}$$

Because the errors are correlated across equations due to the imposition of budget exhaustion condition and the normalization procedure, a seemingly unrelated regression procedure is applied to estimate the parameters. The estimated coefficients are unbiased, consistent, and efficient. The gain in efficiency arising from utilization of information in the demand system enhances the precision or significance of the coefficients.

The model is estimated for rural and urban households separately at two levels. Level one has the same specification as Equation (13), but the price variables are replaced with regional binary variables. Income, household size, and regional variables are used to examine food preferences, predict budget shares, and estimate income and size elasticities. The second level focuses on estimation of a food demand system with prices included in place of regional variables. Homogeneity and symmetry restrictions are applied jointly on the structural parameters in estimating the food demand system.

Results

Engel Curves

The linear logit model in Equation (13) was estimated on 13 commodity groups without commodity price variables. The logarithm of the relative budget shares were related to the logarithm of total weekly expenditure (LTEXP), of number of persons in a household (LHHS) and regional binary

variable (DRE = 1 for Java and 0 otherwise). The estimated coefficients are used to study food preference structure, to predict budget shares, and to estimate a set of representative expenditure and household size elasticities.

Food Preferences

The structural parameter estimates for 12 commodity groups are presented in Tables D.2 and D.3 for urban and rural households, respectively. These estimates measure the effects of socioeconomic variables; namely income, family size, and location of residence on share of ith commodity group relative to share of rice--the reference base commodity group.

The income coefficients measure the relative share responses due to change in the level of income. The coefficients are all positive and statistically significant as indicated by their t-values. The households respond to change in income by reallocating their budget away from the base group (rice) to the other commodity groups. As the values of the coefficients indicate, the responses are much stronger among the urban households than among the rural.

In order to rank the food groups, let P denote that one food group is preferred to another and PI denote indifference between two food groups. Holding the influence of household and location variables constant, the income effects imply that households order their food bundles as follows:

(16) urban: FG6 Ⓟ FG4 Ⓟ FG9 Ⓟ FG7 Ⓟ FG11 Ⓟ FG3 Ⓟ FG5 Ⓟ FG2 Ⓟ FG1

(17) rural: FG6 Ⓟ FG7 Ⓟ FG9 Ⓟ FG4 Ⓟ FG11 Ⓟ FG3 Ⓟ FG5 Ⓟ FG2 Ⓟ FG1.

The orderings imply that as total household expenditure rises, households allocate their budget according to the ranks shown in Equations (16) and (17). Animal product (FG6), fish (FG7), fruits (FG4), and prepared foods (FG11) are

highest in the preference rankings. Lower in the orderings are the staple food (FG1 and FG2).

The parameter estimates for household size, on the contrary, are negative, suggesting that an increase in size is accompanied by a decline in budget share of commodity group i relative to rice. As shown in Equations (18) and (19), the households give staple crops the highest priorities. The lowest priorities are for animal products (FG6), fish (FG7), fruits (FG4), and prepared foods (FG9).

(18) urban: FG1 Ⓟ FG11 Ⓟ FG5 Ⓟ FG3 Ⓟ FG2 Ⓟ FG9 Ⓟ FG7 Ⓟ FG4 Ⓟ FG6

(19) rural: FG1 Ⓟ FG2 Ⓟ FG5 Ⓟ FG3 Ⓟ FG11 Ⓟ FG4 Ⓟ FG9 Ⓟ FG7 Ⓟ FG6

Household size thus induces households to shift away from luxury food groups to the staple crops.

Predicted Budget Shares

The predictions of the linear logit model of the mean budget shares of 13 commodity groups are given in Table D.4 for the urban households and Table D.5 for rural households. The effects of location and income levels on variations in budget shares are also included in the tables.

According to these predictions, the urban households allocate one-third of their total weekly expenditure to nonfood groups (Table D.4). Seventeen percent of their weekly budget goes to rice with fruits and vegetables having a joint share of 9 percent, and fish and animal products accounting for 14 percent. Among the rest of the food groups, beverages and prepared food groups account for 5.1 and 5.0 percent, respectively.

The shares in terms of food budgets are 26.6, 14.1, and 21.9 percent for rice, fruits and vegetables, and fish and animal products, respectively.

An average rural family spends 72 percent of its weekly budget on food (Table D.5). Among the food items, 23 percent of the budget is allocated to rice. Fruits and vegetables, animal products, and fish account for 10.1, 6.7, and 6.2 percent of the total budget, respectively.

Within food budget, the shares of rice and the secondary staple food are 32.0 and 4.0 percent, respectively. Fruits and vegetables take 14 percent of the food budget. Animal products and fish account for 9.3 and 8.6 percent of the food budget, respectively.

Variations in budget shares due to regional effects, i.e., variations in shares between Java and outer Java, are limited. A notable exception is the budget share of fish, which is higher in outer Java than Java.

The comparison of the budget shares between low and high income groups shows systematic patterns that are consistent with Engel's law of demand for food. The share of food in the total budget declines with a rise in income. Across the food groups, the budget shares of the staple foods decline with income. In the case of animal products, prepared foods, fruits, and fish, the shares rise with income. That is, households cut their food budget as they experience a rise in income, and then reallocate their food budget across food groups with an increasing proportions to animal products, fruits, and processed foods.

Expenditure Elasticities

The predicted expenditure elasticities in Tables D.6 and D.7 represent a quantitative expression of the preference ordering implied in Equations (16) and (17). The top four commodity groups--animal products, fish, fruits, and prepared foods--have elasticities more than unity. These represent commodities that are luxuries in the household's food consumption practices. The remaining food groups, most of which are the staple foods, have

elasticities that are positive and less than unity, and hence constitute necessities. Rice, the reference food group, has the lowest expenditure elasticity among all the food groups.

The expenditure elasticities are in general higher in rural than in urban areas. Between Java and outer Java, the regional expenditure elasticities suggest similar food ranking patterns. Regardless of the location of residence, households have top priorities for animal products, fruits, fish, and processed foods. But, as the values of the elasticities indicate, the responses are larger among households in outer Java than in Java. Given that mean income levels are higher in outer Java than in Java, the higher elasticities in outer Java are contrary to the inverse hypothesis between income level and food expenditure elasticities.

Food ranking patterns are also invariant across income groups. Both the low and high income groups prefer more consumption of animal products, fruits, fish, and prepared foods, and less of the staple food groups as income rises. The low income households are, however, more responsive to a change in income level, i.e., the expenditure elasticities of these households are higher than the high income households. They are in particular sensitive to expenditure for animal products, fish, fruits, and prepared foods, which all have elasticities greater than unity.

Household Size Elasticities

The elasticities in Table D.8 for urban households and Table D.9 for rural households show that household size has negative effects on demand for luxury food groups, i.e., animal products, fruits, fish, and prepared foods. The demand for the other food groups is positive with a change in household size. Conversely, the change in household size induces households to

substitute the consumption of the basic food groups for the luxury food groups.

The response patterns are in general similar across regions and income groups. Food preference rankings due to household size are invariant to place of residence and income levels. The levels of the elasticities vary, however, across these variables. The size elasticities are higher in Java than in outer Java. Similarly, the high income households are more responsive to a change in family size than the low income households.

Economies of Scale

The sum of expenditure and household size elasticities can be interpreted as indicating economies of scale in consumption (Tyrell and Mount 1982). When the sum is one, it indicates constant returns to scale. When the sum is greater than one, it indicates diseconomies of scale. If less than one, it indicates economies of scale.

For urban households, all food groups except animal products have elasticities that are less than unity (Table D.10). That is, the urban households both in Java and outer Java enjoy economies of scale in food consumption.

The scale elasticities are lower in general in urban Java than outer Java. Across income groups, the high income households have lower elasticities. Households in urban Java, the high income group in particular, gain the most from efficient utilization of food consumption.

Similar patterns are evident among rural households (Table D.11). Diseconomies of scale are observed in the consumption of animal products. Consumption of fruits and secondary crops is scale neutral. The rest of the food groups have elasticities that are less than unity, indicating the existence of economies of scale in consumption.

Households in Java enjoy relatively high economies of scale in most of the food groups. Similarly, high income households are more efficient in consumption compared with low income households. Diseconomies of scale in animal products remain invariant to region and income groups.

Food Demand System

A linear version of the multinomial logit model (Equation 13) was applied to seven food commodity groups. The miscellaneous food group, which accounted for 22 percent of the average urban food budget and 19 percent of the average rural budget, was used as a base to normalize the food budget shares of the other food groups. The logarithm of the ratios of the budget shares was then related to the logarithm of per capita food expenditure, district commodity prices, and household size. The regional dummy variable used in Engel Equations was omitted from the model.

Because the budget shares sum to unity, only six relative budget share equations were estimated as a system. Both homogenity (Equation 11) and symmetry (Equation 12) restrictions were imposed linearly on the structural parameters. The mean budget shares of the households in the full sample were used to evaluate the symmetry restrictions. The parameter estimates of these relative share equations are given in Table D.12 for urban households and Table D.13 for rural households.

Most of the coefficients in both urban (Table D.12) and rural (Table D.13) have t-values equal to or greater than 2. The statistical significance of these coefficients suggests that the relative budget shares do respond to income, price, and household size variables. Fruits and vegetables, fish, meats and dairy products share equations; in particular, they respond strongly to most of the commodity prices. Among the prices, the prices of rice, fruits

and vegetables, and fish have more sizable influence on most of the relative share equations.

As evident in the expressions in Equations (7-10), the individual coefficients cannot be used in isolation from others to evaluate and interpret the effects of the conditioning variables on food demands. So, the elasticities for the particular specification in Equation (13) were estimated. The elasticities associated with income, own price, cross prices, and household size were derived for the base food group (7th commodity) as:

$$\eta_{7y} = 1 - \sum_{k=1}^{6} \omega_k (\beta_k - \beta_7); \tag{20}$$

$$\varepsilon_{77} = -(1 + \sum_{k=1}^{6} \omega_k (\gamma_{k7} - \gamma_{77}); \tag{21}$$

$$\varepsilon_{7j} = - \Sigma\, \omega_k (\gamma_{kj} - \gamma_{7j}); \qquad j = 1,\ldots, 6; \tag{22}$$

$$\varepsilon_{7X} = - \Sigma\, \omega_k (\Theta_k - \Theta_7). \tag{23}$$

For the other food commodities, say i^{th} commodity group, these elasticities are, respectively,

$$\eta_{iy} = (\beta_i - \beta_7) + \eta_{7y} \qquad i = 1,\ldots, 6 \tag{24}$$

$$\varepsilon_{ii} = (\gamma_{ii} - \gamma_{7i}) + \varepsilon_{77} \qquad i = 1,\ldots, 6 \tag{25}$$

$$\varepsilon_{ij} = (\gamma_{ij} - \gamma_{7j}) + \varepsilon_{7j} \qquad i = 1,\ldots, 6 \tag{26}$$

$$\varepsilon_{iX} = (\Theta_i - \Theta_7) + \varepsilon_{7X} \qquad i = 1,\ldots, 6 \tag{27}$$

The mean budget shares of the full sample were used in evaluating these elasticities. The elasticities based on Equations (24-27) are presented in Tables D.14 and D.15 for urban and rural households, respectively.

The uncompensated own price elasticities are all negative in both rural and urban food demand equations. Own price elasticities are the lowest for

rice and the highest for meats and dairy products. The values of the elasticities of the other commodity groups are close to unity, which suggests there is nearly an equal proportional change in quantity demanded for change in own price. comparing these elasticities between rural and urban households, food demands are more sensitive to own price in rural areas.

The values of the cross price elasticities indicate that food demands are responsive to changes in price of other related commodities. A 10 percent increase in price of fish, for example, will decrease the urban demand for rice by 0.5 percent and rural demand for rice by 0.9 percent. Likewise, a 10 percent increase in price of fruits and vegetables will lead to 0.8 and 0.2 percent increase in urban and rural demand for fish, respectively. Most of the cross price elasticities are lower in values than own price elasticities, suggesting that households are more sensitive to change in own prices.

The signs of the uncompensated cross price elasticities can be used to identify food groups that are substitutes and complements. The limitation of this concept is that if income elasticities of the commodity groups are unequal, the signs can give conflicting results. To overcome such possible inconsistent results, compensated price elasticities are used where income effect is purged out and relative price effects are isolated at a constant real income. These elasticities are given in Table D.16 for urban households and Table D.17 for rural households. According to the signs of these elasticities, rice and beans, palawija and beans, beans, fish and meats, and fruits, fish and meats are net substitutes in both rural and urban food demand patterns. Rice and fish, and beans and fruits are net complements. The relationship between rice and palawija is not quite evident; they are net substitutes in rural data and net complements in urban data.

As shown in Tables D.14 and D.15, the staple food commodities have the lowest expenditure elasticities. A 10 percent increase in per capita income, for example, will lead to a 3.2 percent increase in urban demand for rice and a 6.4 percent increase in rural demand for rice. Fruits and vegetables, fish, and animal products have elasticities that exceed unity. These are income elastic food commodities in both urban and rural areas.

The differences in expenditure elasticities between rural and urban areas suggest that rural households are more sensitive to change in income. Alternatively, given that per capita income is lower in rural (Rp 13,653/month) than urban areas (Rp 19,432/month), the low income households respond more strongly to income effect. A relaxation of income constraint has more impact on the poor than the rich.

For a given household expenditure level, an increase in household size induces consumers to shift their consumption from more income elastic food groups to basic necessities. This is evident in Tables D.14 and D.15 where rural as well as urban households cut their demand for fruits, fish, and animal products, and increase their demand for rice. The shift towards rice is stronger among urban households where rice is the single dominant staple in their diets.

Population and income have opposite implications for agricultural policy. Growth in income calls for an increase in production of income elastic food commodities. On the other hand, a rise in population size has to be accompanied by an increase in production of staple food commodities. As both variables experience growth over time, the choice in production mix reflects such changing demand structure for food commodities.

Table D.1. Variables, Mean Budget Shares, and Definitions

Variables	Group Code	Definition	Mean Budget Shares Rural	Urban
w_1	FG1	Budget share of rice	0.22	0.17
w_2	FG2	Budget share of Nonrice	0.04	0.02
w_3	FG3	Budget share of beans	0.04	0.04
w_4	FG4	Budget share of fruits	0.04	0.04
w_5	FG5	Budget share of vegetables	0.06	0.06
w_6	FG6	Budget share of animal products	0.07	0.09
w_7	FG7	Budget share of fish (FG7)	0.07	0.06
w_8	FG8	Budget share of fats and oils	0.03	0.03
w_9	FG9	Budget share of prepared foods	0.04	0.06
w_{10}	FG10	Budget share of sugar (FG10)	0.03	0.02
w_{11}	FG11	Budget share of beverages and stimulants	0.08	0.07
w_{12}	FG12	Budget share of other foods	0.02	0.02
w_{13}	FG13	Budget share of nonfood	0.25	0.33
TEXP		Weekly total family expenditure	13,753	19,432
HHS		Household size	5.3	5.8

Table D.2. Parameter Estimates for 13 Commodity Groups Based on Multinomial Logit Model -- Urban Households

	N	Intercept	LTEXP	LHHS	DRE
$\ln(w_2/w_1)$	1181	-5.172 (-12.220)	.409 (8.463)	-.632 (-9.947)	-.181 (-3.755)
$\ln(w_3/w_1)$	1181	-6.046 (-15.478)	.525 (11.779)	-.592 (-10.240)	.505 (11.378)
$\ln(w_4/w_1)$	1181	-8.493 (-21.148)	0.881 (19.223)	-1.034 (-17.401)	.156 (3.42)
$\ln(w_5/w_1)$	1181	-4.641 (16.346)	0.481 (14.848)	-.590 (-14.058)	-.297 (-9.203)
$\ln(w_6/w_1)$	1181	-12.412 (-27.445)	1.39 (27.014)	-1.173 (-17.545)	0.135 (2.618)
$\ln(w_7/w_1)$	1181	-7.539 (-18.125)	0.846 (17.826)	-.839 (-13.629)	-.793 (-16.764)
$\ln(w_8/w_1)$	1181	-5.159 (-17.501)	0.454 (13.480)	-.595 (-13.632)	-.055 (-1.643)
$\ln(w_9/w_1)$	1181	-8.394 (-17.878)	0.851 (15.874)	-.806 (-11.608)	.396 (7.409)
$\ln(w_{10}/w_1)$	1181	-4.682 (-13.145)	.361 (8.867)	-.460 (-8.734)	-.186 (-4.592)
$\ln(w_{11}/w_1)$	1181	-5.386 (-9.401)	.532 (8.128)	-.574 (-6.771)	-.067 (-1.034)
$\ln(w_{12}/w_1)$	1181	-6.332 (-15.535)	.509 (10.937)	-.629 (-10.440)	.224 (4.839)
$\ln(w_{13}/w_1)$	1181	-10.002 (-36.639)	1.268 (40.694)	-1.013 (-25.080)	.254 (8.183)

Table D.3. Parameter Estimates for 13 Commodity Groups Based on Multinomial Logit Model -- Rural Households

	Intercept	LTEXP	LHHS	DRE
$\ln(w_2/w_1)$	-2.997 (-4.060)	0.114 (1.348)	-0.008 (-0.079)	-0.037 (-0.430)
$\ln(w_3/w_1)$	-5.464 (-9.387)	0.442 (6.619)	-0.517 (-6.587)	0.491 (7.221)
$\ln(w_4/w_1)$	-6.424 (-10.992)	0.573 (8.537)	-0.498 (-6.324)	0.183 (2.680)
$\ln(w_5/w_1)$	-3.998 (-8.721)	0.358 (6.797)	-0.393 (-6.363)	-0.166 (-3.093)
$\ln(w_6/w_1)$	-10.830 (-15.645)	1.162 (14.620)	-0.887 (-9.501)	0.062 (0.769)
$\ln(w_7/w_1)$	-5.976 (-10.315)	0.640 (9.631)	-0.675 (-8.639)	-0.614 (-9.080)
$\ln(w_8/w_1)$	-3.657 (-7.846)	0.273 (5.103)	-0.479 (-7.622)	-0.031 (-0.563)
$\ln(w_9/w_1)$	-6.881 (-10.542)	0.628 (8.386)	-0.617 (-7.007)	0.373 (4.894)
$\ln(w_{10}/w_1)$	-4.625 (-8.540)	0.352 (5.656)	-0.425 (-5.817)	-0.207 (-3.271)
$\ln(w_{11}/w_1)$	-5.029 (-8.158)	0.491 (6.942)	-0.445 (-5.354)	0.003 (0.038)
$\ln(w_{12}/w_1)$	-6.724 (-10.673)	0.559 (7.730)	-0.690 (-8.122)	0.254 (3.454)
$\ln(w_{13}/w_1)$	-7.551 (-15.762)	0.917 (16.682)	-0.698 (-10.811)	0.459 (8.206)

Table D.4. Predicted Budget Shares by Region and Income Group--Urban Households

Region/ Expenditure Group	Commodity Group														
	FG1	FG2	FG3	FG4	FG5	FG6	FG7	FG8	FG9	FG10	FG11	FG12	FG13	LTEXP	LHHS
Urban	.1659	.0070	.0321	.0358	.0560	.0839	.0566	.0287	.0497	.0219	.0510	.0167	.3947	19,432	5.82
Region															
Java	.1567	.0140	.0386	.0364	.0459	.0845	.0365	.0264	.0568	.0189	.0467	.0175	.4211	18,896	5.80
Outer-Java	.1696	.0182	.0252	.0337	.0669	.0799	.0874	.0302	.0414	.0247	.0540	.0152	.3536	20,283	6.0
Expenditure Group															
Low	.2368	.0082	.0361	.0343	.0643	.0637	.0551	.0334	.0483	.0265	.0573	.0189	.3170	12,344	6.29
High	.1332	.0062	.0293	.0355	.0505	.0941	.0557	.0258	.0593	.0192	.0466	.0151	.4296	24,727	5.47

Table D.5. Predicted Budget Shares by Region and Income Group--Rural Households

Region/ Expenditure Group	Commodity Group														
	FG1	FG2	FG3	FG4	FG5	FG6	FG7	FG8	FG9	FG10	FG11	FG12	FG13	LTEXP	LHHS
Rural	.2249	.0322	.0341	.0406	.0599	.0667	.0615	.0346	.0389	.0281	.0753	.0197	.2836	13,653	5.3
Region															
Java	.2082	.0293	.0409	.0414	.0508	.0638	.0411	.0315	.0439	.0233	.0698	.0209	.3350	10,171	5.0
Outer-Java	.2358	.0344	.0284	.0390	.0679	.0679	.0861	.0368	.0342	.0325	.0788	.0184	.2397	16,916	5.6
Expenditure Group															
Low	.2631	.0364	.0348	.0398	.0628	.0545	.0591	.0372	.0375	.0295	.0757	.0194	.2502	10,029	5.7
High	.1842	.0275	.0327	.0408	.0558	.0827	.0633	.0313	.0399	.0261	.0735	.0198	.3221	19,523	4.7

Table D.6. Predicted Expenditure Elasticities by Region and Income Group--Urban Households

Region/ Expenditure Group	Commodity Group														
	FG1	FG2	FG3	FG4	FG5	FG6	FG7	FG8	FG9	FG10	FG11	FG12	FG13	LTEXP	LHHS
Urban	.1580	.5670	.6830	1.0390	.6390	1.5480	1.0040	.6120	1.0090	.5190	.6900	.6670	1.4260	19,432	5.82
Region															
Java	.1053	.5143	.6303	.9863	.5863	1.4953	.9513	.5593	.9563	.4663	.6373	.6143	1.3733	18,896	5.80
Outer-Java	.1898	.5988	.7148	1.0708	.6708	1.5798	1.0358	.6438	1.0408	.5508	.7218	.6988	1.4578	20,283	6.00
Expenditure Group															
Low	.2735	.6825	.7985	1.1545	.7545	1.6635	1.1195	.7275	1.1245	.6345	.8055	.7825	1.5415	12,344	6.29
High	.1023	.5113	.6273	.9833	.5833	1.4923	.9483	.5563	.9533	.4633	.6343	.6113	1.3703	24,727	5.47

Table D.7. Predicted Expenditure Elasticities by Region and Income Group--Rural Households

Region/ Expenditure Group	Commodity Group														
	FG1	FG2	FG3	FG4	FG5	FG6	FG7	FG8	FG9	FG10	FG11	FG12	FG13	LTEXP	LHHS
Rural	.4679	.5819	.9099	1.0409	.8259	1.6299	1.1079	.7409	1.0959	.8199	.9589	1.0269	1.3849	13,653	5.3
Region															
Java	.4387	.5527	.8807	1.0117	.7967	1.6007	1.0787	.7117	1.0667	.7907	.9297	.9977	1.3557	10,171	5.0
Outer-Java	.4911	.6051	.9331	1.0641	.8491	1.6531	1.1311	.7641	1.1191	.8431	.9821	1.0501	1.4081	16,916	5.6
Expenditure Group															
Low	.5125	.6265	.9545	1.0855	.8705	1.6745	1.1525	.7855	1.1405	.8645	1.0250	1.0715	1.4295	10,029	5.7
High	.4171	.5311	.8591	0.9901	.7751	1.5791	1.0571	.6901	1.0451	.7691	.9081	.9761	1.3341	10,523	4.7

Table D.8. Predicted Household Size Elasticities by Region and Income Group--Urban Households

Region/ Expenditure Group	Commodity Group														
	FG1	FG2	FG3	FG4	FG5	FG6	FG7	FG8	FG9	FG10	FG11	FG12	FG13	LTEXP	LHHS
Urban	.7461	.1231	.1541	-.2879	.1561	-.4269	-.0929	.1511	-.0599	.2861	.1721	.1171	-.2669	19,432	5.82
Region															
Java	.7606	.1376	.1686	-.2734	.1706	-.4124	-.0784	.1656	-.0454	.3006	.1866	.1316	-.2524	18,896	5.80
Outer-Java	.7291	.1061	.1371	-.3049	.1391	-.4439	-.1099	.1341	-.0769	.2691	.1551	.1001	-.2839	20,283	6.00
Expenditure Group															
Low	.6577	.0347	.0657	-.3763	.0677	-.5153	-.1813	.0527	-.1483	.1977	.0837	.0287	-.3553	12,344	6.29
High	.7882	.1652	.1962	-.2458	.1982	-.3848	-.0508	.1952	-.0177	.3282	.2142	.1592	-.2248	24,727	5.47

Table D.9. Predicted Household Size Elasticities by Region and Income Group--Rural Households

Region/ Expenditure Group	Commodity Group														
	FG1	FG2	FG3	FG4	FG5	FG6	FG7	FG8	FG9	FG10	FG11	FG12	FG13	LTEXP	LHHS
Rural	.4591	.4511	-0.579	-.0389	.066i	-.4279	-.2159	-.0199	-.1579	.0341	.0141	-.2309	-.2389	13,653	5.3
Region															
Java	.4777	.4697	-0.393	-..0203	.0847	-.4093	-.1973	-.0013	-.1393	.0527	.0327	-.2123	-.2203	10,171	5.0
Other	.4470	.4390	-.1240	-.0510	.0540	-.4400	-.2280	-.0320	-.1700	.0220	.0020	-.2430	-.2510	16,916	5.6
Expenditure Group															
Low	.4288	.4208	-.0882	-.0692	.0358	-.4582	-.2462	-.0506	-.1882	.0038	-.0166	0.2612	-.2692	10,029	5.7
High	.4974	.4894	-.0196	-.0006	.1044	-.3896	-.1776	.0184	-.1196	.0724	.0524	-.1926	-2.006	19,523	4.7

Table D.10. Estimates of Economies of Scale by Region and Income Group--Urban Households

Region/ Expenditure Group	Commodity Group														
	FG1	FG2	FG3	FG4	FG5	FG6	FG7	FG8	FG9	FG10	FG11	FG12	FG13	LTEXP	LHHS
Urban	.9041	.6901	.8371	.7511	.7951	1.1211	.9110	.7631	.9491	.8051	.8621	.7841	1.1591	19,432	5.82
Region															
Java	.8659	.6519	.7989	.7129	.7569	1.0829	.8729	.7249	.9109	.7669	.8239	.7459	1.1209	18,896	5.80
Outer-Java	.9189	.7049	.8519	.7659	.8099	1.1359	.9259	.7779	.9639	.8199	.8769	.7989	1.1739	20,283	6.00
Expenditure Group															
Low	.9312	.7172	.8635	.7782	.8222	1.1482	.9382	.7902	.9762	.8322	.8892	.8112	1.1862	12,344	6.29
High	.8905	.6765	.8235	.7375	.7815	1.1075	.8975	.7495	.9356	.7915	.8485	.7705	1.1455	24,727	5.47

Table D.11. Estimates of Economies of Scale by Region and Income Group--Rural Households

Region/ Expenditure Group	Commodity Group														
	FG1	FG2	FG3	FG4	FG5	FG6	FG7	FG8	FG9	FG10	FG11	FG12	FG13	LTEXP	LHHS
Urban	.9270	1.0330	.8520	1.0020	.8920	1.2020	.8920	.7210	.9380	.8540	.9730	.7960	1.1460	13,653	5.3
Region															
Java	.9164	1.0224	.8414	.9914	.8814	1.1914	.8814	.7104	.9274	.8434	.9624	.7854	1.1354	10,171	5.0
Outer-Java	.9381	1.0441	.8091	1.0131	.9031	1.2131	.9031	.7321	.9491	.8651	.9841	.8071	1.1571	16,916	5.6
Expenditure Group															
Low	.9413	1.0473	.8663	1.0163	.9063	1.2163	.9063	.7349	.9523	.8683	1.0084	.8103	1.1600	10,029	5.7
High	.9145	1.0205	.8395	.9895	.8795	1.1895	.8795	.7085	.9255	.8415	.9605	.7835	1.1335	19,523	4.7

Table D.12. Parameter Estimates Based on a Multinomial Linear Logit Model--Urban Households

	Intercept	Rice	Palawija	Beans	Fruits/ Vegetables	Fish	Meats/ Dairy	Other	Per Capita Food Expenditure	Household Size
	2.3013	0.9215	-.0393	-.0085	-.0429	-.2171	-.0294	.1219	-.7061	.0594
	(20.5701)	(16.1667)	(-4.5813)	(-.4697)	(-1.2555)	(-7.2728)	(-2.2604)	(6.7748)	(-21.1965)	(1.9261)
$\ln(w_2/w_7)$	-.8247	-.2192	-.0188	.0900	-.0050	-.1094	-.0155	.2911	-.0132	-.0842
	(-4.5822)	(-2.7515)	(-.6886)	(2.2446)	(-2.5740)	(-1.9012)	(-.7123)	(10.5085)	(-.2571)	(-1.7385)
$\ln(w_3/w_7)$	-1.2790	.0031	.0318	-.0222	-.5279	.3701	-.0025	.1618	-.0143	.0625
	(-7.8935)	(.0312)	(1.4397)	(-.3077)	(-9.9466)	(6.1637)	(-.1255)	(6.1316)	(-.3091)	(1.4651)
$\ln(w_4/w_7)$	-1.8141	-.0759	-.0200	-.1844	.2254	.0732	-.0430	.1293	.1648	.0155
	(-3.1778)	(-1.0816)	(-6.2670)	(-10.3694)	(6.4779)	(2.3059)	(-3.0047)	(6.6529)	(4.6783)	(.4716)
$\ln(w_5/w_7)$	-1.3272	-.4657	-.0375	.1571	.1223	-.0831	-.2088	.1761	.3396	.2032
	(-7.1090)	(-7.6050)	(-2.9497)	(6.6250)	(3.4168)	(-1.4356)	(-9.8237)	(6.5591)	(6.2663)	(4.0313)
$\ln(w_6/w_7)$	-2.6963	-.2596	-.0402	-.0428	-.1492	-.2902	-.0785	-.0235	.8834	.3717
	(-15.3406)	(-9.3884)	(-8.0031)	(-4.9415)	(-9.2816)	(-13.9906)	(-3.5119)	(-1.0741)	(17.6092)	(7.5524)

NOTE: The food budget shares are redefined here as w1=budget share of rice, w2=budget shares of palawija crops, w3=budget shares of beans, w4=budget shares of fruits and vegetables, w5=budget share of fish, w6=budget share of animal products and w7=budget share of other foods.

Table D.13. Parameter Estimates Based on a Multinomial Linear Logit Model--Rural Households

	Intercept	Rice	Palawija	Beans	Fruits/ Vegetables	Fish	Meats/ Dairy	Other	Per Capita Food Expenditure	Household Size
$\ln(w_1/w_7)$	1.0938	.8844	-.0227	.0156	-.0772	-.1951	-.0654	-.1389	-.4008	.1035
	(7.2174)	(12.9137)	(-1.2165)	(1.2893)	(-1.9889)	(-5.3720)	(-4.2432)	(-4.8030)	(-8.6245)	(2.4111)
$\ln(w_2/w_7)$	-.4920	.3914	-.0626	.0058	-.0101	-.2025	.0001	.1270	-.2490	.0289
	(-2.2533)	(4.9017)	(-1.5329)	(.3127)	(-3.7266)	(-3.7130)	(.0019)	(3.3370)	(-3.7457)	(.4532)
$\ln(w_3/w_7)$	-1.5661	.2974	-.0556	.0850	-.2702	.0371	.0048	-.0785	-.0199	-.0544
	(-8.2459)	(2.9392)	(-1.7065)	(1.1365)	(-4.3211)	(.4867)	(.2289)	(-2.1674)	(-.3558)	(-1.0589)
$\ln(w_4/w_7)$	-.9839	-.0539	-.0638	-.0636	.1633	-.0561	-.0196	-.0569	.1512	.1635
	(-1.5187)	(-.49[illegible]0)	(-5.3867)	(-3.9497)	(-1.3204)	(-1.3204)	(-1.2343)	(-2.1781)	(3.4190)	(4.0030)
$\ln(w_5/w_7)$	-1.8243	-.2704	-.1331	.0321	.0062	.0594	-.0826	.0430	.3453	.1761
	(-8.4017)	(-3.1898)	(-4.6598)	(1.5303)	(.1365)	(.7907)	(-3.7334)	(1.1638)	(5.3431)	(2.9545)
$\ln(w_6/w_7)$	-2.9567	-.2665	-.0786	-.0048	-.0756	-.2339	-.0416	-.1172	.8032	.3355
	(-13.2462)	(-4.7172)	(-3.9740)	(-.4817)	(-2.8904)	(-6.7727)	(-1.6285)	(-3.7265)	(11.6939)	(5.1280)

NOTE: The food budget shares are redefined here as w1=budget share of rice, w2=budget shares of palawija crops, w3=budget shares of beans, w4=budget shares of fruits and vegetables, w5=budget share of fish, w6=budget share of animal products and w7=budget share of other foods.

Table D.14. Demand Elasticities Based on a Multinomial Linear Logit Model--Urban Households

	Price of								
Food Group	Rice	Palawija	Beans	Fruits/ Vegetables	Fish	Meats/ Dairy	Other	Per Capita Food Expenditure	Household Size
Rice	-.2552	-.0145	.0122	-.0424	-.0482	.0215	.0296	.3166	.6447
Palawija	-.3960	-.9752	.1022	-.0474	.0595	.0509	.1988	1.0095	-.2050
Beans	-.1768	.0248	-.9878	-.5703	.5390	.0509	.0695	1.0084	-.0583
Fruits/Vegetables	-.1768	.0048	-.1722	-.8170	.2421	.0079	.0370	1.1320	-.2856
Fish	-.6425	-.0127	.1693	.0799	-.8311	-.1579	.0838	1.3623	-.2572
Meats	-.4364	-.0154	-.0306	.1068	-.1213	-1.0276	-.0923	1.8458	-.6325

Table D.15. Demand Elasticities Based on a Multinomial Linear Logit Model--Rural Households

Food Group	Price of Rice	Palawija	Beans	Fruits/ Vegetables	Fish	Meats/ Dairy	Other	Per Capita Food Expenditure	Household Size
Rice	-.4337	.0324	.0086	-.0541	-.0895	-.0275	-.0735	.6418	.3524
Palawija	.0733	-.9676	.0086	.0130	-.0969	.0379	.1924	.7936	.0971
Beans	-.0207	.0324	-.9914	-.2471	.1056	.0379	-.0131	1.0426	-.1531
Fruits	-.3181	-.0314	-.0550	-.8136	.1056	.0379	.0085	1.1938	-.1396
Fish	-.5885	-.1007	.0407	.0231	-.8944	-.0447	.0654	1.3879	-.3211
Meats	-.5846	-.0462	.0086	-.0525	-.1283	-.9346	-.0518	1.9061	-.6196

Table D.16. Compensated Price Elasticities Based on a Multinomial Linear Logit Model--Urban Households

	Price of						
Food Group	Rice	Palawija	Beans	Fruits/ Vegetables	Fish	Meats/ Dairy	Other
Rice	-.1610	-.0062	.0280	.0046	-.0103	.0653	.0993
Palawija	-.2898	-.9489	.1525	.1025	.1804	.1904	.4211
Beans	.1231	.0511	-.9376	-.4206	.6598	.1903	.2915
Fruits	.1658	.0349	-.1148	-.6459	.3801	.1671	.2907
Fish	-.2374	.0229	.2371	.2822	-.6679	.0304	.3837
Meats/Dairy	.1305	.0343	.0643	.3899	.1069	-.7642	.3274
Food Budget Share	.2974	.0261	.0498	.1485	.1198	.1382	.2202

Table D.17. A Matrix of Compensated Own and Cross Price Elasticities--Rural Households

	Price of						
Food Group	Rice	Palawija	Beans	Fruits/ Vegetables	Fish	Meats/ Dairy	Other
Rice	-.1889	.0718	.0302	.0326	-.0142	.0242	.0488
Palawija	.3760	-.9189	.0353	.1202	-.0038	.1018	.3437
Beans	.3769	.0964	-.9563	-.1062	.2279	.1218	.1856
Fruits	.1372	.0419	-.0148	-.6523	.2456	.1340	.2360
Fish	-.0592	-.0155	.0875	.2106	-.7316	.0673	.3299
Meats/Dairy	.1194	.0671	.0708	.1969	.1211	-.7856	.3000
Food Budget Share	.3814	.0614	.0337	.1351	.1173	.0805	.1906

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APPENDIX E

A Local Stochastic Approximation to Indonesian Food Demand Patterns

A Local Stochastic Approximation to Indonesian Food Demand Patterns

Introduction

Three key presuppositions were made in estimating the demand parameters based on Almost Ideal Demand System and Multinomial Logit models. First, these particular demand systems were assumed to represent the preference structure of the sample households. Second, the Slutsky restrictions derived from individual demand theory were taken as maintained hypotheses and assumed to hold exactly. Third, the sample information was considered to have a great deal of integrity and internal consistency. The estimated demand coefficients were, hence, conditioned on the sample information, the restrictions of these two demand structures and consumer demand theory. An alternative approach to estimation of demand parameters is through application of an approximate demand structure, and this approach is taken, albeit in an exploratory manner, in this appendix.

The idea of constructing an approximate demand structure is based on the early work of Brandow (1961), George and King (1971), and Hassan and Johnson (1976). The key feature of these studies was the development of demand parameters from constructed demand systems. Using ad hoc demand structures, selected demand parameters were estimated. These selected demand parameters were then utilized with prior information from individual consumer demand theory to derive a complete demand system. As pointed out by Johnson (Johnson et al., 1986), the main drawback of these studies was that the prior information was not applied simultaneously with the data to estimate the demand system. Huang and Haidacher (1983) used restricted least squares to overcome this limitation.

A more recent work, Safyurtlu, Johnson, and Hassan (1986), improves upon these earlier studies extending the pragmatic approximation approach. A log linear demand system was used to approximate the demand system. But, because the Slutsky restrictions were not assumed compatible a priori with the market data, these restrictions were applied locally and stochastically using selected values of the budget shares. These approximate restrictions were then combined with the market data to estimate simultaneously the full demand systems. By varying relative weights for the prior and sample information within a mixed estimation framework, it was possible to evaluate the compatibility of the local stochastic restrictions with the sample data.

Even though the driving force of these earlier pragmatic studies was the quest for plausible demand estimates at the market level, the arguments for using the approximation are applicable as well to estimation of a demand system from household level data. Households are not homogeneous units and exhibit, for example, variations in food preferences. Even though techniques like scaling or translating can be used to approximate these variations, there is no strong basis for assuming that all such factors can be controlled. In short, the transferability of the Slutsky restrictions derived from individual consumer theory to household level survey data remains problematic. Even if one accepts that the Slutsky restrictions hold at the household level, effects of variations in household demographic characteristics and use of proxy variables for prices and income can produce major distortions.

The local stochastic approximation approach of Safyurtlu, Johnson, and Hassan was applied to the 1980 SURGASAR data both to explore the application of the method and to evaluate the consistency of the estimated parameters with respect to those from alternative demand systems specifications. The review

of this work is presented in two parts in this appendix. Part one includes a brief discussion of model specification and statistical procedures applied. The demand estimates under alternative assumptions are presented in part two. The alternative assumptions provide an evaluation of the implications of imposing demand restrictions with exact and stochastic specifications in the SURGASAR data.

It is important to note that the estimates reported in this section are exploratory. They are reported for comparison with the Almost Ideal Demand System and Multinominal Logit estimates. Without further development and testing, parameter estimates should not be used directly as a basis for policy analysis or prediction.

Specification and Estimation Procedure

Approximation of Demand System

The general approach suggested by Safyurtlu, Johnson, and Hassan (1986) is in principle simple. A particular functional form for the demand system is selected with the idea of approximating the full set of demand parameters. Slutsky restrictions pertaining to this particular form are then applied using selected budget shares (local) and assuming that they hold with error (stochastic).

A linear compact system of demand equations for a sample of T households can be written as

$$w_i = X_i\beta_i + U_i, \qquad i = 1,2,\ldots, G, \tag{1}$$

where w_i is a (T x 1) column vector of average budget shares for the ith commodity, X_i is a (T x k_i) matrix of predetermined variables, β_i is a

(k_i x 1) vector of unknown structural parameters, and U_i is a (T x 1) vector of random error terms. Note that there are G equations, and T observations on each variable in each equation. The errors for each equation are assumed to satisfy $E(U_i) = 0$ and $V(U_i) = \sigma_i^2 I_T$.

Using the work of Box and Cox (1964) and Zarembka (1974), the linear demand system in (1) can be expressed in a general form,

$$(2) \qquad w_i(\lambda) = X_i(\lambda)\beta_i + U_i,$$

where λ is a transformation variable (Blanton, 1983). By making an additional assumption that the structural disturbances are normally distributed, maximum likelihood estimates can be obtained. Values of the transformation variable (λ) parameterize functional forms within the Box-Cox family. A likelihood ratio test can be applied to identify the functional form within the family that best approximates the sample data.

Based on preliminary tests and the results from the Almost Ideal Demand System, a semilog demand structure was adopted, shortcutting the need to evaluate the value of λ. The functional form as applied to the SURGASAR data can be written,

$$(3) \quad w_i = \alpha_i + \Sigma\, \gamma_{ij} \ln P_j + \beta_i \ln(Y) + \theta_i \ln(HS) + U_i \qquad i = 1,2,\ldots,G,$$

and is similar to a form used initially by Lesser (1963). The food budget shares (w_i) are related linearily to the logarithm of food prices (P_j), food expenditure (Y), and household size (HS). Note that the semilog form is a member of Box-Cox family when the values of the transformation variable are one ($\lambda = 1$) for the regressands (budget shares) and zero ($\lambda = 0$) for the regressors (price, incomes, and household size). This specification also has

similarity to the AIDS--Almost Ideal Demand System. Thus, the results will be attractive for comparison to those in Chapter Four.

The demand elasticities corresponding to Equation (3) are:

(4) $$\eta_{iy} = \frac{\beta_i}{w_i} + 1 \quad \text{(expenditure elasticity)},$$

(5) $$\epsilon_{ii} = \frac{\gamma_{ii}}{w_i} - 1 \quad \text{(own price elasticity)},$$

(6) $$\epsilon_{ij} = \frac{\gamma_{ij}}{w_i} \quad \text{(cross price elasticity)}.$$

Demand System With Stochastic Slutsky Restrictions

The demand system (3) can be rewritten in condensed form as

(7) $$w = X\beta + U$$

where w is of dimension (G x T) x 1, X is a (G x T) x K block diagonal matrix with diagonal submatrices X_i, β is a (G x k) x 1 vector of unknown structural parameters, and U is (G x T) x 1 vector of structural disturbances. Note that we assume there are equal number of nonzero coefficients (k) in each equation. The vector of structural disturbance terms is assumed to have zero mean, E(U) = 0, and a contemporaneous covariance matrix, Σ, where the structural disturbances between the ith and j^{th} equations are assumed correlated, i.e., $\sigma_{ij} \neq 0$ for all $i \neq j$. The covariance matrix for the system in Equation (7) is

(8) $$V(U) = \Sigma \otimes {}_TI ,$$

where $\otimes$ is a Kronecker product operator, Σ is a G x G square matrix and I_T is a conformable identity matrix.

For a particular demand system of this study, (Equation 3), the Slutsky restrictions are

(9) $\Sigma\, \alpha_i = 1,\ \sum_i \gamma_{ij} = 0,\ \Sigma\, \beta_i = 0,\ \sum_i \theta_i = 0$ (Engel Aggregation)

(10) $\sum_j \gamma_{ij} + \beta_i = 0$ (Homogeneity), and

(11) $\gamma_{ij} = \gamma_{ji}$ (Symmetry) .

These restrictions, Equations 9-11, can be written in a compact form as:

(12) $$r = R\beta,$$

where R is a matrix of coefficients of restrictions of dimension J x (G x k) with J < (G x k), β is a (G x k) x 1 vector of unknown parameters, and r is a (J x 1) vector of constants. Because no prior assumptions are made that these restrictions hold exactly at reference local points, the restrictions are presumed stochastic and an error term V is added. The stochastic version of Equation (12) is then,

(13) $$r = R\beta + V$$

where V is assumed to be distributed with E(V) = 0 and a covariance matrix $E(VV') = \sigma 2 I_T$. Note that the errors corresponding to different localized Slutsky restrictions are assumed uncorrelated.

The mixed estimation problem is then formed by combining the stochastic restrictions and sample information (Theil and Goldberger, 1961). Formulating the problem using an augmented generalized least squares structure, the model becomes:

(14) $$\begin{pmatrix} Y \\ r \end{pmatrix} = \begin{pmatrix} X \\ R \end{pmatrix} \beta + \begin{pmatrix} U \\ V \end{pmatrix},$$

where

$$V\begin{pmatrix} U \\ V \end{pmatrix} = \begin{bmatrix} \Sigma \otimes I & 0 \\ 0 & V \end{bmatrix} \tag{15}$$

and the mixed estimator is

$$\hat{\beta}_m = (X'(\Sigma^{-1} \otimes I)X + R'V^{-1}R)^{-1}(X'(\Sigma^{-1} \otimes I)Y + R'V^{-1}r) \tag{16}$$

with covariance,

$$V(\hat{\beta}_m) = (X'(\Sigma^{-1} \otimes I)X + R'V^{-1}R)^{-1}. \tag{17}$$

Note that ordinary least squares is not an appropriate procedure because of the nonidentity of the error structure in Equation 15. The structure in Equation (15) also reflects the assumption of independence of the prior and the sample information.

The issue of how one should pool the sample and prior information is empirical and depends on statistical comparison of the relative performance of the alternative mixed estimators. As noted in Fomby, Hill, and Johnson (1984), regardless of specification errors in Equation (13), the difference $E(\hat{\beta}_o - \beta)'(\hat{\beta}_o - \beta) - E(\hat{\beta}_m - \beta)'(\hat{\beta}_m - \beta)$ is positive semidefinite. That is, the variances of the mixed estimators $(\hat{\beta}_m)$ are no greater than the variances of the ordinary least squares estimators, $(\hat{\beta}_o)$.

If the stochastic restrictions in Equation (13) are unbiased, i.e. $E(V) = E(r - R\hat{\beta}_o) = \delta = 0$, then the prior and sample information are said to be "compatible" and the mixed estimator will improve the precision of the estimates. To test for such compatibility, Theil (1963) proposed a test statistic with the null hypothesis.

$$H_o: E(r - R\hat{\beta}_o) = 0. \tag{18}$$

The test statistic for this null hypothesis is,

$$(19) \qquad \lambda_1 = (r - R\hat{\beta}_o)' \, (R(X'(\Sigma^{-1} \otimes I)X)^{-1}R' + V)^{-1} \, (r - R\hat{\beta}_o).$$

If U and V in Equation (14) are normally distributed, λ_1 is distributed as χ^2 with J (number of restrictions) degrees of freedom under the null hypothesis.

Alternatively, if the mixed estimator problem is formulated as an exactly restricted least squares model on an extended parameter space (Fomby, Hill, and Johnson, 1984; Judge, Yancey, and Bock, 1973), the test statistic for the null hypothesis becomes

$$(20) \qquad \lambda_2 = (SSE\hat{\beta}_m - SSE\hat{\beta}_o)/J\hat{\sigma}_o^2.$$

where $SSE\hat{\beta}_m = (Y - X\hat{\beta}_m)'(Y - X\hat{\beta}_m)$ and $SSE\beta_o = (Y - X\hat{\beta}_o)'(Y - X\hat{\beta}_o)$. This statistic, λ_2, has an F-distribution with (J, T - (G x k)) degree of freedom. Theil's compatibility test is asympotically equivalent to the F-distribution.

If the restrictions are incorrectly specified, i.e., $\delta \neq 0$, the choice between the mixed and ordinary least squares estimators is more complicated and depends on bias-variance tradeoff. Note that the mixed estimator can be biased, but it is possible that it can offer a gain over OLS if the bias is sufficiently close to zero, i.e., $\delta \to 0$. Measures of goodness of estimators based on the concept of mean square error are often used to identify region(s) where mixed estimator is superior to OLS estimators (Fomby, Hill, and Johnson, 1984). Test statistics for the evaluation of this condition have been summarized by these authors.

Estimation of Equation (14) assumes that the parameters of the covariance matrices, Σ and V, are known. When these values are unknown, the parameters can be replaced by the consistent estimators. In this particular study the

matrix, Σ, was estimated using ordinary least squares residuals. To avoid the singularity problem that arises from the budget exhaustion condition, the residuals from G-1 equations were used to construct Σ. The Engel aggregation condition, one of the Slutsky restrictions, is thus excluded from Equation (13) or implicitly applied exactly. For the specification of the covariance matrix V, trial specifications were used. The parameters of the matrix were set to σ_o^2, the mean square error obtained by estimating the demand system as a single regression. Finally, the weight factor, (1/w), was applied to evaluate the Slutsky restrictions relative to the sample information.

The mixed estimator that incorporates these estimated covariance matrices, $\hat{\Sigma}$ and $\hat{V}$, and prespecified weights, 1/w, is then

$$(21) \qquad \hat{\hat{\beta}}_m = (X'(\hat{\Sigma}^{-1} \otimes I)X + R'P\hat{V}^{-1}P'R)^{-1}(X'(\hat{\Sigma}^{-1} \otimes I)Y + R'P\hat{V}^{-1}P')$$

where P is a diagonal matrix with nonzero elements, $1\sqrt{w}$. The covariance matrix is

$$(22) \qquad V(\hat{\hat{\beta}}_m) = (X'(\hat{\Sigma}^{-1} \otimes I)X + R'P\hat{V}^{-1}P'R)^{-1}.$$

Note that the tests described in equations (19) and (20) are only asymptotically justified if the feasible mixed estimator, $\hat{\hat{B}}$, is utilized.

The relative share of the sample information in the total precision of the mixed estimator can be computed as

$$(23) \qquad S = \frac{1}{k} \operatorname{tr} X'(\Sigma^{-1} \otimes I)X \; (X'(\Sigma^{-1} \otimes I)X + R'PV^{-1}P'R)^{-1},$$

where K is the number of parameters (G x k) and tr is the trace operator (Safyurtlu, et al., 1986). The share or contribution of the prior information is then Q = 1-S.

Results

Five equations representing the demand for rice, fruits and vegetables, fish, meats (excluding fish), and miscellaneous foods were estimated as a system. A semilog demand specification was used with food budget shares related to the logarithm of food prices, food expenditure, and household size. The sample information was obtained from households that had positive budget shares on all the food groups.

The demand system was estimated using three assumptions for the prior information. First, unrestricted Ordinary Least Squares (OLS) estimates were obtained based on the sample information alone. Note that the application of OLS procedure on an equation by equation basis is equivalent to Zellner's seemingly unrelated regressors if the explanatory variables are identical in all equations. Second, the demand systems were reestimated by imposing the exact, localized Slutsky restrictions, Equation (12). Finally, the sample information was combined with the localized but stochastic Slutsky restrictions, Equation (13), and generalized least squares or mixed estimation was applied. By varying the weights for the restrictions, the mixed estimates were evaluated for the compatibility of the prior information and the sample data and their consistency with the postulates of individual consumer demand theory.

Demand System With No and Exact Slutsky Restrictions

Estimates of the unrestricted structural parameters are presented in Table E.1, for urban households and in Table E.2 for rural households. The corresponding exact restricted least squares estimates are provided in Tables E.3 and E.4 for urban and rural households, respectively. As the t-ratios

indicate, most of these estimators were statistically significant. Both the unrestricted and restricted estimates exhibited larger impacts of own prices, food expenditure, and household size.

The estimated parameters of the own prices were all positive. The exception was fish in urban data, Table E.1, which was negative but statistically insignificant. The restricted estimate for the coefficient of fish price switched in sign, but it remained statistically insignificant. As one would expect with food commodities, these positive values for the estimated coefficients on own prices imply inelastic demand for food commodities.

All the share equations, except the one for rice, had positive food expenditure coefficient estimates. For rice, as was the case for staple crops, the budget share decreased with a rise in the expenditure level. Fruits and vegetables, fish and other meats, on the other hand, had a rising budget share with income, a pattern consistent with "luxury" food groups.

These patterns in budget share relationships were reversed when the source of change was household size, rather than food expenditure level. The budget share for rice increased and the shares for other food groups fell as household size increased. The implication is that food budgets were reallocated from the "luxury" foods to more basic foods.

Interestingly, there were no appreciable differences in the values of the estimated coefficients for direct price, total expenditure and household size in the restricted and unrestricted models. The differences were more marked for the cross price effects. The signs were more consistent with generally accepted food consumption patterns for the restricted estimators. Fruits and vegetables, for example, were gross substitutes with rice and fish for both

the rural and urban households. Moreover, the imposition of the restrictions enhanced the influence of the magnitudes of the cross price effects especially for the rural households. The share equations in rural households, for instance, showed more responsiveness to price of rice for the exact restricted least squares estimators.

Demand System and Stochastic Slutsky Restrictions

The parameter estimates for the mixed demand model, Equation (14), were obtained using the feasible generalized least squares procedure. A summary of test results for selected combinations of prior and sample information is given in Table E.5. These results exhibit two notable patterns. First, as more weight was applied to the restrictions, the estimates moved toward restricted least squares estimators reported in Table E.3 and E.4. Second, the compatibility with the sample data fails as the restrictions were imposed more exactly and the share of the precision of the estimators due to the restrictions increased. Given the narrow range over which the data and prior information were compatible, it was surprising that the coefficients were close to the OLS estimators. This result can be attributed to a large or disproportionate amount of the sample relative to prior information in the combined set of stochastic restrictions on the parameters.

Results for two cases, $1/\sqrt{w} = .01$ and $1/\sqrt{w} = 1.0$, are presented in Tables E.6 and E.7 for urban households and in Tables E.8 and E.9 for rural households. The estimated coefficients for own price, expenditure and household size were largely the same as obtained for the unconstrained ordinary least squares estimates, Tables E.1 and E.2. The selected elasticities presented in Table E.10 highlight the fact that the differences

among the mixed estimators and ordinary least squares estimators were limited. The improvements in the consistency of the signs of the cross prices were mixed. The most notable improvement was the cross price effect for rice price on the food shares in the rural households.

Again, the estimated parameters and elasticities reported in this section are based on exploratory analysis. They should not be used directly as a basis for policy analysis or prediction.

Table E.1. Unrestricted or ordinary least squares estimates of semilog demand model--Urban Indonesia

Food Group	Intercept	Price					Household Size	Food Expenditure	Food Budget Share
		Rice	Fruits and Vegetables	Fish	Meats	Others			
Rice	.828 (4.26)[a]	.198 (5.02)	.018 (2.00)	-.026 (-2.86)	-.037 (-2.62)	-.035 (-3.71)	.164 (25.86)	-.168 (-27.39)	.263
Fruits and Vegetables	-.383 (2.94)	.055 (2.08)	.012 (1.93)	-.015 (-2.40)	.016 (1.64)	0.015 (2.37)	-.034 (-8.00)	.022 (5.40)	.151
Fish	-1.115 (-7.02)	.183 (5.67)	.032 (4.33)	-.004 (-.56)	-.027 (-2.30)	-.009 (-1.08)	-.023 (-4.50)	.035 (7.06)	.108
Meats	.584 (3.48)	-.187 (-5.49)	-.002 (-.19)	-.019 (-2.38)	.032 (2.65)	.003 (.33)	-.051 (-9.28)	.057 (10.81)	.129

SOURCE: 1980 SURGASAR Data

[a]t-ratios in parentheses.

Table E.2. Unrestricted or ordinary least squares estimates of semilog demand model--Rural Indonesia

Food Group	Intercept	Price					Household Size	Food Expenditure	Food Budget Share
		Rice	Fruits and Vegetables	Fish	Meats	Others			
Rice	-.190 (-.93)[a]	.260 (6.66)	.015 (1.40)	.064 (5.08)	-.047 (-3.29)	-.036 (-5.54)	.136 (14.08)	-.123 (-13.15)	.315
Fruits and Vegetables	.167 (1.46)	-.014 (-.63)	.006 (.98)	-.018 (-2.58)	-.004 (-.47)	-.003 (-.72)	-.025 (-4.63)	.022 (4.19)	.131
Fish	-.413 (-3.45)	.018 (.77)	.033 (5.10)	.020 (2.68)	-.019 (-2.23)	.013 (3.49)	-.035 (-6.15)	.029 (5.29)	.107
Meats	-.429 (-2.69)	.036 (1.15)	.003 (.39)	-.025 (-2.53)	.033 (2.97)	.014 (2.81)	-.045 (-5.86)	.034 (4.64)	.151

SOURCE: 1980 SURGASAR Data

[a]t-ratios in parentheses.

Table E.3. Restricted least squares estimates of semilog demand model with exact Slutsky Conditions--Urban Indonesia

Food Group	Intercept	Price					Household Size	Food Expenditure
		Rice	Fruits and Vegetables	Fish	Meats	Others		
Rice	.911 (4.93)[a]	.190 (4.94)	.027 (3.15)	-.016 (-1.80)	-.058 (-4.49)	-.036 (-3.76)	.164 (25.90)	-.168 (-27.60)
Fruits and Vegetables	-.296 (-5.05)	.027 (3.15)	.019 (3.43)	.015 (3.29)	-.006 (-.91)	.020 (3.08)	-.033 (-7.74)	.021 (5.08)
Fish	-.138 (-2.05)	-.016 (-1.80)	.015 (3.29)	.006 (.80)	-.023 (-3.50)	-.002 (-.22)	-.030 (-5.75)	.047 (9.53)
Meats	-.019 (-.21)	-.058 (-4.49)	-.006 (-.91)	-.023 (-3.50)	.033 (2.64)	.002 (.22)	-.048 (-8.69)	.052 (9.99)

SOURCE: 1980 SURGASAR Data

[a]t-ratios in parentheses.

Table E.4. Restricted least squares estimates of semilog demand model with exact Slutsky Conditions--Rural Indonesia

Food Group	Intercept	Price: Rice	Price: Fruits and Vegetables	Price: Fish	Price: Meats	Price: Others	Household Size	Food Expenditure
Rice	-.199 (-1.12)[a]	.268 (7.55)	.020 (2.06)	.036 (3.39)	-.033 (-2.71)	-.036 (-5.45)	.134 (13.85)	-.119 (-13.05)
Fruits and Vegetables	-.099 (-1.57)	.020 (2.06)	.004 (.66)	.008 (1.67)	-.003 (-.52)	-.003 (-.91)	-.020 (-3.69)	.013 (2.66)
Fish	-.447 (-6.55)	.036 (3.39)	.008 (1.67)	.022 (3.01)	-.016 (-2.41)	.012 (3.05)	-.038 (-6.59)	.034 (6.37)
Meats	-.108 (-1.21)	-.033 (-2.71)	-.003 (-.52)	-.016 (-2.41)	.029 (2.71)	.016 (3.19)	-.047 (-6.28)	.039 (5.64)

SOURCE: 1980 SURGASAR Data

[a]t-ratios in parentheses.

Table E.5. Applications of compatibility tests for selected combinations of sample and prior information--Indonesia

		Rural			Urban		
Case	$1/\sqrt{w}$	Sample Share	SSE_m	F	Sample Share	SSE_m	F
1	.03	1.000	22.429	0.000	1.000	24.671	0.000
2	.10	1.000	22.429	0.000	1.000	24.671	0.000
3	1.00	.974	22.473	0.659	.961	24.728	1.180
4	10.00	.774	23.656	18.510	.750	25.473	16.514
5	31.60	.704	22.924	22.924	.697	25.718	21.573
6	100.00	.689	24.001	23.719	.689	25.779	22.829

SOURCE: 1980 SURGASAR Data

SSE_m: Sum of squares error of mixed estimates.

Table E.6. Mixed estimate of semilog demand model--urban households ($1/\sqrt{w}$ = .10)

Food Group	Intercept	Price: Rice	Price: Fruits and Vegetables	Price: Fish	Price: Meats	Price: Others	Household Size	Food Expenditure
Rice	.832 (4.20)[a]	.197 (5.02)	.018 (2.02)	-.026 (-2.86)	-.037 (-2.64)	-.036 (-3.73)	.164 (25.92)	-.168 (-27.46)
Fruits and Vegetables	-.382 (-2.92)	.055 (2.07)	.012 (1.92)	-.015 (-2.39)	.016 (1.63)	.015 (2.36)	-.034 (-7.97)	.022 (5.38)
Fish	-1.112 (-6.90)	.182 (5.57)	.032 (4.27)	-.004 (-.55)	-.027 (-2.26)	-.009 (-1.07)	-.023 (-4.43)	.035 (6.95)
Meats	.589 (3.43)	-.186 (-5.43)	-.002 (-.20)	-.019 (-2.37)	.033 (2.63)	.003 (.34)	-.051 (-9.20)	.057 (10.72)

SOURCE: 1980 SURGASAR Data

[a]t-ratio in parentheses.

Table E.7. Mixed estimate of semilog demand model--urban households ($1/\sqrt{w} = 1$)

Food Group	Intercept	Price: Rice	Price: Fruits and Vegetables	Price: Fish	Price: Meats	Price: Others	Household Size	Food Expenditure
Rice	1.147 (6.66)[a]	.136 (3.85)	.025 (2.79)	-.022 (-2.40)	-.048 (-3.45)	-.040 (-4.22)	.160 (25.71)	-.164 (-27.30)
Fruits and Vegetables	-.361 (-3.07)	.050 (2.12)	.012 (2.10)	-.015 (-2.37)	.016 (1.65)	.015 (2.38)	-.034 (-8.06)	.022 (5.47)
Fish	-.877 (-6.29)	.131 (4.69)	.036 (4.90)	-.002 (-.28)	-.028 (-2.40)	-.010 (-1.22)	-.025 (-4.79)	.037 (7.43)
Meats	.258 (1.79)	-.120 (-4.16)	-.007 (-.93)	-.022 (-2.77)	.038 (3.06)	.006 (.72)	-.048 (-8.75)	.054 (10.24)

SOURCE: 1980 SURGASAR Data

[a]t-ratio in parentheses.

Table E.8. Mixed estimate of semilog demand model--rural households ($1/\sqrt{w}$ = .10)

Food Group	Intercept	Price: Rice	Price: Fruits and Vegetables	Price: Fish	Price: Meats	Price: Others	Household Size	Food Expenditure
Rice	-.1861 (-.92)[a]	.260 (6.68)	.015 (1.40)	.064 (5.10)	-.047 (-3.31)	-.036 (-5.57)	.136 (14.14)	-.122 (-13.20)
Fruits and Vegetables	.166 (1.46)	-.014 (-.62)	.006 (.98)	-.018 (-2.60)	-.004 (-.47)	-.003 (-.72)	-.025 (-4.65)	.022 (4.20)
Fish	-.414 (-3.47)	.018 (.77)	.033 (5.12)	.020 (2.69)	-.019 (-2.24)	.013 (3.51)	-.035 (-6.18)	.029 (5.31)
Meats	-.430 (-2.70)	.036 (1.18)	.003 (.39)	-.025 (-2.54)	.033 (2.98)	.014 (2.82)	-.045 (-5.89)	.034 (4.66)

SOURCE: 1980 SURGASAR Data

[a]t-ratio in parentheses.

Table E.9. Mixed Estimate of Semilog Demand Model--Rural Households ($1/\sqrt{w} = 1.0$)

Food Group	Intercept	Price: Rice	Price: Fruits and Vegetables	Price: Fish	Price: Meats	Price: Others	Household Size	Food Expenditure
Rice	.129 (.70)[a]	.198 (5.59)	.014 (1.30)	.063 (5.06)	-.051 (-3.68)	-.036 (-5.61)	.129 (13.61)	-.115 (-12.63)
Fruits and Vegetables	.083 (.78)	.003 (.14)	.006 (1.01)	-.018 (-2.57)	-.003 (-.34)	-.003 (-.73)	-.023 (-4.37)	.020 (3.88)
Fish	-.449 (-4.00)	.025 (1.18)	.033 (5.10)	.020 (2.67)	-.018 (-2.22)	.013 (3.47)	-.035 (-6.14)	.029 (5.26)
Meats	-.429 (-3.00)	.034 (1.26)	.004 (.46)	-.024 (-2.46)	.033 (3.02)	.015 (2.91)	-.044 (-5.84)	.033 (4.64)

SOURCE: 1980 SURGASAR Data

[a]t-ratios in parentheses.

Table E.10. Comparison of Selected Estimated Price and Income Elasticities

	Rural				Urban			
	OLS	Exact	P=.10	P=1.0	OLS	Exact	P=.10	P=1.0
Own-Price Effect								
Rice	.260 (-.17)[a]	.268 (-.15)	.260 (-.18)	.198 (-.37)	.198 (-.25)	.190 (-.28)	.197 (-.25)	.136 (-.48)
Fruits and Vegetables	xx[b]	xx	xx	xx	.012 (-.92)	.019 (-.87)	.012 (-.92)	.012 (-.92)
Fish	.020 (-.81)	.022 (-.79)	0.020 (-.81)	.020 (-.81)	xx	xx	xx	xx
Meats	.033 (-.78)	.029 (-.81)	.033 (-.78)	.033 (-.78)	.032 (-.75)	.033 (-.75)	.033 (-.75)	.038 (-.71)
Expenditure Effect								
Rice	-.123 (.61)	-.119 (.62)	-.122 (.61)	-.115 (.64)	-.168 (.36)	-.168 (.36)	-.168 (.36)	-.164 (.38)
Fruits and Vegetables	.022 (1.17)	.013 (1.10)	.022 (1.17)	.020 (1.15)	.022 (1.15)	.021 (1.14)	.022 (1.15)	.022 (1.15)
Fish	.029 (1.27)	.034 (1.32)	.029 (1.27)	.029 (1.27)	.035 (1.33)	.047 (1.44)	.035 (1.33)	.037 (1.35)
Meats	.034 (1.22)	.039 (1.86)	.034 (1.22)	.033 (1.22)	.057 (1.44)	.052 (1.41)	.057 (1.44)	.054 (1.42)
Cross Price Effect of Rice								
Fruits and Vegetables	xx	.020 (.15)	xx	xx	.055 (.37)	.027 (.18)	.055 (.37)	.050 (.33)
Fish	xx	.036 (.34)	xx	.025 (.23)	.032 (.30)	-.016 (-.15)	.182 (1.69)	.131 (1.22)
Meats	xx	-.033 (-.22)	xx	.034 (.22)	-.019 (-.15)	-.058 (-.45)	-.186 (-1.45)	-.120 (-.93)

SOURCE: 1980 SURGASAR Data

[a]elasticities in parentheses.

[b]estimated coefficient not statistically significant

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