A Study on the Income and Price Elasticities of Food Demand*

—Difference between the Rich and the Poor—

Yoshimi Kuroda

1. Introduction

The interaction between population, food and development can be studied at several levels of disaggregation, such as the global level, the level of developed (DCs) and less developed countries (LDCs), or the level of income strata within a specific group of countries.

The last approach is rather infrequent in the literature. Yet, it is vital to distinguish socio-economic groups, and specifically the poor in LDCs, since they are the ones that determine at the margin at the demographic-nutrition-development interactions.

The objective of this study is to provide a general picture of the structure of food consumption by the poor as compared to that of the rich by resorting to estimates in the literature. Development will enter the analysis by focusing on income elasticities of demand for food at different income levels. Demographic patterns will enter the analysis by considering the elasticity of demand for food with respect to household size[1], again separately for income starta. Finally, the state of food supplies relative to population is reflected in the basic behavior of food prices, and the elasticity of demand with respect to price must be examined again at specific income levels.

The difference in the structure of consumption between the poor and the rich will be examined in terms of several indicators such as the average and marginal budget shares of food consumption expenditure and income and price elasticities of demand for foodstuffs.

There are in general two sources for the magnitudes for these indicators of the structure of food consumption. One set is based on the estimation of Engel curves using household budget data, while the other is derived from the estimation of demand functions on the basis of a time-series of aggregated national food consumption data. The former, in general, does not give us price elasticities because of the nature of cross-section data. From the latter, however, one may derive price elasticities of demand for food.

In order to identify differences in the structure of food consumption among households in different income strata, the appropriate procedure for estimating Engel curves is income-group specific. Unfortunately, very little work has been done in this direction. There are however a great deal of quantitative studies which mainly focus on international patterns of food consumption. Although there may exist a wide range of differences in socio-economic factors such as economic preferences, income distribution, degrees of urbanization and the like among countries with various stages of economic development, those studies may still be useful as a prozy for the present purpose.

2. Income Elasticities of Food Consumption[2]

Two of the earliest studies in the field of international patterns of food consumption were done by Houthakker [1957] and Goreux [1960]. They fit Engel curves to household budget data mainly for developed countries which were collected for the years during the 1950s and earlier.

From the above studies, however, one could not obtain a clearcut picture of how DCs and LDCs differ in the structure of food consumption. However, FAO [1976] recently presented a fairly comprehensive report on up-dating income elasticities (actually, total expenditure elasticities) of demand for agricultural products for various countries including both DCs and LDCs.

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1) "Household" and "family" are alternately used, but they are treated as equivalent in the present paper.

2) The words "income" and "total expenditure" elasticities are used as synonymous in the present study.

Table 1 GDP Per Capita, Budget Shares and Total Expenditure Elasticities of Demand for Foodstuffs, International Sample

	Country	Year	GDP per capita in 1975 constant U. S. dollars	Budget shares of total food		Total expenditure elasticity		
				Average	Marginal	Total food	Cereals and cereal products	Meat and meat products
1	Malawi	1968/69	118	0.34	0.27	0.79	0.49	1.02
2	India	1964/65	135	0.68	0.54	0.79	0.37	1.07
3	Pakistan	1963/64	141	0.51	0.37	0.74	0.33	1.35
4	Chad	1965	153	0.42	0.37	0.89	1.23	1.07
5	Tanzania	1969	166	0.43	0.29	0.69	0.58	0.99
6	Indonesia	1969	168	0.71	0.66	0.93	0.66	2.19
7	Kenya	1968/69	213	0.34	0.19	0.57	0.42	0.62
8	Sierra Leone	1967	238	0.50	0.26	0.51	0.13	1.47
9	British Honduras	1969	348	0.50	0.42	0.84	0.58	0.98[a]
10	Republic of Korea	1971	403	0.45	0.27	0.60	0.30	1.33[a]
11	El Salvador	1969	408	0.50	0.67	1.33	1.16	1.69
12	Colombia	1967/68	440	0.57	0.42	0.74	0.58	0.77
13	Ghana	1967/68	443	0.54	0.22	0.42	0.17	1.00
14	Dominican Republic	1969	485	0.37	0.25	0.67	0.31	0.84[a]
15	Guatemala	1969	493	N. A.	N. A.	0.76	0.14	0.91
16	Zambia	1966/68	494	0.51	0.22	0.44	0.26	0.56
17	Brazil	1968	585	0.43	0.30	0.69	0.29	0.88
18	Iraq	1972	675	0.51	0.38	0.75	0.36	1.12[c]
19	Peru	1971/72	750	0.36	0.19	0.51	0.28	0.74
20	Chile	1968	923	0.40	0.24	0.62	0.29	0.77[a]
21	Portugal	1967/68	1,171	0.49	0.25	0.52	−0.13	1.01
22	Mexico	1969/70	1,195	N. A.	N. A.	0.57	0.14	0.98[b]
23	Iran	1971	1,260	0.55	0.40	0.73	0.40	1.14
24	Yugoslavia	1970	1,294	0.45	0.27	0.60	−0.17	0.59
25	Greece	1963/64	1,342	0.26	0.27	1.02	0.88	1.24
26	Cyprus	1971	1,506	N. A.	N. A.	0.22	−0.08	0.28
27	Gabon	1963	1,674	N. A.	N. A.	0.11	0.21	0.29
28	Hungary	1970	1,943	0.43	0.28	0.65	0.18	0.65
29	Venezuela	1967	2,049	0.38	0.17	0.45	0.13	0.59
30	Japan	1969	3,102	0.36	0.21	0.57	0.10	1.07
31	Austria	1964	3,336	0.34	0.15	0.45	0.23	0.35
32	United Kingdom	1973	4,131	0.22	0.03	0.12	−0.06	0.11
33	Netherlands	1964/65	4,333	0.23	0.08	0.35	0.22	0.30
34	Norway	1967	5,337	0.32	0.10	0.30	0.02	0.35
35	Libyan Arab Republic	1969	5,367	0.37	0.27	0.72	0.34	0.84
36	France	1970	5,479	0.34	0.07	0.22	−0.08	0.24
37	Denmark	1967/68	5,513	0.19	0.05	0.25	0.04	0.15
38	Canada	1969	5,801	0.20	0.04	0.18	−0.09	0.12
39	U. S. A.	1965/66	6,355	N. A.	N. A.	0.36	0.18	0.32
40	Sweden	1969	7,401	0.26	0.11	0.43	0.08	0.14
41	Switzerland	1972	8,687	0.18	−0.10	−0.54	−0.61	−0.76

Sources : Total expenditure elasticities and average budget share were taken from FAO, *Income Elasticities of Demand for Agricultural Products*, ESC/ACP/WD 76/3, March 1976.

Notes : 1) The total expenditure elasticities are not always ones for nation wide. The followings are how these estimates are obtained. Averages are all simple arithmetic averages. (1) Malawi, nation wide; (2) India, average of urban and rural areas; (3) Pakistan, nation wide; (4) Chad, average of Fort Achambault, Moundou, and rural areas; (5) Tanzania, average of urban and rural areas and Tanzania Mainland; (6) Indonesia, nation wide; (7) Kenya, average of Kisumu and Mombasa; (8) Sierra Leone, Western Province; (9) British Honduras, Belize City; (10) Republic of Korea, average of urban and rural areas; (11) El Salvador, urban areas; (12) Colombia, urban areas; (13) Ghana, average of urban and rural areas in Eastern Region; (14) Dominican Republic,

Table 1 presents total expenditure elasticities for total food, and separately for cereals and cereal products and meat and meat products for 41 countries that include both DCs and LDCs. There are two reasons why the elasticities for cereals and cereal products and meat and meat products are emphasized in this connection. First, cereals and cereal porducts are the basic foodstuffs at low levels of income. Second, meat consumption is an indirect form of cereal consumption, and is considered to increase as income grows. In Table 1, both the average and marginal budget shares of food consumption expenditure appear to differ systematically with the levels of per capita income. Compared to the DCs, the LDCs devote a larger proportion of their total expenditure to foodstuffs. The total expenditure elasticities for total food, cereals and cereal products, and meat and meat products seem to show a similar behavior as in the case of the budget shares. The LDCs tend to have higher total expenditure elasticities for all the cases than do the DCs. From these findings, one may infer that the budget shares and income elasticities are inversely related to the level of income of households[3].

In order to gain a better understanding of the differences of food consumption patterns between the LDCs and the DCs in terms of numerical values, the author computed the simple averages of the budget shares and the income elasticities for the LDCs and the DCs based on Table 1. The results are reported in Table 2.

First, the average budget share for the LDCs is 0.47 while that for the DCs is only 0.28. This finding implies that the LDCs spend a relatively larger proportion of the income, or the total expenditure, on foodstuffs than do the DCs. This is the well-known Engel's law. This law may also be extended to the marginal budget share of food consumption expenditure, with the coefficient for the LDCs being 0.31 and for the DCs 0.11.

Second, the total expenditure elasticity for total food is 0.66 for the LDCs and 0.36 for the DCs. These estimates are fairly comparable with the total expenditure elasticities for total food, 0.70 and 0.50 for the LDCs and the DCs, respectively, obtained by Lluch, Powell and Williams [1977] using time-series of aggregated national food consumption data for the period 1955–1968. Furthermore, Parks and Barten [1973], employing the Stone-Geary linear expenditure system, obtained 0.53 for the income elasticity for total food for the DCs during the period 1950–1969. It may be concluded that for the period from the late 1950s through early 1970s, the income elasticitiy for LDCs is around 0.7 and that for DCs is around 0.4 to 0.5.

3. Family Size Elasticities of Food Cousumption

In understanding the implications of the differences in the income elasticities of food commodities for DCs and LDCs, it is more economically meaningful if the concept of the elasticities with respect to the household size (size

3) The author tested this hypothesis empirically by fitting $Z=a+bY+u$, where Z is a budget share or an income elasticity, Y is the per capita income, u is the disturbance term, and a and b are the parameters to be estimated. The results are presented in Appendix A. All the estimated coefficients of per capita income were uniformly negative, which supports the hypothesis that both budget shares and income elasticities are inversely related to income.

St. Domingo City; (15) Guatemala, average of urban and rural areas; (16) Zambia, ruban areas; (17) Brazil, average of Estado de Guanabara and Rio de Janeiro; (18) Iraq, nation wide; (19) Peru, Lima Metropolitana; (20) Chile, Great Santiago; (21) Portugal, nation wide; (22) Mexico, average of urban and rural areas of Estado de Chichuahua, Estado de Jalisco, and Estado de Veracruz; (23) Iran, average of urban and rural areas; (24) Yugoslavia, average of three-persons workers' households and four-persons workers' households; (25) Greece, semi-urban and rural areas; (26) Cyprus, average of urban and rural areas; (27) Gabon, average of N'Gounie and Woleu N'Tem; (28) Hungary, average of agricultural and industrial workers and white collars and intellectual workers; (29) Venezuela, average of Barinas, Merida, and San Cristobal; (30) Japan, nation wide; (31) Austria, nation wide; (32) United Kingdom, nation wide; (33) Netherlands, average of manual and agricultural workers, non-manual workers, farmers, and self-employed persons; (34) Norway, nation wide; (35) Libyan Arab Republic, Tripoli and Benghazi; (36) France, nation wide; (37) Denmark, workers; (38) Canada, average of non-farm households in Atlantic, British Columbia, Ontario, Prairie, and Quebec Regions; (39) U. S. A., average of urban, rural non-farm, rural farm, and all urbanizations; (40) Sweden, nation wide; (41) Switzerland, workers and employees.

2) The elasticities are derived from the estimation of a double-log form where the dependent variable is the per capita consumption and the independent varibale is the per capita total expenditure.

3) The marginal budget share of food consumption expenditure is simply a product of the average budget share and the total expenditure elasticity of demand for total food consumption.

4) The LDCs are the countries numbered from 1 to 29, and the DCs are those numbered from 30 to 41.

a) Meat and fish. b) Meat, fish, eggs, and milk. c) Meat, fish, and eggs.

Table 2 Averages of Budget Shares and Income Elasticities for DCs and LDCs

	Budget share		Income elasticity		
	Average	Marginal	Total food	Cereals and cereal products	Meat and meat products
LDCs	0.47	0.31	0.66	0.36	0.97
DCs	0.28	0.11	0.36	0.09	0.36

Notes: 1) The values of the budget shares and the income elasticities in Table 1 were used in order to compute the simple arithmetic averages.
2) The LDCs are countries with the sequence numbers from 1 to 29 and the DCs are countries numbered 30 through 41 in Table 1.

elasticity in short) is introduced.

A standard way to catch the family size effect in demand for foodstuffs by using family budget data is to explicitly introduce the family size variable. In this case, the dependent variable in the demand function is the total consumption expenditure on each commodity instead of the per capita consumption, while the independent variables are the total family income and the family size. Only by empirically estimating such a function, can one test the hypothesis of whether there exist constant, increasing, or decreasing returns to scale in food consumption. The simplest but a most meaningful functional form is a double-log. The test of the hypothesis can directly be proceeded in this functional form by examining if the sum of the coefficients with respect to the family income and the family size is equal to, greater than, or less than unity.

Houthakker [1957] used this form and obtained 0.6 for the total expenditure elasticity and 0.3 for the size elasticity for 13 OECD countries. Although he did not test specifically, the sum of the two elasticities, 0.9, might not be significantly different from unity. Weisskoff [1971], in his study for LDCs, found constant returns to scale in aggregated food consumption. For the sake of convenience, the author assumes constant returns to scale in consumption of foodstuffs by resorting to the results of Houthakker [1957] and Weisskoff [1971]. With this assumption the size elasticity is simply given by $\eta+\varepsilon=1$, where η and ε are the elasticities with respect to income and household size, respectively. Using this the author calculated the size elasticities for cereals and cereal products and meat and meat products which are given in Table 3.

According to Houthakker [1965], the influences of family size on consumption may be classified into two effects. One is the *specific effect* which results from the increase in the need for various commodities when family size increases. The other is the *income effect*, that is, an increase in family size makes the family members relatively poorer. If the specific effect is stronger than the income effect, the size elasticities will be positive, otherwise they will be nagative. Bearing this in mind, one may now investigate the elasticities given in Table 3.

First, the size elasticities for cereals and cereal products for the LDCs and DCs are respectively 0.64 and 0.91 which are much larger than the income elasticities. This implies that for households in both groups of countries, the specific effect is much stronger than the income effect when the family size increases. The extent of this is much stronger in households in the DCs where an increase in consumption of cereals is dependent almost entirely on an increase in the family size. In other words, consumption of cereals has been reaching its saturation in the DCs.

On the other hand, the size elasticities for meat and meat products in the LDCs and DCs are 0.03 and 0.64, respectively. For households in the DCs, the specific effect is much stronger than the income effect. Indeed, meat and meat products are a necessity for them. However, the consumption of meat and meat products in households in the LDCs does not increase when the family size increases. This means that the positive specific effect is almost completely offset by the negative income effect. This may

Table 3 Income and Size Elasticities for Cereals and Cereal Products and Meat and Meat Products

	Cereals and cereal products		Meat and meat products	
	Income elasticity	Size elasticity	Income elasticity	Size elasticity
LDCs	0.36	0.64	0.97	0.03
DCs	0.09	0.91	0.36	0.64

Notes: 1) The values of the income elasticities were taken from Table 2.
2) The size elasticities were obtained by subtracting the income elasticities from one by assuming constant returns to scale in consumption both in the cases of cereals and meats.

be interpreted as follows. Even when a household experiences an addition of another person, the total amount of consumption of meat and meat products is not increased. This, in turn, implies that the per capita consumption of meat and meat products will decrease after the addition of another member in the household, unless the increase in income is large enough to offset this decrease. This strong negative income effect of an increase in family size in the consumption of meat and meat products may be partly responsible for the "animal-protein malnutrition" among the poor in LDCs where the rate of growth of population has been very high.

4. Price Elasticities of Food Consumption

Thus far the author has assumed that relative prices of food are constant. However, a glance at changes in international grain prices during the early 1970s immediately leads us to question the justification of this assumption. The "food crisis" that occurred early in the 1970s has drastically raised the level of the international prices of cereals. Since cereals are the major basic food commodities all over the world, a rise in their prices at the international level eventually causes a rise in the general price level of foodstuffs in any individual countries. In this sense, therefore, it is more practical and economically meaningful to discard the assumption of stable prices of foodstuffs and to investigate the effects of changes in food prices on demand for foodstuffs.

The standard way to investigate the effects of price changes on demand for foodstuffs is to look into price elasticities of demand. The objective in this section is therefore to investigate the magnitudes of price elasticities of demand for foodstuffs. As in the case of income elasticities, special attention will be paid on differences in the magnitudes of price elasticities between different income groups, specifically DCs and LDCs. For this purpose, the author will rely on the literature on international cross-country studies.

A standard method of estimating price elasticities is to fit a double-log demand equation to time-series data or a combination of cross-section and time-series data. Two representative studies in this line are by Houthakker [1965] and Weisskoff [1971]. Houthakker estimated the income and price elasticities for 13 OECD countries by developing "within-countries" and "between-countries" models in order to obtain the "short-run" and "long-run" elasticities. By using the same method suggested by Houthakker, Weisskoff estimated the income and price elasticities for 17 LDCs.

Another method for obtaining price elasticities is to derive them indirectly from the estimated structural linear expenditure system. Studies using this method have been accumulating. Parks and Barten [1973] and Lluch, Powell and Williams [1977] are representative in this direction. The former presents the derived income and price elasticities for 14 OECD countries for the period 1950–1969. The latter reports the income and price elasticities not only for DCs but also for LDCs for the various periods during the last two decades. In the following paragraphs, the estimated price elasticities based on these representative work will be summarized and some empirical implications will be derived.

Table 4 summarizes the income and price elasticities of demand for aggregated foodstuffs for DCs and LDCs. Since income elasticities have already been discussed in the previous sections, the author will focus only on price elasticities. From the table, the price elasticity ranges from −0.11 to −0.44 for DCs, while for LDCs it ranges from −0.46 to −0.87. From this finding, one may infer that the demand for aggregated foodstuffs in DCs is relatively more inelastic to changes in food prices than that in LDCs.

The low price elasticity of demand for total foodstuffs by DCs implies that the price elasticity of demand for meat and meat products is also low since the budget share of meat and maet products by DCs is relatively high[4]. This in turn implies that the possibilities of substitution between direct and indirect consumption of grains by DCs are very low. On the other hand, the relatively high price elasticity of LDCs implies a relatively high price elasticity for grains since the proportion of expenditure on this group of foodstuffs is high in LDCs.

One may further consider the implications of this both at an international level and at a national level. In years of short supply of grains at an international level, households in rich countries will slightly reduce their total consump-

4) The terms "low" and "high" are used in absolute terms.

Table 4 Income and Price Elasticities of Foodstuffs for DCs and LDCs

Countries	Researcher	Model	Period	Income (or expenditure) elasticity	Price elasticity
DCs	Houthakker[1]	Within-countries	1948–59	0.351	−0.161
	Parks and Barten[2]	Linear expenditure system	1950–69	0.526	−0.113
	Lluch, *et al.*[3]	Linear expenditure system	1955–69	0.574	−0.405
LDCs	Weisskoff[4]	Within-countries	1950–66	1.110	−0.874
		Between-countries	1950–66	0.826	−0.461
	Lluch, *et al.*[3]	Linear expenditure system	1955–69	0.681	−0.501

Notes: 1) Houthakker [1965].
2) Parks and Barten [1973]. The elasticities are simple averages of the 14 OECD countries in Table AI, p. 851.
3) Lluch, Powell and Williams [1977]. The elasticities are simple averages of the 10 LDCs and the 7 DCs given in Tables 3.12 and 3.13.
4) Weisskoff [1971]. The estimates are taken from Table 14.3, p. 330.

tion of grains since there are narrow limits for the substitution of direct for indirect consumption of grains. This implies that poor countries which rely largely on imports of grains will face a more severe shortage of grains at the higher level of grain prices. In such countries, in turn, the poor will be crowded out by the rich in the limited markets of grains because of their limited purchasing power. Yet, grains are the basic source of their nutritional intake. Obviously, such a situation will increase the degree of animal-protein malnutrition of the poor in poor countries because of the rapidly growing population.

(University of Tsukuba)

Appendix A Relationships between Budget Shares and Income Elasticities and Per Capita GDP

Dependent Variable		Constant	per capita GDP	R^2
Average budget share	(a)	0.488 (0.020)	−0.0000391 (0.0000064)	0.523
	(b)	0.490 (0.021)	−0.0000404 (0.0000073)	0.479
Marginal budget share	(a)	0.357 (0.026)	−0.0000494 (0.0000082)	0.519
	(b)	0.356 (0.027)	−0.0000482 (0.0000094)	0.444
Income elasticity for total food	(a)	0.738 (0.048)	−0.0000892 (0.0000153)	0.466
	(b)	0.713 (0.045)	−0.0000698 (0.0000159)	0.337
Income elasticity for cereals and cereal products	(a)	0.435 (0.059)	−0.0000809 (0.0000188)	0.321
	(b)	0.418 (0.060)	−0.0000679 (0.0000208)	0.219
Income elasticity for meat and meat products	(a)	1.112 (0.073)	−0.0001645 (0.0000234)	0.559
	(b)	1.091 (0.074)	−0.0001477 (0.0000258)	0.463

Notes: 1) The estimating equation is linear where only constant and per capita GDP are employed. 2) All samples are based on Table 1. 3) (a) includes Switzerland while (b) excludes Switzerland. 4) Figures in parentheses are computed standard errors.

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