# Cross-Country Analysis of Food Consumption Patterns

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**Abstract:** Low-income countries spend a greater portion of their budget on food and are more responsive to income and food price changes than middle- and high-income countries. Higher value food products undergo greater budget adjustments to price and income shocks, while budgets for staple food products like cereal change the least.

## Introduction

The world population is expected to increase by more than 1.2 billion people between 1998 and 2018, almost all of whom will reside in low and middle-income countries (The World Bank, 2000). The expected increase in population, combined with rising income levels in developing countries, is expected to account for most of the anticipated increases in global food demand over the next couple of decades. Cross-country food demand analysis can improve understanding of global food trends by quantifying the relationship between food demand, composition of food, and income levels. This knowledge in turn can provide crucial input in assessing future global food needs.

While the previous chapter described the factors that affect food consumption and trade patterns across time, focusing on region-specific income effects, this chapter will examine how changing incomes and prices affect changes in food expenditure for a cross-section of countries ranging from low, to middle, to high income. The results discussed in Chapter 1 were derived from a simulation study based on demand elasticity estimates from 1985 data. Our paper in turn will estimate demand elasticities using 1996 data, which could potentially be used in future simulation studies. In addition to examining the effect on aggregate food demand, this chapter will also examine the effect of income and price changes on food subgroups such as: bread and cereals, meat, fish, dairy products, oils and fats, fruit and vegetables, and other food products.

### Background

As described in the previous chapter, rising income and improved access to a greater variety of food results in changes in food consumption patterns. This chapter further indicated that developed countries exhibit greater preference for high-value processed products as income increases. Other studies indicate that with an expected large growth in population and income levels, developing countries will mainly account for overall future increases in global food demand. For example, a recent publication suggests that about 85 percent of the increase in the global demand for cereals and meat between 1995 and 2020 will occur in developing countries (Andersen, Pandya-Lorch, and Rosegrant 1999). The same study also indicates that the demand for meat in the developing world could potentially double during this 25-year period.

While global food demand, especially in developing countries, is expected to increase with income, the food share of total budget is expected to decline as income increases. An Economic Research Service (ERS) analysis of 51 countries indicated that on average, high-

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income countries spend 16 percent of their expenditures on food, while low-income countries spend 55 percent (ERS 1997). Similarly, the cross-country demand analysis conducted by Theil, Chung, and Seale (1989) using the first four phases (1970-1980) of the International Comparison Project (ICP) further confirms that the proportion of budget spent on food decreases with income, and that wealthier countries are less responsive to changes in income and food prices. Results from the study by Cranfield, *et al*. (1998), using the 1985 ICP data, indicates that poorer countries are expected to experience larger growth in total food demand during the next two decades.

Rising income is also expected to change the composition of food demand, especially in developing countries. This is illustrated both by the ERS study (July 1997), which indicates that rising income levels generally result in a more diverse diet, as well as by Cranfield, *et al*.'s analysis which concludes that the composition of food demand will undergo a greater change in developing countries compared with developed countries. In low per capita income countries, cereal consumption accounts for a large share of the total food budget. As per capita income rises, consumers in these countries will shift some consumption away from lower value cereals to higher value livestock products. In developed countries, where incomes and livestock product consumption are already high, consumers are expected to make relatively small adjustments between food consumption groups with changes in income levels. As indicated in Chapter 1, the substitutions made by consumers in developed countries may lead to greater consumption of processed high-value products, or consumers may upgrade food consumption to newer and foreign varieties that are perceived to be of better quality. These shifts in food consumption may be within the same food subgroups and therefore may not be evident by demand analyses of broad food subgroups.

## International Evidence on Food Consumption Patterns

The 1995 International Comparison Project data are used to analyze the demand for food in 99 countries ranging from low- and middle- to high-income (see box). Consumer response to changes in factors affecting demand is measured by elasticities. For example, an income elasticity measures the responsiveness of the quantity demanded to a unit change in income, while price elasticity measures the responsiveness of the quantity demanded to a unit change in price. When an income elasticity for a product is greater than one, the product is considered to be a luxury good and accounts for an increasing proportion of total expenditures with increases in income. When an income elasticity of demand is less than one, the product is considered to be a necessary good and accounts for a smaller proportion of total expenditure as income increases.

To examine the effect of income on consumption, countries are grouped together according to per capita income (as calculated from the expenditure data). Low-income countries represent those with real per capita income less than 15 percent of the U.S. level, middle-income with real per capita income between 15 and 50 percent of the U.S. level, and high-income with per capita income greater than 50 percent of the U.S. level. This criterion for grouping places the majority of Sub-Saharan African countries, poor transition economies such as Mongolia and Turkmenistan, and low-income Middle Eastern countries such as Yemen within the first group. High income countries include most Western European countries, Australia, New Zealand, Canada, Japan, and the United States; while the middle income countries include better-off transition economies such as Estonia, Hungary and the Czech Republic, North African countries, and many Latin American countries.

### *Poorer Countries Spend a Higher Proportion Of Their Budget on Food*

Consistent with past findings, our results indicate that low-income countries spend a greater portion (47 percent) of their total expenditures on food compared with richer countries, which on average spend 13 percent of their total budget on food (table B-1). In general, lower income countries spend a greater proportion of their budget on necessities such as food, while richer countries spend a greater proportion on luxuries. With income elasticity below one, food, beverages and tobacco, and clothing and footwear appear to be necessities in all countries, while education, gross rent, fuel and power, house operations, medical care, recreation, transport and other groups are all luxuries.

### *Food Demand in Poorer Countries is More Responsive to Income Changes*

To compare our estimates with those of Theil, Chung, and Seale from the earlier phases of ICP, we observe

**Table B-1—Budget shares and income elasticities of aggregate consumption categories**

| Consumption categories | Low income <15% of U.S. | Middle income 15-50% of U.S. | High income >50% of U.S. | Low income <15% of U.S. | Middle income 15-50% of U.S. | High income >50% of U.S. |
|---|---|---|---|---|---|---|
| | --- *Budget shares* --- | | | --- *Income elasticity* --- | | |
| Food | 0.47 | 0.29 | 0.13 | 0.73 | 0.58 | 0.29 |
| Beverages & tobacco | 0.04 | 0.05 | 0.04 | 0.97 | 0.97 | 0.97 |
| Clothing & footwear | 0.08 | 0.07 | 0.05 | 0.90 | 0.88 | 0.86 |
| Education | 0.06 | 0.07 | 0.08 | 1.06 | 1.05 | 1.05 |
| Gross rent, fuel & power | 0.09 | 0.14 | 0.18 | 1.24 | 1.18 | 1.16 |
| House operations | 0.05 | 0.07 | 0.07 | 1.17 | 1.14 | 1.12 |
| Medical care | 0.04 | 0.08 | 0.11 | 1.74 | 1.35 | 1.26 |
| Other | 0.07 | 0.09 | 0.15 | 1.59 | 1.32 | 1.24 |
| Recreation | 0.02 | 0.04 | 0.07 | 1.76 | 1.42 | 1.29 |
| Transport | 0.08 | 0.11 | 0.13 | 1.24 | 1.18 | 1.15 |
| Number of countries | 32 | 41 | 26 | 32 | 41 | 26 |

the income levels and elasticities for the 39 countries present in both datasets. As earlier mentioned, Theil, Chung, and Seale used the first four phases of ICP, which included data collected between 1970 and 1980, to estimate the demand for the same aggregate consumption groups as estimated in this study. The horizontal axes in figures B-1 and B-2 represent countries arranged in ascending order of 1996 per capita income, with Tanzania near the origin and the United States at the extreme end. As shown in figure B-1, between 1980 and 1996, real per capita income grew faster for wealthier countries than for the poorer countries. Figure B-2 compares the income elasticity for food from the two studies, which appear to be relatively similar. These results indicate that poorer countries are more willing to change their expenditures on food in response to changes in income, as measured by the income elasticity. As income level rises, the income elasticity declines.

Between 1980 and 1996, there is very little change in income elasticity among the poorer countries, which experienced slower growth in per capita real income compared with developed countries (fig. B-1). During this time, developing countries experienced rapid urbanization, which increased the availability and the selection of food in these markets. Urbanization, as will be discussed in greater detail in the next chapter, may have contributed to maintaining or even increasing the income elasticity for food in low-income and many middle-income countries in 1996 compared with 1980 (fig. B-2). The large increase in the estimated income elasticity for Brazil (the lone peak in the graph) can be attributed to the prevailing currency crises during this period. Except for several European countries, among the wealthier middle-income and higher income countries, the income elasticity for food in 1996 is lower than in 1980. The adoption of the Common Agricultural Policy (CAP) by several countries between 1980 and 1996 and the subsequent modification of the CAP in 1992 may have influenced income elasticities in European countries. The CAP maintained agricultural prices at artificially high levels in European countries, thereby increasing expenditures for food as per capita incomes rose. In addition, European countries that adopted the CAP were forced to maintain the same trade barriers as the rest of the European Union (EU), thereby diverting trade away from lower cost imports from countries outside the EU.

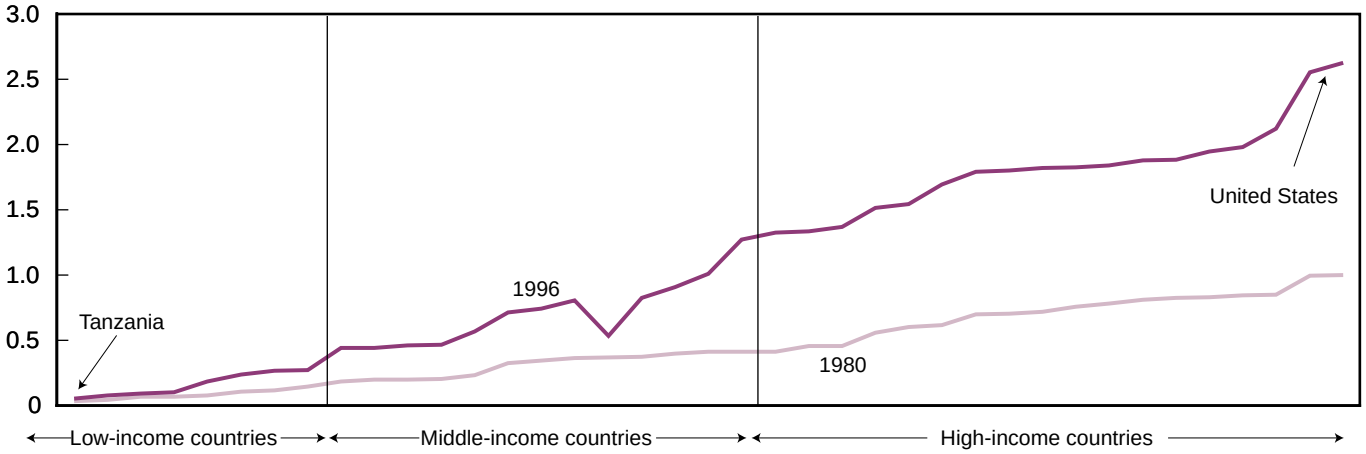
### *Food Demand in Poorer Countries is More Responsive to Food Price Changes*

Figure B-3 compares the price elasticities for aggregate food groups between 1980 and 1996, reflecting the consumer response to price changes with no compensation in income levels. For both years, poorer countries are highly responsive to changes in food prices compared with wealthier countries. As incomes increased between 1980 and 1996, the price elasticity for food for many middle-income and all low-income countries also increased contrary to expectations. This is because income levels did not grow much for most low-income and many middle-income countries during 1980-1996, and real per capita income in 1996, although higher than in 1980, continued to remain at very low levels compared with wealthier countries. Additionally, as discussed earlier, developing countries experienced rapid urbanization, which has increased the availability and choices of food in these countries. This in turn has enhanced consumer ability to select lower value substitutes within a food group as prices increase for certain food items within the same group. Food price elasticities for many higher income coun-

Figure B-1

**Per capital real income**

Index, 1980 US$=1.0

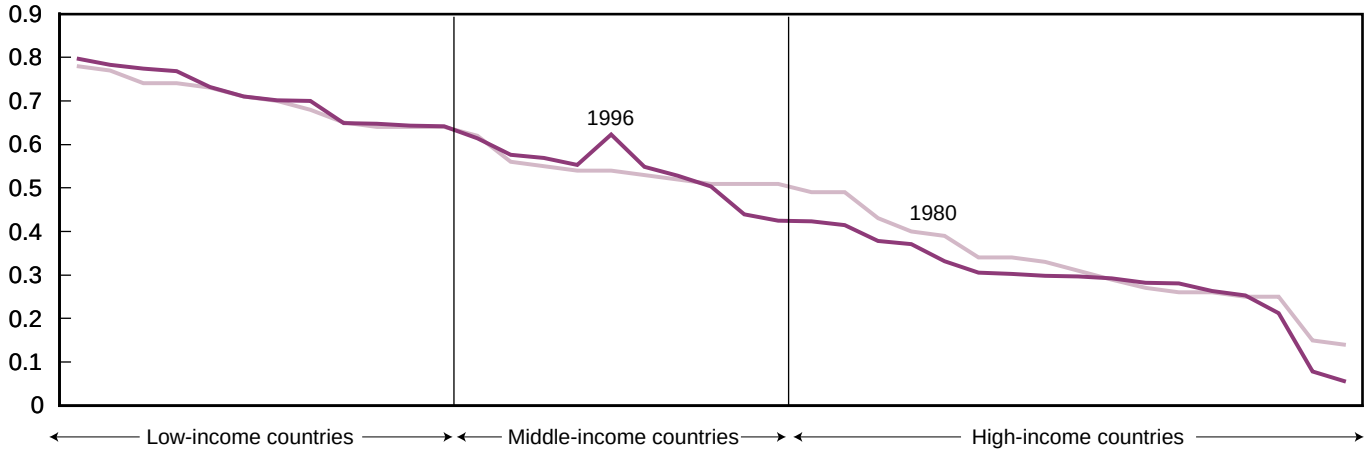



Source: 1996 data are ERS/USDA estimates based on International Comparison Project data. 1980 data are from Theil, Henri, Ching-Fan Chung, and James L. Seale, Jr., International Evidence on Consumption Patterns (1989).

Figure B-2

**Income elasticity for food**

Elasticity




Source: 1996 data are ERS/USDA estimates based on International Comparison Project data. 1980 data are from Theil, Henri, Ching-Fan Chung, and James L. Seale, Jr., International Evidence on Consumption Patterns (1989).

tries were about the same or less in 1996 than in 1980. The exception to this category is again several European countries, which as already mentioned, may have been affected by the adoption and modification of the Common Agricultural Policy.

### *Composition of Food Moves from Low-Value To High-Value as Income Increases*

As indicated in table B-2, cereals, fats and oils, and fruit and vegetables (including tubers) account for a larger share of the total food budget in low-income countries compared with high-income countries. On the other hand, meat and dairy budget shares are greater for high-income countries compared with both low- and middle-income countries. Excepting dairy products among the extremely poor countries and fish for all low-income and many middle-income countries, all other food groups are necessary goods as indicated by elasticity levels that are less than one.

## Analysis of Cross-Country Food Demand Model

### *Analytical Framework*

Our analysis employs a two-stage budgeting process (Deaton Muellbauer, pp. 122, Theil, Chung, and Seale, pp. 129-138) which assumes that consumers first allocate their budget to broad consumption groups. Given the budget for the broad groups, consumers then make budget decisions for items within each group. Accordingly, we first estimate an aggregate demand system across 10 broad consumption categories (food being one of them), followed by a second demand system comprising seven food sub-categories. The first stage assumes preference independence between the 10 broad consumption categories: food, beverages and tobacco, clothing and footwear, gross rent, fuel and power, house furnishings and operations, medical care, transport and communications, recreation, education, and other consumption expenditures. This implies that the preference ordering among items within one broad consumption group is not dependent on the quantities of items consumed in other groups. Using the maximum likelihood estimation process, parameters for the Working's Preference Independence model (Theil, Chung, and Seale 1989) are estimated from the first stage of the analysis, which in turn yield income and price elasticities for the 10 broad consumption groups.

The second stage of the analysis involves the estimation of parameters for the seven food sub-categories, bread and cereals, meat, fish, dairy products, fats and oils, fruit and vegetables, and other food products. In this analysis, preference independence cannot be assumed since the demand for a particular food group may be dependent on consumption of items in other food groups. For example, demand for meat products may be dependent on consumption of fish. Therefore, the more suitable Working Slutsky model (Theil, Chung, and Seale, 1989) is used in this estimation. Based on the parameters estimated from the second model, we can calculate the conditional income and price elasticities for each food group. The unconditional demand elasticities can then be obtained by multiplying the conditional elasticities by the corresponding elasticity for food as an aggregate group obtained from the first step of the analysis.

The analytical framework used in this study follows the methodology developed and described in detail by Theil, Chung, and Seale (1989). They estimated the demand for 10 broad consumption categories, namely, food, beverages and tobacco, clothing and footwear, gross rent, fuel and power, house furnishings and operations, medical care, transport and communications, recreation, education, and other consumption expenditures. All data are normalized with reference to the United States, and all domestic prices are converted into U.S. dollars to facilitate comparison.

### *Data*

The International Comparison Project (ICP), initiated by researchers at the University of Pennsylvania, is currently maintained by the Statistical Advisory Services of the World Bank. Over the years, data collected by the ICP has increased from 10 countries in Phase I (1970) to 115 countries in 1996. The study conducted by Theil *et al*. (1989) used the Phase IV data from 60 countries, while the study by Cranfield *et al*. (1998) used the 1985 data covering 64 countries. The current study uses the 1996 ICP data, which covers expenditure and price data for 115 countries, over 10 broad consumption categories, and 22 sub-categories.

To conduct cross-country analysis, consumption expenditures and prices expressed in different currencies must be expressed in terms of a base country currency comparable across countries. One solution to convert expenditures into a single currency would be to use the exchange rates. However, exchange rates do not account for the fact that services are cheaper in less developed countries. Therefore, exchange rates tend to overstate the poverty of poorer countries. To obtain more accurate estimates for individual countries, ICP uses the Geary-Khamis (The World Bank, 1993) method of aggregation to arrive at prices that are in terms of purchasing power parities (PPPs) relative to a base country. Similarly, expenditures are aggregated using the Geary Khamis method to arrive at total per capita real expenditures relative to a base country, which is used as a proxy for per capita real income. Our analysis uses the United States as the base country for calculating PPP and per capita real income.[1]

[1] The program ICP ToolPak developed by Yuri Dikhanov, Statistical Advisory Service, the World Bank, was used.

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The 1996 ICP data was collected between 1993 and 1996 by six different agencies contracted by the United Nations for countries in Asia, Africa, the Middle East, the Caribbean, Latin America, OECD, and the Commonwealth of Independent States (CIS). Each of the agencies was responsible for collecting data for a particular region for which the data was collected at a very disaggregate level and then aggregated upward using the PPP methodology to express it in terms of base country currency, which in most cases was 1996 U.S. dollars. However, not all PPPs were expressed relative to the United States. Data for Asia were expressed relative to Hong Kong and data for Latin America were expressed relative to Mexico. Since Mexico was also represented in the OECD data, merging Latin America with the rest of the data was relatively easy. Merging Asia has proven to be more challenging. Japan is represented in both the Asian and OECD data, but matching the two datasets indicated scaling problems within the Asian data. Therefore, the current analysis is conducted for 99 countries, excluding 13 countries from Asia, two from the Caribbean, and Herzegovina, for which population data were unavailable. Food expenditure data for the two Caribbean countries, Bermuda and Belize, appeared to include a large amount of expenditures by tourists and were therefore unrepresentative of the indigenous population.

### *Results*

The results from the estimation of our demand systems confirm Engel's Law and appear to be consistent with previous studies closely matching those obtained by Deepak, Shapouri, and Seale for Brazil (June 2000). Similarly, the estimated elasticities for cereal and horticultural products presented in table A-4 are similar to those obtained in our study. The elasticity of demand for meat estimated from our study cannot be compared with the elasticity of demand for livestock in Chapter 1, since Gehlhar and Coyle include dairy in their estimation of demand for livestock products, while our study separates dairy and meat into two food categories. Furthermore, in comparing the elasticity from the two studies, one has to bear in mind that the elasticities presented by Gehlhar and Coyle are computed based on parameters estimated using the 1985 data (Cranfield et al. 1998) and are not derived from direct estimation of 1980 or 1995 data. A detailed list of the estimated elasticities together with the respective countries will be presented in a forthcoming ERS technical bulletin.

Most of the parameters estimated for food sub-categories, except for fish and fruit and vegetables, were statistically significant at the 1-percent level, but all parameters were significant at the 5-percent level. These results could be explained by the data. Fish consumed in poor developing countries may not enter the retail market, while fish consumption in developing land-locked countries may be very low. Similarly, this fruit and vegetables group also includes data on roots and tubers and may explain why the parameters estimated for this sub-group are not very robust. As income increases in poor countries, consumers tend to move away from consuming cassava, sweet potatoes and other tubers, to consuming staples such as rice and wheat. On the contrary, as income increases, consumption of fresh fruits and vegetables is expected to increase.

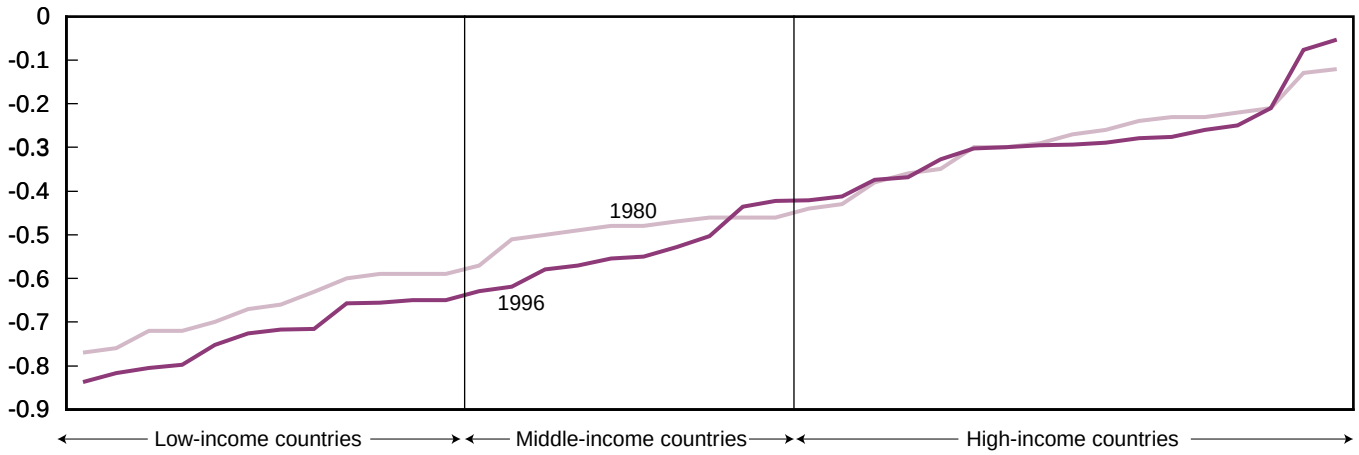
### *Food Sub-Group Demand in Poorer Countries Is More Responsive to Income Changes*

For all food subgroups, poorer countries exhibit a greater responsiveness, as given by the income elasticity (table B-2), to changes in income levels compared with wealthier countries. For example, when income falls, poorer countries make bigger cutbacks in consumption expenditure of different food groups than wealthier countries do. However, these cutbacks are not implemented evenly across the different food groups. Larger cuts are made on higher value items such as fish, dairy, and meat, while the consumption of cereal, the main staple, is cut the least. Conversely, when income increases, poorer countries increase their expenditure on different food items to a greater extent than wealthier countries, with the greatest increase in expenditure on higher value food items such as dairy and meat.

### *Staple Food Demand is Less Responsive to Income Changes*

For all income levels, countries indicate comparatively lower income elasticities for staple products such as cereals, fats and oils, and fruits and vegetables (includes tubers), than for meat and dairy products. However, the difference between the elasticities for the

Figure B-3
**Own-price elasticity for food**




Source: 1996 data are ERS/USDA estimates based on International Comparison Project data. 1980 data are from Theil, Henri, Ching-Fan Chung, and James L. Seale, Jr., International Evidence on Consumption Patterns (1989).

**Table B-2—Budget shares and income elasticities of food sub-categories**

| Consumption categories | Low income <15% of U.S. | Middle income 15-50% of U.S. | High income >50% of U.S. | Low income <15% of U.S. | Middle income 15-50% of U.S. | High income >50% of U.S. |
|---|---|---|---|---|---|---|
| | | *--- Budget shares ---* | | | *--- Income elasticity ---* | |
| Cereals | 0.28 | 0.20 | 0.16 | 0.56 | 0.41 | 0.19 |
| Meat | 0.18 | 0.22 | 0.25 | 0.82 | 0.65 | 0.33 |
| Fish | 0.05 | 0.05 | 0.06 | 2.77 | 0.92 | 0.43 |
| Dairy | 0.09 | 0.13 | 0.14 | 0.93 | 0.71 | 0.35 |
| Oils & fats | 0.07 | 0.05 | 0.04 | 0.58 | 0.43 | 0.21 |
| Fruit & vegetables | 0.23 | 0.21 | 0.20 | 0.66 | 0.53 | 0.27 |
| Other food | 0.11 | 0.13 | 0.15 | 0.80 | 0.63 | 0.32 |
| Number of countries | 32 | 41 | 26 | 32 | 41 | 26 |

lower value staples and the higher valued items are dramatically larger for poorer countries than for the wealthier countries. For example, the difference between the estimated elasticity for cereal and dairy ranged from a low of .03 for the United States to .42 for Tanzania, while the difference between the elasticity for cereal and fish for the two countries are .042 and 4.04, respectively. This again illustrates that consumers in poorer countries are more willing to change their consumption patterns as income changes.

### *Food Subgroup Price Change Responsiveness Is Dependent on Income Level*

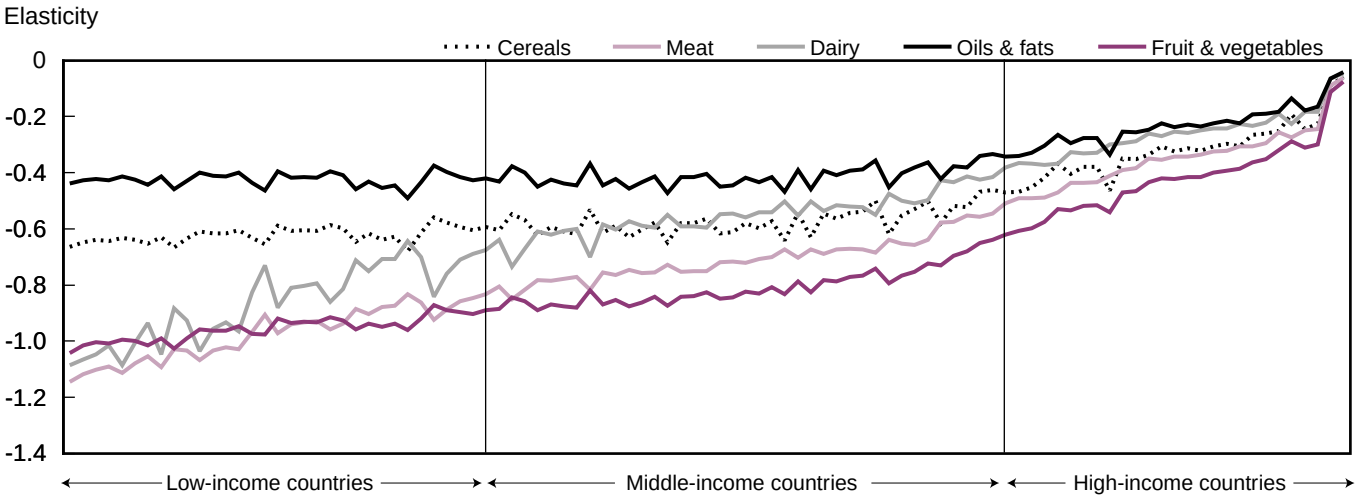
Figure B-4 presents own-price elasticities for the five food subgroups. As shown in the figures, poorer countries are more responsive to food-price changes than wealthier countries. Low- and middle-income countries exhibit similar responses to price changes for staples such as cereals and fats and oils. It is possible that for the lowest income group of countries, price changes may result in substitutions among food within a particular group. For example, when the price of rice increases, poorer consumers may choose to consume corn or sorghum rather than move to a different group such as meat and dairy. Consumers with greater disposable income, on the other hand, may choose to substitute products outside the cereal group. However, for higher value food sub-categories such as meat, dairy, and fruit and vegetables, price change responsiveness directly increases as countries get poorer.

### *Cereal Price Changes Inversely Affect the Demand for Fruit and Vegetables*

Cross-price effects within food consumption subgroups are explored considering the case of cereal price changes. Figure B-5 provides the changes in

Figure B-4

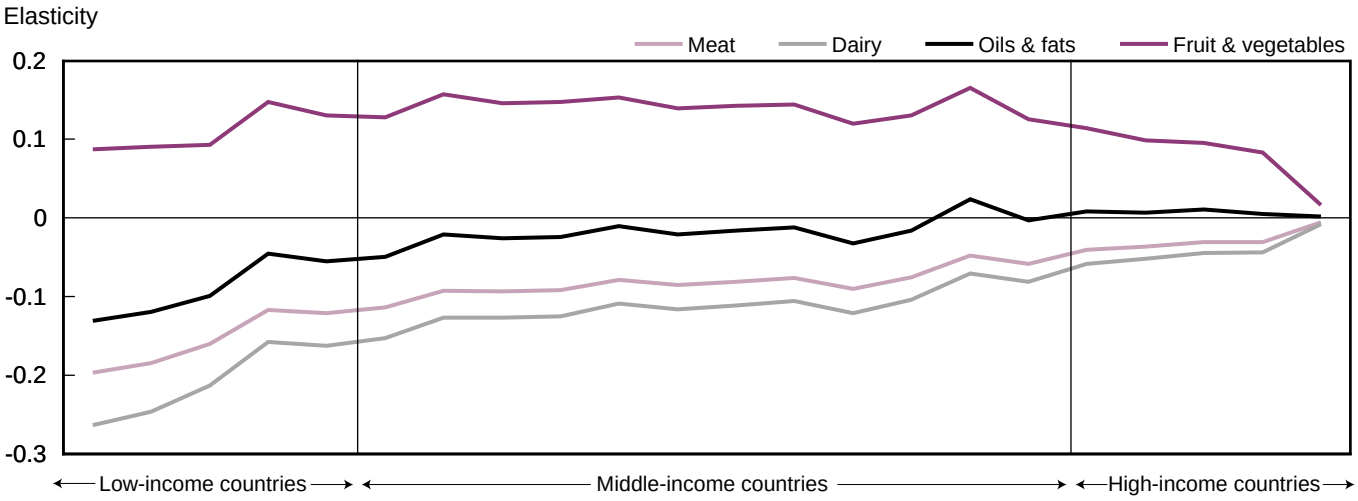
**Own-price elasticity for food groups**




Source: ERS/USDA estimates based on 1996 International Comparison Project data.

Figure B-5

**Cross-price elasticities for cereal**




Source: ERS/USDA estimates based on 1996 International Comparison Project data.

demand for meat, dairy, fats and oils, and fruit and vegetables for changes in cereal prices. Fruit and vegetables are substitutes for cereals in all countries, while meat, dairy, and fats and oils are generally complements. As with other elasticities, poorer countries are more price-responsive than wealthier countries, and the dispersion of cross-price elasticities between the food sub-groups greatly increases as the per capita income of a country declines. Cereal cross-price elasticities for the United States range from .0017 for fruit and vegetables to -.008 for meat, while for Tanzania, the range is from .087 for fruit and vegetables to -.26 for dairy.

## Conclusion

This paper provides further evidence that both the budget share allocated to food, as well as the income elasticity of food decline as income increases. Low-income countries spend a greater portion of their budget on necessities such as food, while richer countries spend a greater proportion of their income on luxuries, such as recreation. Low-value staples, such as cereals, account for a larger share of the food budget in poorer countries, while high-value food items such as dairy and meat are a larger share of the food budget in richer countries.

Low-income countries are also more responsive to income and food price changes, and therefore, make larger adjustments to their food consumption pattern with changes in incomes and prices. However, our study illustrates that adjustments to price and income changes are not made uniformly across all food categories. Staple food consumption changes the least, while greater changes are made to higher value food items such as dairy and meat. In fact, our results indicate that price changes of staple food such as cereals lead to similar responses in low- and middle-income countries, indicating that consumers in poorer countries may resort to greater substitutions within a food sub-category.

This paper also suggests that per capita income changes in developing countries are often correlated with urbanization, which in turn affects food consumption patterns. The effect of urbanization on food consumption will be discussed in more detail in the following chapter.

## References


Cranfield, John A.L., Thomas W. Hertel, James E. Eales, and Paul V. Preckel. "Changes in the Structure of Global Food Demand," *American Journal of Agricultural Economics*, Vol. 80, Number 5, 1998, pp. 1042-1050.

Deaton, Angus, and John Muellbauer. "Economics and Consumer Behavior," Cambridge University Press, 1984.

Deepak, M.S., Shahla Shapouri, and James L. Seale, Jr. "Food Access and Differential Demand for Food in Brazil," Paper presented at the Annual Meeting of the Northeastern Agricultural Resource Economics Association, Rhode Island, June 11-13, 2000.

Meade, Birgit and Stacy Rosen. "The Influence of Income on Global Food Spending," *Agricultural Outlook*, USDA/ERS, July 1997.

Pinstrup-Andersen, Per, Rajul Pandya-Lorch, and Mark W. Rosegrant. "World Food Prospects: Critical Issues for the Early Twenty-First Century," Food Policy Report, International Food Policy Research Institute, Washington, D.C., October 1999.

The World Bank. "World Development Indicators," CD-ROM data, 2000.

The World Bank. "Purchasing Power of Currencies: Comparing National Incomes Using ICP Data," Socio-Economic Data Division, International Economics Department, 1993.

Theil, Henri, Ching-Fan, Chung and James L. Seale, Jr. *International Evidence on Consumption Patterns*, Greenwich, CT: JAI Press Inc., 1989.