Chapter 8

# Role of National Income and Prices

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*While health concerns are important in affecting food choice decisions, food prices and consumer income are also important determinants of food choices, with potential consequences for nutrient availability. This study describes how a price or income change affects the availability of a nutrient of particular interest, as well as the simultaneous effects on the availability of other nutrients also.*

## Introduction

Concerned about their nutritional and health status, Americans appear to be trending toward more healthful diets, as measured by increased consumption of low-fat and nonfat foods and leaner cuts of meat. But a considerable gap still exists between public health recommendations and nutrient intakes (see chapters 3-6). According to the *Third Report on Nutrition Monitoring in the United States* (FASEB, 1995), consumption of a number of nutrients and food components remains a public health issue because of either excessive intake levels—such as for total fat, saturated fatty acids, and cholesterol—or intake level shortfalls, as is the case for calcium and iron.

For the past several decades, Federal nutrition education efforts in the United States have focused on providing consumers with information to help them make healthful food choices. While health concerns are important, economic factors such as food prices and consumer income are also important determinants of food choices, with potential consequences for nutrient availability. For example, if the price of beef goes up while the price of chicken remains the same, con-

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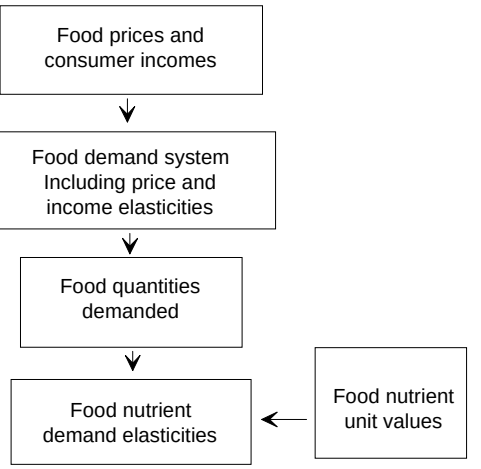
Figure 1
**Measuring food nutrient demand elasticities**




Source: USDA/ERS.

sumers will likely buy less beef and more chicken. Consumption of other foods could also be affected. If consumers buy less beef, such as hamburger meat, they might also buy less cheese and fewer hamburger rolls because of their complementary use in cheeseburgers. But they might buy more coleslaw, to go with the chicken. Because different foods provide different nutritional profiles, changes in the price of any one food or in consumer income are likely to translate into changes in the overall food basket that is purchased, thereby affecting the quantities of nutrients available and the nutritional quality of consumer diets.

Given the demand structure for foods and the bundle of nutrient attributes in each food product, one can derive the implied relationship between the overall availability of nutrients and changes in food prices and income. A change in the price of any one particular food group or in per capita income will affect the quantities demanded of all foods, and thus change the total level of nutrients available for consumption (fig. 1). Therefore, nutrient responses can be measured by directly incorporating all own- and cross-price and income effects of a complete food demand system into the measurement.

This chapter describes how changes in the price of food or in personal income affect nutrient quantities. The results are drawn from a larger research project that estimates the net change in 28 selected nutrients from among 35 food categories in response to changes in food prices and per capita income (Huang, 1997). That study provides a methodology for determining how a price or income change affects the availability of a particular nutrient, as well as the simultaneous effects on the availability of all other nutrients. These estimated price and income effects help food policy decisionmakers understand what changes occur in the amount of nutrients available and how these changes—including unanticipated changes—affect the overall nutritional quality of the diet.

## Food Consumption and Nutrient Values

Average per capita food consumption data for 1989-93 are obtained from the Economic Research Service's food disappearance series (Putnam and Allshouse, 1994). The disappearance data represent the quantities of food supplies moving through the U.S. marketing channels. The foods are reported mostly in their raw commodity form, such as wheat flour or meats in retail-weight equivalent, rather than as finished food products, such as baked goods, ground round, or roasted chicken. The data measure average food consumption at the aggregate level, rather than at the individual or household level. For this study, annual estimates are divided by 365 days to obtain average daily per capita consumption levels and daily per capita nutrient changes in response to a change in a particular food price or in per capita income. Information on nutrient values is from the updated version of *USDA's Agricultural Handbook No. 8*, containing data on the nutrient content of 5,635 food items (USDA, 1996).

This study analyzes 12 nutrients. Food energy is measured in kilocalories (commonly referred to simply as calories); protein, fat and saturated fat, and dietary fiber are measured in grams; vitamin A is measured in retinol equivalents, vitamin E in alpha-tocopherol equivalents, folate in micrograms, and all other nutrients in milligrams. All foods are classified into one of seven food groups: (1) the grain group, which includes wheat flour and rice; (2) the vegetable group, which includes potatoes and fresh and processed vegetables; (3) the fruit group, which includes fresh and processed fruits and fruit juice; (4) the dairy group, which includes milk, evaporated and dry milk,

**Table 1—Nutrient shares, by food group, 1989-93**

| Nutrient | Grain | Vegetables | Fruit | Dairy | Meat | Fats | Sweet-eners |
|---|---|---|---|---|---|---|---|
| | | | *Percent of total* | | | | |
| Energy | 25.22 | 2.74 | 2.53 | 13.67 | 21.52 | 22.88 | 11.44 |
| Protein | 22.87 | 3.18 | 0.89 | 25.45 | 47.48 | 0.12 | 0.01 |
| Total fat | 1.28 | 0.23 | 0.18 | 14.36 | 33.33 | 50.63 | 0.00 |
| Saturated fat | 0.65 | 0.11 | 0.11 | 27.28 | 35.22 | 36.64 | 0.00 |
| Cholesterol | 0.00 | 0.00 | 0.00 | 20.35 | 74.90 | 4.75 | 0.00 |
| Dietary fiber | 51.42 | 30.73 | 15.76 | 0.00 | 2.09 | 0.00 | 0.00 |
| Calcium | 3.60 | 5.01 | 1.57 | 84.08 | 5.15 | 0.38 | 0.21 |
| Iron | 62.42 | 9.15 | 1.66 | 3.12 | 23.05 | 0.06 | 0.54 |
| Vitamin A | 0.00 | 36.89 | 1.31 | 31.32 | 13.53 | 16.94 | 0.00 |
| Vitamin C | 0.00 | 45.82 | 46.51 | 5.76 | 1.89 | 0.02 | 0.00 |
| Folate | 26.95 | 21.56 | 16.97 | 14.70 | 19.69 | 0.13 | 0.01 |
| Vitamin E | 0.95 | 3.63 | 1.86 | 2.74 | 7.71 | 83.11 | 0.00 |

Note: Food groups are grain (wheat flour and rice), vegetable (fresh and processed vegetables, including potatoes), fruit (fresh and processed fruits), dairy (milk, cheese, and frozen dairy products), meat (meat, poultry, fish, eggs, dry beans, and nuts), fats (added fats and oils), and sweeteners (added sugars and corn sweeteners).
Source: USDA/ERS.

cheese, and frozen dairy products; (5) the meats group, which includes red meats, poultry, fish, eggs, dry beans, and nuts; (6) the added fats group, which includes butter, margarine, lard, and salad and cooking oils; and (7) the added sweeteners group, which includes all added sugars and corn sweeteners.

Nutrient values are applied to the quantities of food to compute the share each food group contributes to each nutrient's total. (Estimates in table 1 may differ from numbers in Putnam and Allshouse (1994) because of differences in the food groupings. For example, their meat group includes only meat, poultry, and fish, and not eggs, dry beans, and nuts, as in this study.) No single food group can provide all the nutrients and other food components that people need. Energy is provided mainly by the grain, meats, and added fats groups, with each group contributing slightly less than a quarter of the total energy available. Major sources of protein are the meats group (48 percent), and the dairy and the grain groups (about 25 percent each). Total fat comes mostly from the added fats group (51 percent) and the meats group (33 percent), with the meats group providing 35 percent of total saturated fat and most of the cholesterol (75 percent).

Over half of the dietary fiber comes from the grain group, with an additional 46 percent provided by the vegetable and the fruit groups. Major sources of vitamin A are the vegetable group (37 percent), and the dairy group (31 percent), while the fruit and vegetable groups contribute 92 percent of total vitamin C. The largest share of folate (a B-vitamin) comes from the grain group, although the vegetable, fruit, dairy, and meats groups also contribute considerable amounts. Vitamin E comes mainly from the added fats group (83 percent), while the dairy group is the major source of calcium, contributing 84 percent of the total. The grain and the meats groups contribute about 62 percent and 23 percent of iron, respectively.

These estimates are based on the food groups in their raw commodity form rather than as final food products. For example, the grain group is naturally low in fat, and, in its raw commodity form, provides less than 2 percent of the total fat available for consumption at this aggregate level. Nutrient shares would be considerably different at the consumer level, since preparation methods that incorporate added fats may result in a high fat content for many grain products, such as baked goods. However, because the demand analysis is based on food disappearance data, which measure average per capita consumption of foods in their commodity form, nutrient values must also be based on food groups in their commodity form.

## Food Prices and Income Affect Nutrients Consumed

Given the nutrient shares of individual food categories and a complete set of own- and cross-price and income elasticities obtained from Huang (1993), the nutrient responses to price and income changes can be measured by following the procedure developed in Huang (1996). Under that procedure, the nutrient responses to a price change for any particular food group can be estimated as the weighted average of all own- and cross-price elasticities, with each weight expressed as the nutrient share for each food group. Similarly, the nutrient responses to income can be estimated as the weighted average of all income elasticities, with each weight again expressed as the nutrient share for each food group. These estimated nutrient responses for individual food categories are then summed to obtain the total group price effect on nutrients.

**Table 2—Changes in nutrient availability in response to a 10-percent decrease in food price or a 1-percent increase in income**

| Nutrient | Grain | Vegetables | Fruit | Dairy | Meat | Fats | Sweeteners | Income |
|---|---|---|---|---|---|---|---|---|
| | | | | *Percent change* | | | | |
| Energy | 0.22 | 0.18 | 0.50 | 0.16 | 0.52 | 0.34 | 0.25 | 0.26 |
| Protein | 0.25 | 0.01 | 0.35 | 0.69 | 1.82 | -0.04 | 0.21 | 0.27 |
| Total fat | 0.24 | 0.30 | 0.53 | 0.03 | 0.34 | 0.70 | 0.28 | 0.37 |
| Sat. fat | 0.27 | 0.20 | 0.50 | 0.55 | 0.88 | 0.71 | 0.23 | 0.38 |
| Cholest. | 0.40 | -0.13 | 0.24 | 0.20 | 1.46 | 0.17 | -0.08 | 0.31 |
| Diet. fiber | 0.13 | 0.59 | 1.10 | -0.38 | 1.31 | 0.13 | 0.20 | 0.21 |
| Calcium | 0.08 | -0.03 | 0.86 | 2.60 | 0.95 | -0.02 | 0.47 | 0.32 |
| Iron | 0.33 | 0.27 | 0.33 | -0.24 | 1.89 | -0.02 | 0.24 | 0.21 |
| Vitamin A | 1.10 | -0.65 | 0.66 | -2.32 | -0.26 | 0.30 | 0.63 | 0.35 |
| Vitamin C | -0.59 | 1.49 | 4.57 | -0.13 | 2.31 | -0.39 | -0.04 | 0.35 |
| Folate | 0.07 | 0.44 | 1.44 | -0.11 | 1.42 | -0.24 | 0.14 | 0.26 |
| Vitamin E | 0.22 | 0.71 | 0.94 | -0.56 | -1.47 | 1.12 | 0.47 | 0.38 |

See table 1 for definition of food groups.
Source: USDA/ERS.

Table 2 shows the percentage change in the availability of 12 nutrients in response to a 10-percent decrease in the price of any one food group (holding the prices of other food groups constant) or to a 1-percent increase in consumer income. All the prices of food commodities within a food group are assumed to change at the same rate as the group price. A 10-percent decrease in the price of the meat group would increase daily per capita availability of protein by 1.82 percent, saturated fat by 0.88 percent, cholesterol by 1.46 percent, and iron by 1.89 percent. Although the meat group contributes little to the total availability of fiber, calcium, or vitamin C, a 10-percent price reduction for this group would increase availability of fiber by 1.31 percent, of calcium by 0.95 percent, and of vitamin C by 2.31 percent. At the same time, it would reduce availability of vitamin E. This is because a reduction in the price of the meat group is associated with increased consumption of foods from the grains, vegetables, and fruit groups, which would explain the higher availability of fiber, calcium, and vitamin C. These results highlight the interdependence among the different food groups through cross-price effects.

Table 3 translates the percentage changes in table 2 into quantity changes per capita per day. A 10-percent decrease in the price of the meat group would increase availability of energy by 15.6 calories, total fat by 0.52 gram, saturated fat by 0.44 gram, cholesterol by 5.75 mil-

**Table 3—Changes in daily per capita nutrient availability in response to a 10-percent decrease in food price or a 1-percent increase in income**

| Nutrient | Daily Value[1] | Grain | Vege-tables | Fruit | Dairy | Meat | Fats | Sweet-eners | Income |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | *Quantity change* | | | | |
| Energy (cal.) | 2,000 | 6.65 | 5.37 | 14.95 | 4.87 | 15.61 | 10.19 | 7.59 | 7.82 |
| Protein (grams) | 50 | 0.23 | 0.01 | 0.32 | 0.63 | 1.66 | -0.03 | 0.19 | 0.24 |
| Total fat (grams) | 65 | 0.37 | 0.46 | 0.80 | 0.05 | 0.52 | 1.08 | 0.42 | 0.57 |
| Sat. fat (grams) | 20 | 0.13 | 0.10 | 0.25 | 0.28 | 0.44 | 0.36 | 0.12 | 0.19 |
| Cholesterol (mg) | 300 | 1.57 | -0.52 | 0.94 | 0.80 | 5.75 | 0.68 | -0.32 | 1.24 |
| Diet. fiber (g) | 25 | 0.01 | 0.06 | 0.11 | -0.04 | 0.14 | 0.01 | 0.02 | 0.02 |
| Calcium (mg) | 1,000 | 0.75 | -0.26 | 8.09 | 24.39 | 8.89 | -0.21 | 4.39 | 2.97 |
| Iron (mg) | 18 | 0.05 | 0.04 | 0.05 | -0.03 | 0.27 | -0.00 | 0.03 | 0.03 |
| Vit. A (RE)[2] | 1,500 | 9.52 | -5.62 | 5.67 | -20.07 | - 2.24 | 2.60 | 5.43 | 3.06 |
| Vit. C (mg) | 60 | -0.40 | 1.01 | 3.11 | -0.09 | 1.58 | -0.26 | -0.03 | 0.24 |
| Folate (mcg)[2] | 400 | 0.13 | 0.83 | 2.69 | -0.20 | 2.65 | -0.44 | 0.26 | 0.49 |
| Vit. E (ATE)[2] | 20 | 0.03 | 0.11 | 0.15 | -0.09 | -0.23 | 0.18 | 0.08 | 0.06 |

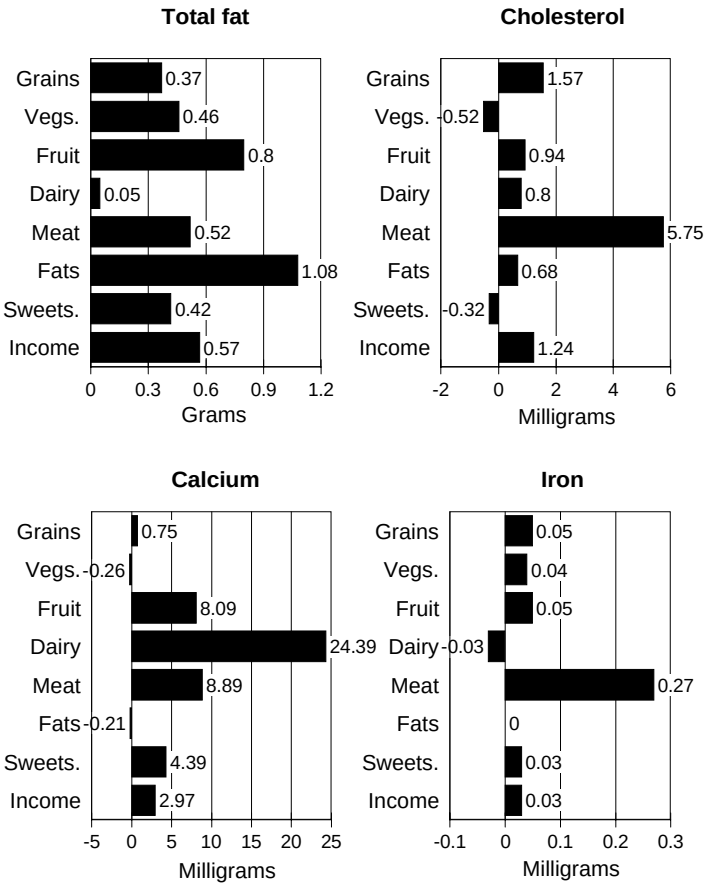
[1] Established by the Food and Drug Administration for nutrition labeling purposes, based on 2,000 calories a day, for adults and children over 4 (Kurtzweil, 1993).
[2] RE = retinol equivalents; mcg = micrograms; ATE = alpha-tocopherol equivalents. See table 1 for definition of food groups.
Source: USDA/ERS.

ligrams, calcium by 8.89 milligrams, vitamin C by 1.58 milligrams, and folate by 2.65 micrograms. This same price decrease would also reduce daily per capita availability of vitamin A by 2.24 retinol equivalents, and of vitamin E by 0.23 alpha-tocopherol equivalent.

A comparison of the nutrient quantity changes with FDA's Daily Values (DV) used on nutrition labels shows that the nutrient quantity changes are small, and therefore not likely to be of nutritional significance. However, the results again highlight the interdependence among the different food groups through cross-price effects. For example, although the meats group contributes very little to total dietary fiber (about 2 percent), a 10-percent decrease in the price of the meats group has a much larger effect on the overall availability of dietary fiber than does a 10-percent decrease in the price of the grain group (which contributes over half of the total dietary fiber available).

Figure 2

**Selected nutrient responses, by food group, per capita per day (effects of a 10-percent price decrease and 1-percent income increase)**




Source: USDA/ERS.

Figure 2 demonstrates the complexity of the effect of an income or price change on overall diet quality for four selected nutrients (total fat, cholesterol, calcium, and iron). For example, whereas a 10-percent price cut for the meat group would increase the levels of calcium and iron—a nutritional improvement, given that these components are consumed in insufficient amounts— it would also increase the levels of total fat and cholesterol, two components currently con-

sumed in excess. Lower prices for the dairy and the fruits group would increase consumers' calcium intakes, but also increase availability of total fats. Increased consumer income would increase consumption of nutrients currently consumed in low amounts, such as calcium and iron, but it would also increase the consumption of other nutrients—such as fat, saturated fats, and cholesterol—which are already consumed in excessive amounts.

Proponents of price manipulation as a means of influencing consumption levels of particular foods or nutrients (such as subsidizing fruits and vegetables to increase their consumption, or taxing fats to reduce their consumption) should be aware of the interdependent nature of food choices and the ramifications for different nutrients. For example, a price decrease for fruits or vegetables, while encouraging their consumption, would also increase availability of total fat. A price decrease for vegetables would also trigger an unanticipated reduction in overall availability of vitamin A. Although the magnitudes of these changes are relatively small, it is possible that they could exacerbate existing nutritional problems if carried out over prolonged periods of time.

## Conclusion

Consumers respond to changes in food prices and income by adjusting their food choices to maximize their satisfaction. The adjusted food choices are then translated into changes in nutrient levels. This study applies a new research model developed by Huang (1996) to measure how economic factors influence aggregate nutrient availability. This model incorporates existing interdependent demand relationships among foods, including own- and cross-price effects, into the measurement of aggregate nutrient responses. The empirical results show that changes in the availability of all nutrients vary depending on how food price and income changes manifest themselves through the food demand relationships.

Thus, these nutrient response estimates provide useful information for studying possible food program effects on the overall availability of nutrients. One way to accomplish this task would be to simulate alternative food policy scenarios and explore the effects of the resulting changes in food prices or income on the amounts of foods and nutrients that are available for consumption. For example, the esti-

mates of nutrient income responses can be a starting point in evaluating possible effects of income changes on dietary quality when the benefits of food stamp recipients are cut or increased.

The estimates in this study represent an average person's nutrient response, and adjustments will be needed to reflect differences in behavior across different population groups. Adjustments would also be needed when studying food stamp benefits since food spending from food stamps may be different than food spending from money income.

These nutrient responses were estimated at the aggregate level, based on foods in their commodity forms, and may not reflect the nutrient responses that would occur at the consumer level. The food disappearance data commonly used by demand analysts are unable to take into account food preparation methods, which can heavily influence the final nutrient content of foods. For example, whether the chicken is fried or roasted, and whether the skin is eaten, considerably affects the final nutritional characteristics of the chicken consumed. Similarly, although grain products are naturally low in fat, preparation methods that incorporate added fats result in a high fat content for many grain products, such as baked goods. Finally, the food disappearance data are slow in measuring and reflecting changes in the nutrient composition of the commodities themselves—such as meats that are leaner and cheeses that are lower in fat—and therefore may not accurately reflect the current nutrient contribution of each food group to each nutrient's total.

To develop a consumer-based comprehensive food demand and nutrition study, further collaborative research between economists and nutritionists is needed to improve the availability of data on prices, quantities, and nutritional profiles for final food products.

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