Economic Equity and the Food Stamp Program

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Working Paper 88-WP 30
June 1988

Contents

Figures

Tables

Abstract

The Thrifty Food Plan (TFP) is used to estimate the household food cost used for determining benefits for participants in the food stamp program. Dietary norms and requirements for macro and micronutrients are reflected in the TFP. Because the TFP is important in calculating benefit levels for FSP participants, it has received broad attention in policy debate. The present analysis shows that household food costs quite similar to those from the TFP can be calculated directly from available USDA Nationwide Food Consumption Survey data. The method developed and applied is simpler and more specialized to household by size and composition than the TFP. Also, it does not use dietary requirements. The new approach has a sound foundation in economics and could result in a more equitable distribution of food stamp program benefits.

Introduction

The food stamp program (FSP) has become the primary instrument of U.S. federal food assistance policy. In 1985, there were about 19.9 million FSP participants. Approximately $10.7 billion in bonus stamps were issued to these participants, an average of about $45.00 per person per month (Table 1). The primary objective of the FSP is to supplement the food budgets of households with deficient diets. Eligibility for the FSP and the bonus are determined by using household income, proxies for wealth, size, and other special conditions to target households at diet risk. Presently, the bonus is in food stamps, which have a face monetary value but are restricted in circulation.

Since January 1, 1976 (Federal Register 1976), the household food requirements and food stamp allotments have been calculated using a Thrifty Food Plan (TFP). The TFP prescribes a diet and food cost for a standard four-person household consisting of two adults (one male and one female) and two children. Allotments or food requirements for households of other sizes are computed by adjusting the estimate for the standard household. Adjustments to the standard household allotment are based on a hypothesis of economies of size in food consumption.

Generally, the FSP has been successful in ensuring the nutritional status of target households (Basiotis et al. 1987). But there continues to be debate about the TFP and the household size adjustment as appropriate norms for food cost (Blaylock and Smallwood 1986; Senauer and Young 1986).[1] In part, this criticism has come from economists, who argue that the basis for estimating these major FSP parameters can be improved. Only prices of foods that occupy important budget shares in the TFP are reflected in the updating of the allotment. Cross price effects between food and nonfood, for example, are omitted. And the allotment level and adjustments

are not developed to assure a comparable standard of living among participating households (Brown and Johnson 1983, 1984).

The paper develops an alternative to the TFP for determining FSP benefits. Using Engel curves and standard scaling and translating methods economically, more sound calculations of FSP benefits are made. These benefits calculations are compared to the TFP-based benefits that incorporate dietary objectives. As might be expected, based on a broad assumption of economic rationality for this federal food assistance program, the two benefits calculations are similar. In fact, the major differences are for budget shares by food group, reflecting the bias to low-cost but nutritious diets in the TFP.

Current FSP Methods

The TFP is the least costly of four family food plans developed by the Human Nutrition Information Service (HNIS) of the United States Department of Agriculture (USDA). Originally published in 1975, the TFP was revised in 1983 to incorporate new information on household food consumption, prices, nutrient composition of foods, the food supply, and human nutritional requirements (Peterkin et al. 1975, 1983; Rizek 1981; Rudd 1981).

Allotment

The TFP specifies the quantities of 31 food groups required for nutritious diets of household members. The quantities of the foods are estimated, by group, for individuals in 11 age-sex categories. The TFP for a household is constructed by totaling the quantities of foods by group for the members, categorized by age and sex. Then, using food prices specified externally, the quantities are converted to required values for household food budgets (Peterkin et al. 1983).

Major inputs to the development of the TFP are nutrition requirements; that is, the Recommended Dietary Allowances (RDA) and food consumption patterns estimated from the Nationwide

Food Consumption Survey (NFCS) for 1977-78. The procedure for calculating the TFP is constrained so that it does not substantially distort "usual" consumption patterns. Specifically, a quadratic programming model is used to select quantities from the 31 food groups that minimize a weighted sum of squared percentage deviations (from observed average consumption levels) for a standard household. Dietary standards and the total cost of the plan are imposed as restrictions in the quadratic programming problem. Figure 1 compares the TFP to the observed average consumption levels of four-person households from the 1977-78 NFCS.

The TFP cost originally was estimated using average U.S. prices paid, by household, for more than 2,400 food items in the 1977-78 NFCS. The TFP cost is updated monthly using price indices provided by the Bureau of Labor Statistics (BLS). The updated TFP costs, or allotments, for four-person households are released by the USDA News Service.[2] Table 2 shows, as an illustration, the TFP cost for food at home, on weekly and monthly bases, for individuals in four-person households during June of 1982.

Household Size and Composition

The monthly TFP cost for a standard four-person household (a couple 20-50 years each and two children, one 6-8 and one 9-11 years) is the FSP allotment of all four-person households. The monthly allotment for four-person households during June 1982 was $255.80 ($53.00 + $62.90 + $73.30 + $66.60). The allotment, or food cost estimate, for households of other sizes is calculated as

$$A_N = N(A_4/4)(1 + Q),$$

where A_N is the allotment for a household of size N; A_4 is the allotment for the standard household; and Q is an economy-of-size factor. Specifically, Q takes the value 0.20 for one-person households, 0.10 for two-person households, 0.05 for three-person households, -0.05 for five- or six-person households, and -0.10 for households of seven or more (Peterkin et al. 1983). In June 1982, monthly allotment levels

for households with one to eight people were $77, $141, $202, $256, $304, $365, $403, and $461, respectively. The value of the bonus in food stamps can be roughly approximated as the difference between the allotment and one-third the monthly income, as estimated by FSP rules (Brown and Johnson 1983, 1984).

Issues

The method for determining FSP benefits has been criticized for a number of reasons. Standard households represent only a small fraction of all households participating in the FSP (for example, in 1978, only 2.5 percent). Linear interpolation of the TFP cost for the standard household to households of other sizes and compositions may result in over- or understatements of food requirements. Changes in household composition, using the present rules for establishing the allotment, produce estimated food costs that are difficult to reconcile. For instance, consider the following calculations, based on the TFP requirement specifications in Table 2.

Household A	TFP Cost	Household B	TFP Cost
Male, 20-50 yrs	$ 73.30	Male, 20-50 yrs	$ 73.30
Female, 20-50 yrs	66.60	Female, 20-50 yrs	66.60
Child, 1-2 yrs	40.20	Male, 12-14 yrs	66.30
Child, 3-5 yrs	43.30	Male, 15-19 yrs	69.10
Total Cost/Allotment	$223.40	Total Cost/Allotment	$275.30

Working from the standard allotment for four-person households of $256, the application of current rules results in a TFP that is more generous to household A than to household B. Also, the TFP-based allotments do not reflect changes in nonfood prices. During periods when nonfood prices rise more rapidly (more slowly) than food prices, participating households will realize lower (higher) real program benefits, changing their living standards (Brown and Johnson 1983).

An Alternative to the TFP

Recall that the FSP allotment is the maximum benefit (bonus) available to eligible households. Alternatively, the allotment can be viewed as the implied requirement, or cost, of food by any household of a given size, that has an income just above the FSP-eligible level. This marginal household is ineligible for FSP participation because it can afford to, or is estimated to spend, an amount on food at least as large as the allotment. Participating households of the same size, with incomes lower than the marginal household, are provided stamps (at a value of less than the allotment) to permit food expenditures equal to those of the marginal households.

Assuming that households have identical preferences, the food expenditure for the marginal household automatically provides an estimate of the allotment level for all households of the same size and composition. The bonus for any other household of the same size, but with lower income, is the difference between what it is estimated to spend on food and the food expenditure of the marginal household. Assuming that households face the same prices, an Engel curve estimate linking food expenditures to household income can be used for these calculations.

The process of computing the bonus using the Engel relationship is illustrated in Figure 2. The marginal household with an income level of y^* consumes x^* of food and with expenditure $p_x x^*$. This expenditure level defines the allotment. Another household of the same size with income y^0 consumes x^0 of food and with expenditure $p_x x^0$. The difference $p_x(x^* - x^0)$ is the estimated bonus. Panel D in Figure 2 illustrates the familiar Engel curve. If the bonus were completely fungible and both food and nonfood were normal goods, the participating household would consume food at less than x^*. That is, if the household were to actually consume x^* of food, it still would not reach the utility level of the "marginal" household.

Specific Scales

Despite being the same size, households may differ by age-sex composition. Of course, the age-sex composition of households affects food consumption and cost in different ways. Therefore, more accurate calculation of the FSP parameters requires estimation of Engel functions by specific food category, with household income and composition as arguments. These food-group-specific estimates of Engel curves adapted to age-sex composition of households are termed commodity specific scales (Prais and Houthakker 1955; Muellbauer 1975).

For the estimated specific scales used in calculating food stamp benefits, a semi-logarithmic Engel specification was employed that related household costs for selected food groups to household income,

$$c_i = m_i [a_i + b_i \, Ln \, \frac{(y)}{m_o}], \qquad (1)$$

with c_i the weekly household expenditure on the i^{th} food group ($i = 1,2,\ldots,I$); y the weekly household income; m_i a household size and composition parameter, specific to the i^{th} food group (the commodity specific scale); and m_o the household size and composition parameter, specific to household income (the income scale).

The simple specification for m was hypothesized as

$$m_i = \sum_{g=1}^{G} w_{ig} \, n_g, \qquad (2)$$

with w_{ig} the weight of an individual in the g^{th} age-sex class ($g = 1,2,\ldots,G$), measured on a scale appropriate to the i^{th} food group; and n_g the number of household members in the g^{th} age-sex class, adjusted for meals eaten away from home.[3] If the estimate for the male adult is set to unity, m_i can be

interpreted as the number of equivalent male adults in the household, measured using the scale appropriate to the i^{th} food group.

Size Economies

Equation 2 does not admit economies of size in food consumption. To investigate this possibility, an alternative specification for m_i was used. Specifically, the weights (w_{ig}'s) were treated as variational parameters depending linearly on total (by count) household size (Brown and Johnson 1984),

$$w_{ig} = w^{o}_{ig} + w^{1}_{ig} N. \qquad (3)$$

A negative value for w^{1}_{ig} indicated that the associated weights decreased in magnitude as household size increased. Notice also that the reference age-sex class is not now simply the adult male, but the adult male in a household of a specific size. Two persons in the same age-sex class will have the same weight only if they are members of households of the same size.

Estimation of Engel relationships with specific income scales involves a well-known identification problem (Muellbauer 1975). This problem can be resolved by either the use of time series/cross section data and the associated price variation, or the introduction of prior information (Muellbauer 1975). In this study, the identification problem was resolved by assuming an income scale (m_o) equal to the household size (N). This method of dealing with the problem is identical to that employed by Prais and Houthakker (1955). Other methods require significant extensions of the model structure (for example, Chavas and Gitzler 1987).

Data Description

Data for the analysis were from the 1977-78 Nationwide Food Consumption Survey (NFCS). The survey collected

information on food consumption and other features of households, such as education, size, income, and race (Rizek 1978). Food disappearance was measured from home food supplies for seven days. Recorded costs included purchases of food used by the household and an imputed value for home-produced food or food received as a gift or payment. The value of nonpurchased food was estimated using average per unit prices paid by other households in the same region (Rizek 1978).

Food items reported as consumed by the households were aggregated into 12 food groups (Morgan et al. 1985). These food groups (Table 3) were developed from the 31 groups used by Peterkin et al. (1983) in designing sample, standard diets. Household income was the sum of the FSP bonus, in-kind income (home-produced food, food received as gift or pay), and other income (for example, wages before taxes and other nonwelfare income, excluding the FSP bonus). Household members were classified by six age-sex classes (Table 4). These classes were developed by Brown and Johnson (1983) from the 14 classes for which RDA are specified. Multicollinearity problems in estimation precluded the use of all 14 age-sex classes for which the RDA are available.

Several aspects of data from the 1977-78 survey should be highlighted. First, a recall survey method was used in the 1977-78 NFCS to estimate household food cost. Household food disappearance does not include meals and snacks eaten away from home. For households with members that frequently had meals away from home, such as households with working members and children in school lunch programs, at-home food costs were lower. The correction for meals away from home was made by adjusting the household size (numbers of individuals by age-sex class) for meals not consumed at home, using 21 meals as the total possible per household member (Rizek 1978). Food expenditures were for one week; income, except for in-kind, was for the month prior to the interview. The level of household income was imputed to a weekly basis for the present analysis.

The "basic sample" of the 1977-78 NFCS contained information on 14,930 households. However, nonhousekeeping households, households not reporting income, and households with total food expenditures per week greater than their weekly incomes (a screen for possible reporting errors) were excluded

from the sample data. The resultant sample size was 9,432 households. Descriptive statistics for household food cost, household income, and household size from this reduced, or screened, sample are reported in Table 5.

Estimation and Empirical Findings

Substituting (2) and (3) into (1), respectively, and replacing m_o with household size (N), yields

$$c_i = \sum_{g=1}^{G} \delta_{ig} \left[\eta_g(\lambda_i + L\eta \frac{(y)}{N}\right] \tag{4}$$

and

$$c_i = \sum_{g=1}^{G} \Pi_{ig} \left[\eta_g(\lambda_i + L\eta \frac{(y)}{N}\right] + \sum_{g=1}^{G} \Theta_{ig} \left[\eta_g(\lambda_i + L\eta \frac{(y)}{N})N\right], \tag{5}$$

with $\delta_{ig} = b_i w_{ig}$, $\lambda_i = a_i/b_i$, $\Pi_{ig} = b_i w_{ig}^o$, and $\Theta_{ig} = b_i w_{ig}^1$. These equations, which are nonlinear in λ_i, were estimated using Marquardt's convergence method. This method, which combines the Gauss-Newton and steepest ascent concepts, was used because in preliminary runs it converged faster than did the alternatives.

Results

Results from the estimation of Equations 4 and 5 are reported in Tables 6 and 7, respectively. Note that these regressions do not include the intercept term from the Engel specification (1). Accordingly, the root mean square error (RMSE), instead of the coefficient of determination, is reported as a measure of goodness of fit. From the estimated values of the asymptotic t-ratios, almost all of the coefficients for the 12 food groups in Table 6 were significant at the 5 percent level. Moreover, all signs of the

coefficients were positive for variables indicating presence of members in the age-sex classes . This implies, if other factors are equal, that the addition of a household member in any age-sex class results in higher weekly household cost for all food groups.

Based on the signs of the θ_{ig}'s (Table 7), economies of scale in food consumption existed for most of the age-sex classes. A negative and statistically significant sign indicates that economies of scale in consumption for the corresponding food group existed for the age-sex class. Again, most coefficients were statistically significant at the 5 percent level.

Estimates of Benefits

Models 4 and 5 were used to estimate the FSP allotment for the first half of 1982, using the method described in "An Alternative to the TFP." The FSP income eligibility levels during August 1981 (Table 8) were used for these calculations. Calculated monthly allotments from models 4 and 5, the monthly cost of the TFP in June 1982, and the actual FSP allotments for selected households are reported in Table 9. Note that model 5 resulted in higher allotment levels than model 4 for all households. Also, for several households, models 4 and 5 estimated allotment levels lower than the cost of the TFP and the TFP-based allotment levels. The general observation is, however, that the Engel curve approaches produced results quite similar to those from the TFP.

To examine how the estimated allotment levels were allocated among food groups, monthly budget shares derived from estimated models 4 and 5 were calculated for selected types of households. These budget shares are reported in Tables 10 and 11. Budget shares derived from the TFP parameters for the same types of households are reported in Table 12.

Two major observations are suggested by the shares reported in these tables. First, with few exceptions, the budget shares for all food groups did not vary significantly among the different types of households. That is, the selected households allocated approximately the same portions of their

total food budgets to the 12 food groups, regardless of their composition. Both the budget shares based on the TFP and those estimated from the Engel curve-specific scale models 4 and 5 exhibited this feature.

Second, for all of the selected household types, the budget shares of certain food groups based on the TFP were quite different from the ones based on the Engel curve-specific scale models. For instance, the budget share of high-cost meats (HMT) from the TFP was estimated to be much lower using models 4 and 5. This should have been expected because, as indicated by Figure 1, the TFP intentionally distorts observed average consumption patterns. Clearly, households are exhibiting a very different behavior in their actual food consumption patterns than is prescribed by the TFP, even though total food costs are about the same (Table 9).

Updating of the allotment and bonus levels based on models 4 and 5 can be accomplished in two ways. The most obvious method is to use revised income eligibility levels and recalculate all parameters for the different household types. A second way of updating the FSP parameter estimates is similar to one currently used. Recall that, using models 4 and 5, the bonus (B) is calculated as the difference between the food expenditure level of the marginal household (C*) and the food expenditure level of any other household of the same type but of lower income (C). That is,

$$B = C^* - C.$$

For the food group costs (c_i), this equation becomes

$$B = \left(\sum_{i=1}^{12} C_i^*\right) - \left(\sum_{i=1}^{12} C_i\right) = \sum_{i=1}^{12} (C_i^* - C_i). \qquad (6)$$

From this expression it is clear that the bonus can be directly updated by calculating the differences $C_i^* - C_i$, using BLS indices of food prices.

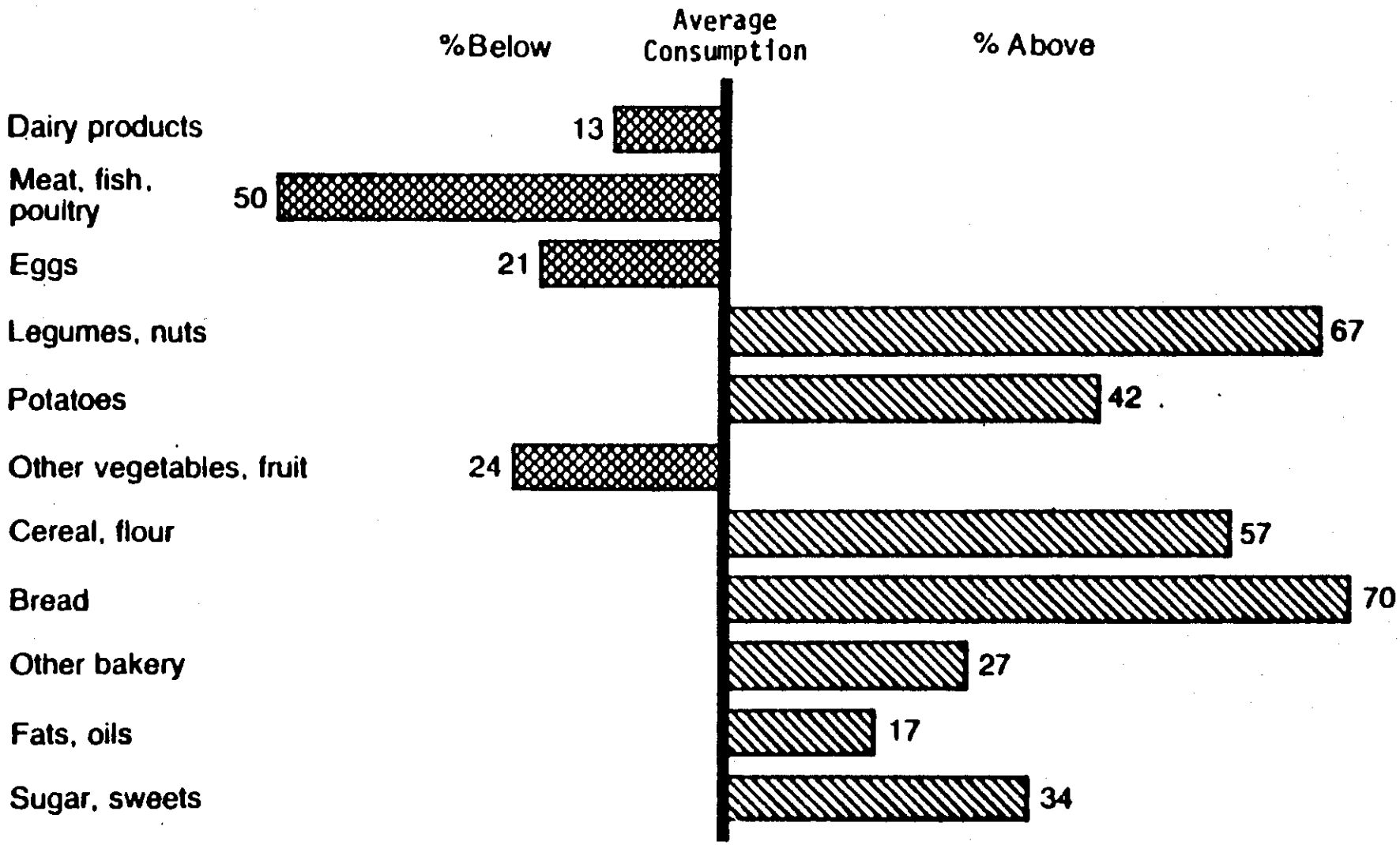
Notice that these two methods of updating the FSP parameters are not equivalent. Consider, for instance, an increase in nonfood prices only. The first method would adjust the FSP parameters upward because of increased income

eligibility levels, while the second method would not change the allotment. In contrast, both methods would adjust the FSP parameters if only food prices increased. However, the second method would be more accurate if, for example, an increase occurred only in meat prices. The impact on the FSP income eligibility levels of an increase only in meat prices probably would be very small.

Conclusion

Using standard concepts from the theory of consumer behavior, a model for determining benefits for FSP eligible households has been developed and applied using data from the 1977-78 NFCS. The method produces estimates of food cost, or allotments, and food stamp bonus that are similar to those obtained currently by using the TFP. Moreover, the estimates by food group with the specific scales suggest that the dietary implications of the alternative estimates are similar to those used for the TFP. The alternative estimators of the two key FSP parameters are easily adjusted to changes in food and nonfood prices. Finally, estimates based on the Engel curve do not require dietary norms and are more easily understood than are the TFP-based estimates.

Despite the simplicity and other advantages of the Engel curve-based method for deriving FSP parameters, caution should be exercised in making comparisons with the TFP. Besides minor "technical" differences such as definitions of food groups and age-sex classifications, the two methods differ greatly in theoretical foundation. The TFP is optimal from a nutritional viewpoint, whereas results based on models 4 and 5 will not necessarily satisfy recommended dietary standards. That the Engel curve-specific scale estimates of food cost may imply diets that do not meet the RDA is itself an interesting finding: it shows that the prescriptions of the TFP are not consistent with household behavior. This observation, together with the advantages of the Engel curve-specific scale methods, suggests a high priority on reevaluating the basis for calculating FSP eligibility and benefits.



Food plan and food consumption for 4-person family
USDA Nationwide Food Consumption Survey, Spring 1977, 48 states

Figure 1. Thrifty Food Plan Compared with Observed Average Food Consumption (Rizek 1981).

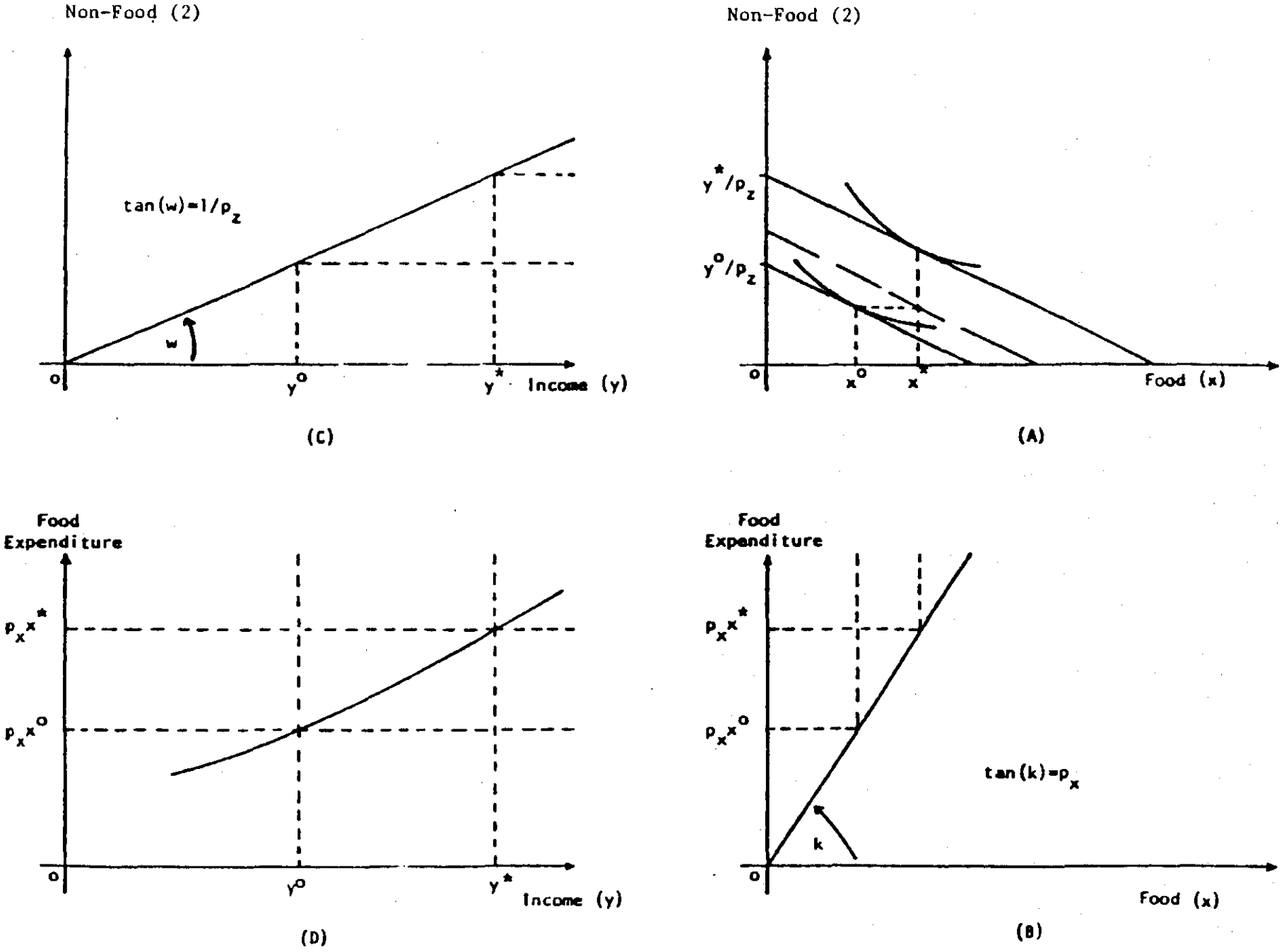


Figure 2. Engle Curves and the Calculation of the Food Stamp Program Allotment.

Table 1. Annual food stamp participation and cost data, 1969 through 1984

Fiscal Year	Average Monthly Number of Participants (in millions)	Value of Bonus (in billions of dollars)	Average Monthly Bonus per Person (in dollars)
1969	2.878	.229	6.63
1970	4.340	.550	10.55
1971	9.368	1.523	13.55
1972	11.109	1.797	13.48
1973	12.166	2.131	14.60
1974	12.862	2.718	17.61
1975	17.064	4.386	21.42
1976	18.549	5.327	23.93
1977	17.077	5.067	24.74
1978	16.001	5.139	26.77
1979	17.653	6.480	30.59
1980	21.071	8.721	34.35
1981	22.431	10.630	39.49
1982[a]	21.717	10.208	39.17
1983	21.625	11.152	42.98
1984	20.854	10.696	42.74
1985[b]	19.902	10.744	44.99

[a]Omits Puerto Rico beginning July 1, 1982, when a Special Nutrition Assistance Program began there.
[b]Estimated.

SOURCE: United States Department of Agriculture, Agricultural Statistics, 1986, Table 689.

Table 2. Weekly and monthly costs of food at home based on the thrifty food plan (TFP), June 1982 U.S. average

	Cost for One Week (dollars)	Cost for One Month (dollars)
Child:		
1-2 years	9.30	40.20
3-5 years	10.00	43.30
6-8 years	12.20	53.00
9-11 years	14.50	62.90
Male:		
12-14 years	15.30	66.30
15-19 years	15.90	69.10
20-50 years	16.90	73.30
51 years and over	15.50	67.40
Female:		
12-19 years	15.30	66.20
20-50 years	15.40	66.60
51 years and over	15.30	66.30

Note: Costs are for members of four-person households.

SOURCE: Peterkin et al. 1983, p. 20.

Table 3. Name, description, and identification of the 12 food groups

Food Group Name	Identification	Description
Vegetables	VG	Potatoes, high-nutrient vegetables, and other vegetables
Fruits	FR	Vitamin C-rich fruits and other fruits
Cereals, rice, pasta	GR	Whole-grain/ high-fiber breakfast cereals, whole grain/high-fiber flour, meal, rice, pasta, and other flour
Bread	BR	Whole-grain/ high-fiber bread and other bread
Cheese, milk	MK	Cheese and converted milk and yogurt
High-cost meats	HMT	High-cost meats and variety meats

Table 3. continued

Food Group Name	Identification	Description
Lower-cost meats	LMT	Bacon, sausage, luncheon meats, fish, shellfish, poultry and lower-cost meats, and variety meats
Eggs, beans, nuts	PT	Converted eggs, dry beans, peas, lentils, nuts, and peanut butter
Mixtures, condiments, bakery products		Mixtures, condiments, and bakery products
Fats, oils	FAT	Fats and oils
Sugar, sweets	SU	Sugar and sweets
Beverages	DR	Soft drinks, punches, -ades, coffee, tea, and alcoholic beverages

Table 4. Household size and composition variables

Variable	Notation	Description
Household size	N	Number of persons in the household
Infants	η_1	Number of household members equal to or less than three years old, adjusted for meals eaten away from home
Children	η_2	Number of household members, 4-10 years old, adjusted for meals eaten away from home
Male teenagers	η_3	Number of male household members, 11-18 years old, adjusted for meals eaten away from home
Male adults	η_4	Number of male household members, 19 years and older, adjusted for meals eaten away from home

Table 4. Continued

Variable	Notation	Description
Female teenagers	η_5	Number of female household members, 11-18 years old, adjusted for meals eaten away from home
Female adults[a]	η_6	Number of female household members, 19 years and older, adjusted for meals eaten away from home

[a]Includes pregnant and/or lactating women less than 19 years old.

Table 5. Descriptive statistics for selected variables, reduced 1977-78 NFCS sample

Variable	Mean Value	Standard Deviation	Sample[a] Size
Expenditure (per week)			
Vegetables	$ 4.78	$ 3.30	9364
Fruits	3.47	3.01	8949
Cereals, rice, pasta	1.98	1.80	9133
Bread	1.52	1.34	9261
Cheese, milk	4.64	3.76	9432
High-cost meats	6.57	5.95	7377
Lower cost meats	9.76	7.69	9338
Eggs, beans, nuts	1.63	1.40	9238
Mixtures, condiments, bakery products	4.18	3.74	9143
Fats, oils	1.41	1.10	9190
Sugar, sweets	1.53	1.82	9006
Beverages	4.84	5.14	9260
Total food expenditure (per week)	44.14	25.11	9432
FSP bonus (per week)	16.42	13.83	768
In-kind income (per week)	5.32	7.97	5809
Other household income (per week)	227.34	136.96	9429
Total household income (per week)	231.88	136.30	9432
Household size	2.94	1.64	9432

[a] Number of households used in computing the descriptive statistics.

Table 6. Semi-logarithmic Engel curves: Estimated coefficients and related statistics for 12 food groups, 1977-78 NFCS

Coefficient	Food Group[a]					
	VG	FR	GR	BR	MK	HMT
δ_1	.13	.25	.02	.04	.46	.26
	(6.96)[b]	(9.54)	(3.00)	(6.83)	(15.12)	(4.95)
δ_2	.20	.23	.03	.08	.31	.43
	(11.71)	(10.86)	(3.08)	(10.53)	(14.70)	(9.34)
δ_3	.29	.29	.04	.13	.51	.71
	(12.45)	(10.77)	(3.08)	(11.38)	(15.98)	(10.77)
δ_4	.40	.33	.02	.11	.37	.90
	(18.98)	(16.52)	(3.25)	(14.05)	(19.43)	(16.77)
δ_5	.28	.25	.03	.10	.36	.51
	(12.14)	(9.96)	(3.06)	(10.74)	(14.29)	(8.78)
δ_6	.49	.44	.03	.10	.33	.78
	(18.60)	(17.03)	(3.18)	(13.11)	(18.02)	(15.33)
λ	.68	-.36	21.97	1.69	.81	-.80
	(2.69)	(-1.69)	(2.67)	(4.01)	(3.29)	(-4.12)
Observations[c]	9364	8949	9133	9261	9432	7377
RMSE[d]	3.00	2.84	1.47	1.16	3.03	5.61

Table 6. Continued

Coefficient	Food Group[a]					
	LMT	PT	MX	FAT	SU	DR
δ_1	.13	.01	.61	.04	.11	.34
	(5.15)[b]	(3.15)	(14.82)	(7.43)	(7.74)	(6.38)
δ_2	.18	.02	.63	.05	.17	.38
	(5.85)	(3.46)	(18.35)	(9.81)	(10.59)	(9.13)
δ_3	.28	.03	.77	.07	.16	.58
	(6.05)	(3.50)	(17.78)	(9.95)	(9.65)	(10.17)
δ_4	.31	.04	.57	.09	.13	.93
	(6.81)	(3.77)	(22.42)	(13.20)	(12.45)	(19.40)
δ_5	.28	.02	.62	.07	.14	.50
	(6.05)	(3.46)	(15.56)	(10.06)	(8.81)	(9.09)
δ_6	.31	.03	.53	.10	.14	.64
	(6.60)	(3.69)	(21.39)	(12.63)	(12.26)	(16.18)
λ	9.33	16.69	-1.45	2.48	-.10	-1.40
	(4.58)	(2.95)	(-16.15)	(4.84)	(-.35)	(-10.44)
Observations[c]	9338	9238	9143	9190	9006	9260
RMSE[d]	6.54	1.25	3.34	.97	1.70	4.96

[a]Estimators are rounded to two places.
[b]Asymptotic t-ratios are in parentheses. Values greater than 1.96 (2.57) indicate that the corresponding coefficient is significant at the 5 percent (1 percent) level.
[c]Number of households included in the analysis.
[d]Root mean square error.

Table 7. Semi-logarithmic Engel curves with size economies: Estimated coefficients and related statistics for 12 food groups, 1977-78 NFCS

Coefficient	Food Group[a]					
	VG	FR	GR	BR	MK	HMT
π_1	.139[b]	.198	.004	.030	.484	.346
	(3.44)	(3.26)	(.52)	(2.23)	(9.09)	(2.59)
π_2	.201	.310	.007	.117	.352	.487
	(6.34)	(6.58)	(.53)	(8.06)	(8.95)	(4.80)
π_3	.280	.136	.009	.119	.396	.463
	(6.99)	(2.48)	(.53)	(7.57)	(8.41)	(3.77)
π_4	.417	.465	.006	.096	.395	.999
	(13.51)	(12.92)	(.53)	(9.71)	(13.99)	(11.96)
π_5	.198	.280	.004	.075	.291	.906
	(5.42)	(5.21)	(.53)	(5.66)	(6.64)	(7.08)
π_6	.516	.513	.006	.098	.393	.745
	(14.40)	(14.72)	(.53)	(10.02)	(15.00)	(11.14)
θ_1	.003	.023	.001	.003	-.001	-.014
	(.30)	(1.70)	(.48)	(.93)	(-.07)	(-.49)
θ_2	.003	-.007	-.001	-.010	-.005	-.009
	(.50)	(-.78)	(-.50)	(-4.63)	(-.65)	(-.45)
θ_3	.005	.044	-.001	-.001	.027	.053
	(.66)	(3.90)	(-.53)	(-.22)	(3.03)	(2.17)
θ_4	-.026	-.049	-.001	.002	-.010	-.069
	(-4.84)	(-5.69)	(-.52)	(.92)	(-1.57)	(-3.84)
θ_5	.018	.007	.001	.004	.019	-.075
	(2.84)	(.73)	(.52)	(1.92)	(2.42)	(-3.48)
θ^6	-.049	-.040	-.001	-.006	-.028	-.030
	(-8.98)	(-5.44)	(-.53)	(-3.50)	(-4.88)	(-1.92)
λ	1.819	-.200	142.305	2.685	.886	-.300
	(4.51)	(-.84)	(.51)	(4.29)	(3.22)	(-1.10)
[c]	2	.006	.817	.036	.051	.440
Observations	9364	8949	9133	9261	9432	7377
RMSE[d]	2.97	2.82	1.47	1.15	3.02	5.58
π_1	.042[b]	.006	.817	.036	.051	.440
	(1.55)	(1.52)	(8.43)	(3.94)	(1.62)	(3.11)
π_2	.188	.012	.583	.044	.153	.477
	(4.03)	(1.80)	(8.49)	(5.66)	(5.98)	(4.64)
π_3	.176	.019	.937	.064	.168	.814
	(3.91)	(1.84)	(10.64)	(6.17)	(5.35)	(6.20)
π_4	.294	.024	.634	.080	.138	1.108
	(4.50)	(1.89)	(14.59)	(8.60)	(8.11)	(14.34)
π_5	.219	.012	.813	.070	.185	.698
	(4.04)	(1.78)	(9.73)	(6.50)	(5.94)	(5.62)
π_6	.238	.02-	.537	.083	.169	.622
	(4.47)	(1.88)	(14.68)	(8.67)	(9.76)	(11.22)
θ_1	.015	.001	-.056	-.001	-.015	-.014
	(2.18)	(.75)	(-2.71)	(-.22)	(2.08)	(-.45)
θ_2	-.009	.001	-.008	-.001	-.003	-.008
	(-2.25)	(.77)	(.60)	(.37)	(.62)	(-.41)
θ_3	.010	-.001	-.037	-.001	.001	-.034
	(1.85)	(-.48)	(-2.34)	(-.36)	(.05)	(-1.39)
θ_4	-.023	-.001	-.044	-.004	-.004	-.093
	(-3.67)	(-1.71)	(-3.74)	(-3.61)	(-.89)	(-5.10)
θ_5	.001	.001	-.037	-.001	-.008	-.026
	(.15)	(1.20)	(-2.51)	(-.98)	(-1.65)	(-1.13)
θ_6	-.007	-.001	-.036	-.016	-.015	-.026
	(-2.04)	(-1.76)	(-3.35)	(-5.27)	(-3.89)	(-1.64)
λ	14.709	34.587	-1.049	5.021	.261	-1.102
	(3.47)	(1.67)	(-8.03)	(4.81)	(.70)	(-6.24)
Observations[c]	9338	9238	9143	9190	9006	9260
RMSE[d]	6.50	1.24	3.31	.96	1.70	4.94

[a] Estimators are rounded to two places.
[b] Asymptotic t-ratios are in parentheses. Values greater than 1.960 (2.576) indicate that the corresponding coefficient is significant at the 5 percent (1 percent) level.
[c] Number of households included in the analysis.
[d] Root mean square error.

Table 8. Food stamp eligibility standards in August 1981: Continental United States, Puerto Rico, Guam, and the Virgin Islands

Household Size	Monthly Income[a]
1	$ 360
2	475
3	590
4	705
5	820
6	935
7	1,050
8	1,165

SOURCE: U.S. Department of Agriculture, 1981.

[a]OMB poverty levels for the households, divided by 12 and rounded up to the nearest dollar.

Table 9. Estimated cost of food at home: Engel curve-specific scale models and the TFP, June 1982 U.S. average

Household Size and Composition	Food Cost Estimate		
	Model 4	Model 5	TFP[a]
Households of two persons:			
Couple 19 years and over each	$161.40	$172.05	$150.39
Female 19+ and child 4-10	133.30	147.37	136.80
Households of three persons:			
Couple 19+ each and child 4-10	205.97	216.16	204.29
Female 19+ and 2 children 4-10 each	179.12	198.01	191.33
Female 19+, female 11-18, and child 4-10	190.31	210.85	200.20
Households of four persons:			
Couple 19+ each and 2 children 4-10 each[b]	251.10	258.51	252.42
Couple 19+ each, male 11-18, and child 4-10	273.10	280.89	262.17
Female 19+ and 3 children 4-10 each	224.93	246.18	240.07
Female 19+, female 11-18, and 2 children 4-10 each	235.92	259.42	248.52
Households of five persons:			
Couple 19+ each and 3 children 4-10 each	295.93	298.30	294.75
Couple 19+ each, male 11-18, and 2 children 4-10 each	317.60	323.36	304.02
Couple 19+ each, male 11-18, female 11-18, and child 4-10	328.44	337.10	312.04

[a]A round-up error included from adjusting the age-sex categories used in the TFP to be compatible with those used for models 4 and 5.
[b]Household closest to the TFP standard household.

Table 10. Estimated food group budget shares (percent) for selected households, based on Engel curve-specific score model 4, June 1982 U.S. average

Household Size and Comparison	Food Group											
	VG	FR	GR	BR	MK	HMT	LMT	PT	MX	FAT	SU	DR
Households of two persons:												
Couple 19 years and over each	11.24	7.51	3.70	3.27	8.99	14.49	22.40	3.78	7.55	3.22	2.92	10.94
Female 19+ and child 4-10	10.59	7.93	5.27	3.29	10.01	12.63	21.32	3.60	9.65	3.14	3.97	8.62
Households of three persons:												
Couple 19+ each and child 4-10	10.35	7.24	4.71	3.39	9.78	13.39	22.19	3.88	8.60	3.17	3.49	9.86
Female 19+ and 2 children 4-10 each	9.74	7.50	6.00	3.41	10.61	11.96	21.26	3.74	10.23	3.09	4.31	8.15
Female 19+, female 11-18, and child 4-10	9.94	7.25	5.41	3.53	10.55	11.78	23.02	3.66	9.60	3.19	3.78	8.31
Households of four persons:												
Couple 19+ each and 2 children 4-10 each[a]	9.81	7.08	5.34	3.45	10.25	12.75	22.04	3.94	9.18	3.13	3.82	9.24
Couple 19+ each, male 11-18, and child 4-10	9.65	6.82	5.14	3.61	10.83	13.02	22.39	3.86	8.93	3.04	3.49	9.23
Female 19+ and 3 children 4-10 each	9.27	7.27	6.43	3.47	10.98	11.59	21.24	3.82	10.52	3.07	4.50	7.89
Female 19+, female 11-18, and 2 children 4-10 each	9.45	7.07	5.93	3.57	10.88	11.46	22.65	3.76	10.00	3.14	4.08	8.01
Households of five persons:												
Couple 19+ each and 3 children 4-10 each	9.45	6.96	5.78	3.50	10.57	12.32	21.94	3.98	9.54	3.11	4.04	8.82
Couple 19+ each, male 11-18, and 2 children 4-10 each	9.34	6.75	5.58	3.63	11.04	12.57	22.27	3.91	9.30	3.04	3.75	8.83
Couple 19+ each, male 11-18, female 11-18, and child 4-10	9.46	6.63	5.26	3.69	10.98	12.44	23.26	3.86	8.97	3.09	3.47	8.88

[a]Household closest to the TFP standard household.

Table 11. Estimated food group budget shares (percent) for selected households, based on Engel curve-specific score model 5, June 1982 U.S. average

Household Size and Comparison	Food Group											
	VG	FR	GR	BR	MK	HMT	LMT	PT	MK	FAT	SU	DR
Households of two persons:												
Couple 19 years and over each	11.50	7.67	3.80	3.12	8.79	14.44	22.34	3.78	7.53	3.24	2.90	10.92
Female 19+ and child 4-10	10.71	8.17	5.23	3.62	9.79	12.59	21.66	3.38	9.27	3.08	3.74	8.80
Households of three persons:												
Couple 19+ each and child 4-10	10.37	7.25	4.74	3.51	9.56	13.43	22.43	3.78	8.53	3.15	3.37	9.92
Female 19+ and 2 children 4-10 each	9.72	7.70	5.88	3.65	10.15	12.12	21.75	3.49	9.95	3.02	3.98	8.59
Female 19+, female 11-18, and child 4-10	9.63	7.31	5.06	3.42	9.62	12.98	22.78	3.38	9.90	3.20	3.73	9.01
Households of four persons:												
Couple 19+ each and 2 children 4-10 each[a]	9.79	6.98	5.33	3.58	10.05	12.85	22.09	3.84	9.28	3.13	3.73	9.35
Couple 19+ each, male 11-18, and child 4-10	9.75	6.58	5.24	3.68	10.45	13.01	22.15	3.83	9.25	3.09	3.46	9.55
Female 19+ and 3 children 4-10 each	9.31	7.42	6.27	3.49	10.38	11.88	21.43	3.64	10.48	3.03	4.20	8.47
Female 19+, female 11-18, and 2 children 4-10 each	9.38	7.19	5.69	3.45	10.10	12.16	22.54	3.55	10.18	3.14	3.91	8.70
Households of five persons:												
Couple 19+ each and 3 children 4-10 each	9.53	6.79	5.75	3.48	10.43	12.48	21.53	3.95	9.91	3.15	4.04	8.97
Couple 19+ each, male 11-18, and 2 children 4-10 each	9.43	6.62	5.57	3.62	10.83	12.79	21.90	3.88	9.59	3.08	3.74	8.98
Couple 19+ each, male 11-18, female 11-18, and child 4-10	9.57	6.52	5.24	3.69	10.71	12.65	22.93	3.81	9.22	3.14	3.47	9.05

[a]Household closest to the TFP standard household.

Table 12. Estimated food group budget shares (percent) for selected households, based on the TFP, June 1982 U.S. average

Household Size and Comparison	Food Group											
	VG	FR	GR	ER	MK	HMT	IMT	PT	MX	FAT	SU	DR[a]
Households of two persons:												
Couple 19 years and over each	15.17	6.29	8.86	5.42	10.39	6.01	28.13	6.89	6.49	2.68	2.97	0.70
Female 19+ and child 4-10	14.45	7.84	10.47	4.45	15.24	4.46	25.05	6.20	5.80	2.56	2.73	0.77
Households of three persons:												
Couple 19+ each and child 4-10	13.88	7.11	9.83	5.46	12.61	5.01	25.66	6.51	6.66	3.03	3.44	0.81
Female 19+ and 2 children 4-10 each	13.25	8.27	11.04	4.79	16.18	3.83	23.28	5.99	6.20	2.98	3.32	0.87
Female 19+, female 11-18, and child 4-10	12.84	7.98	10.70	4.77	17.08	3.84	24.43	5.87	6.99	2.11	2.38	1.00
Households of four persons:												
Couple 19+ each and 2 children 4-10 each[b]	13.15	7.57	10.37	5.49	13.86	4.44	24.27	6.29	6.75	3.22	3.70	0.88
Couple 19+ each, male 11-18, and child 4-10	13.29	6.67	10.12	5.79	13.54	4.44	24.79	6.74	6.07	3.50	4.06	0.99
Female 19+ and 3 children 4-10 each	12.61	8.49	11.34	4.98	16.69	3.50	22.35	5.88	6.41	3.20	3.63	0.93
Female 19+, female 11-18, and 2 children 4-10 each	12.33	8.26	11.06	4.95	17.35	3.52	23.29	5.79	7.01	2.52	2.88	1.03
Households of five persons:												
Couple 19+ each and 3 children 4-10 each	12.68	7.86	10.73	5.50	14.66	4.08	23.38	6.15	6.82	3.35	3.87	0.92
Couple 19+ each, male 11-18, and 2 children 4-10 each	12.83	7.10	10.50	5.75	14.36	4.10	23.86	6.53	6.24	3.57	4.16	1.01
Couple 19+ each, male 11-18, female 11-18, and child 4-10	12.61	6.99	10.32	5.70	14.94	4.09	24.49	6.44	6.69	3.05	3.59	1.08

Note: A small round-up error exists because the age-sex categories used in the TFP were adjusted to be compatible with the ones used in this study.

[a]The cost of coffee, tea, and seasonings is not included because the quantities of these items were not reported (see Peterkin et. al. 1983).

[b]Household closest to the TFP standard household.

Endnotes

1. Sample menus were published by the USDA to illustrate that the TFP were found to provide less than 100 percent of the RDA for 8 out of 17 nutrients evaluated (U.S. House of Representatives 1985, p. 5).

2. The costs of the TFP also are published periodically in the Agricultural Research Service's Family Economics Review.

3. All meals eaten at home during the week by family members in the same age-sex class were added together, then divided by 21.

4. The linearization used by Paris and Houthakker (1955) results in identical parameters but underestimates the parameter variances. See Fomby et al. (1984, pp. 430-31).

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