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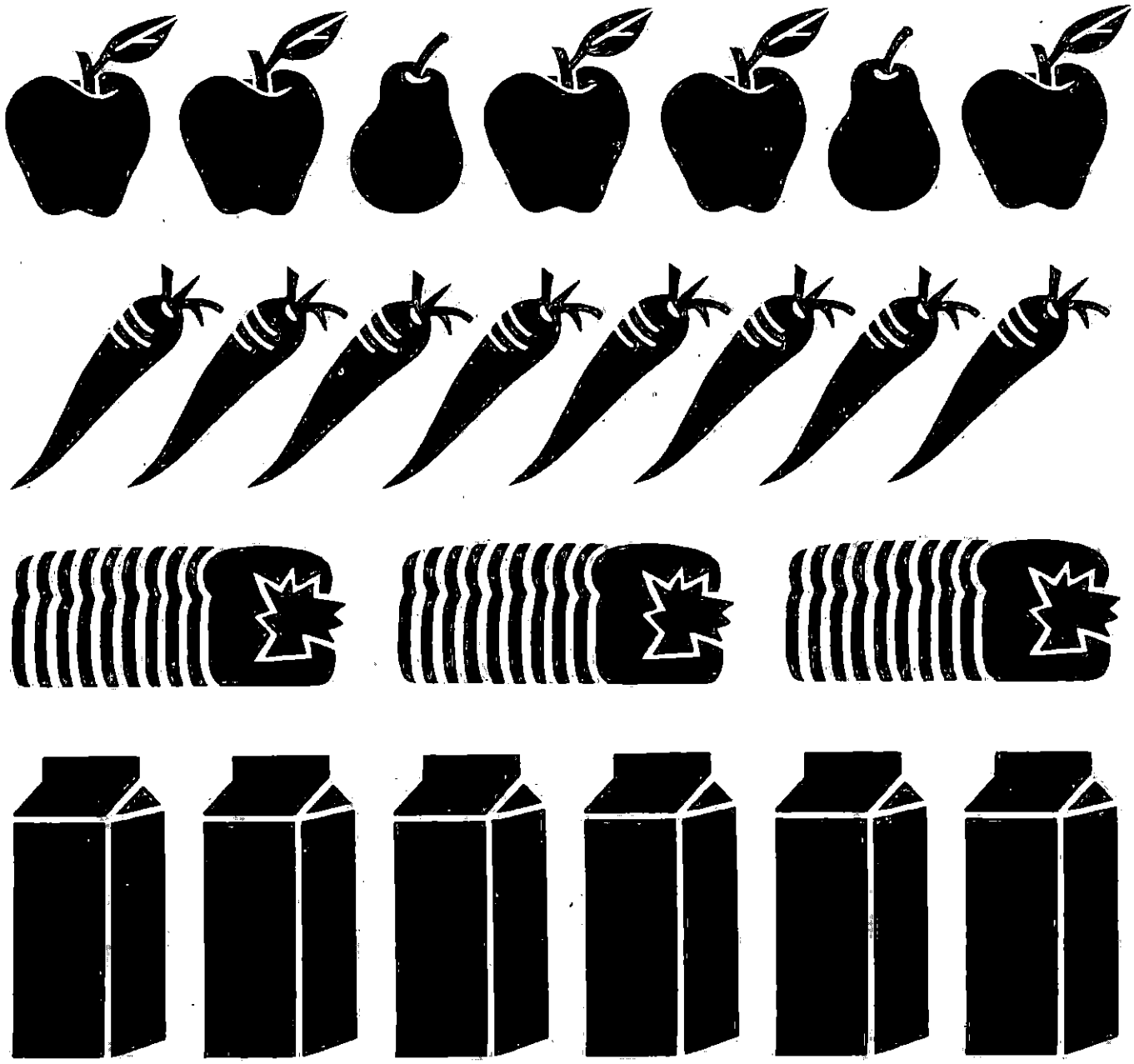
The Effect of Food Stamps and Income on Household Food Expenditures

J. William Levedahl



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The Effect of Food Stamps and Income on Household Food Expenditures. By J. William Levedahl. Commodity Economics Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No. 1794.

Abstract

This report, reexamining past estimates of the effect of income and food stamp benefits on food expenditures, finds that a cash-only Food Stamp Program would result in a significant reduction in food expenditures, although smaller than suggested by some previous results. Most prior studies found spending on food from marginal food stamp benefits to be several times greater than from marginal income, suggesting that cashing out the Food Stamp Program could greatly reduce food expenditures. The present study finds a 10-cent reduction in food spending for each dollar of food stamp benefits converted to a cash payment. Previous specifications of the food expenditure equation plus one based on the translog specification are estimated using data from the 1979-80 Nationwide Food Consumption Survey, Low Income Sample. In contrast to prior studies, the structural relationship of food stamp benefits to income is explicitly modeled. The report demonstrates that the functional form of the food expenditure equation was important in obtaining results previously reported.

Keywords: Food expenditures, food stamps, Nationwide Food Consumption Survey, poverty.

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Summary

It is generally believed that food stamp benefits, compared with an equal amount of cash income, result in more food expenditures. This report questions that belief. Results from prior studies estimating the marginal propensity to spend out of food stamp benefits and out of income imply that providing cash instead of food stamps would greatly reduce food expenditures of low-income households. Based on a more comprehensive specification and flexible estimating model, however, this study finds an expenditure reduction at the lower end of the range of previous estimates. It is demonstrated that the functional form of the food expenditure equation was important in obtaining results of previous studies.

As this report demonstrates, the choice of functional form for the food expenditure equation is very important in determining what values of the marginal propensities to spend are obtained. Earlier studies have relied on food expenditure specifications that were linear in the coefficients. These equations imply prior restrictions that may cause estimates of the marginal propensities to spend from cash income and from food stamps to diverge. Using data from the 1979-80 Nationwide Food Consumption Survey, Low Income Sample, estimates of the marginal propensities to spend obtained using previous food expenditure equations are compared with estimates obtained from an alternative based on a generalization of Roy's identity and a translog indirect utility function. This alternative specification is consistent and more flexible than previous specifications. Across the various specifications, the estimated marginal propensities to spend were found to show large and significant variation.

Using the least restrictive specifications, this study estimates the decline in food expenditures resulting from a cash-only Food Stamp Program to average about 10 cents for every dollar of food stamp benefits converted to income. This result suggests that the decline in food expenditures caused by cashing out the Food Stamp Program may not be as great as previously thought.

The report also investigates the difference in the estimates of the marginal propensity to spend out of permanent income compared with reported income. In addition, the study examines how Food Stamp Program regulations affect the marginal propensity to spend out of income of households that receive food stamps.

The Effect of Food Stamps and Income on Household Food Expenditures

J. William Levedahl*

Introduction

The effect of food stamps and income on food expenditures has important policy implications for the nutrition of poor Americans. It is generally believed that food stamp benefits generate more food expenditures than would an equal amount of cash income. However, the additional food expenditures resulting from food stamps require the added expense of administering an in-kind program such as the Food Stamp Program (FSP). Compared with a cash program (which would involve eliminating all food stamps while transferring to participating households an amount of cash equal to the value of their food stamp benefits), food stamps also impose a cost on participants by limiting their choice. Some observers have, however, counted this restrictive choice as a benefit rather than a cost.

Many studies have attempted to measure how much food expenditures are increased by food stamp benefits and income. This report reviews this measurement effort and develops some new dimensions.

The conceptual basis for the relationship between food stamps and food expenditures was initially presented by Southworth.[1] His formulation implies that the marginal propensities to spend (MPS's) out of food stamps and money income are equal when food expenditures exceed food stamp benefits.

Most studies testing the Southworth hypothesis have used various large cross-sectional household data sets. These studies have consistently found that, for food at home, the MPS out of food stamps is several times greater than the MPS out of money income. The results of these studies have been summarized by Fraker in a report for USDA's Food and Nutrition Service. A summary of these studies is also provided in table 1. The evidence from these studies has been interpreted to mean that a cash-only FSP would result in a significant reduction in food expenditures that would exceed any saving in program administrative expenses.

In contrast with studies using survey data, experimental evidence on the magnitude of the MPS's shows little or no difference. However, there have been fewer studies using this kind of data. The principal examples of studies using experimental data are associated with the initiation of a cash-only program in Puerto Rico in 1982 (Devaney and Fraker, 1986; Moffitt) and a 1982-83 USDA demonstration project involving the elderly. In both studies, only a slight reduction in food expenditures was observed when a cash-only program was implemented. The Food and Nutrition Service is undertaking demonstration projects designed to measure the effect of a cash-only FSP. These projects are based on an experimental design and are being undertaken at various locations around the country. Results from these projects, however, are not yet available.

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[1] References are denoted by author's last name. References are cited in the References section at the end of this report.

Table 1--Estimated ratio of MPS(S_o) to MPS(Y) and other summary measures from previous studies comparing food expenditures out of food stamps and out of income

Study	Ratio	MPS(S_o)	MPS(Y)	Data source 1/	P/All 2/
Allen and Gadson	3.75	0.30	0.08	1977-78 NFCS-LI	All
Chavas and Yeung 3/	2.85	.37	.13	1972-73 CES	All
Moffitt:					
Linear	1.27	.17	.13	1977 PS from Puerto Rico	All
	1.25	.21	.17	1984 PS from Puerto Rico	All
Log	.92	.11	.12	1977 PS from Puerto Rico	All
	.97	.15	.15	1984 PS from Puerto Rico	All
Neenan and Davis	7.50	.45	.06	1976 EFNEP	P
West, Price, and Price	10.71	.31	.03	1972-73 PS from Washington State	All
Senauer and Young	6.50	.33	.05	1978 PSID	P
	3.60	.26	.07	1979 PSID	P
Smallwood and Blaylock	2.30	.23	.10	1977-78 NFCS-LI	All
Ranney and Kushman	6.00	.60	.10	1978-79 PS from California, Ohio, Virginia, and Indiana	P
Benus, Kmenta, and Shapiro 4/	17.20	.86	.05	1968-72 PSID	All
Devaney and Fraker:					
Weighted	3.07	.21	.07	1977-78 NFCS-LI	All
Unweighted	5.05	.42	.08	1977-78 NFCS-LI	All
West and Price	7.40	.37	.05	1972-73 PS of households with children 8-12 from Washington State	All
Chen	2.09	.23	.11	1979-80 NFCS-LI	P
Fraker, Long, and Post	5.80	.29	.05	1985 Continuing Survey of Food Intake by Individuals	All 5/

1/ NFCS-LI: Nationwide Food Consumption Survey, Low Income Sample
CES: Consumer Expenditure Survey
PS: Primary Survey by author(s)
PSID: Panel Survey of Income Dynamics
EFNEP: Expanded Food and Nutrition Education Program
2/ Sample consists of just Food Stamp Program participant (P) or all households (All) eligible for food stamps.
3/ For households with a college educated nonblack head living in a metropolitan area.
4/ Food stamp benefits consist of all benefits received from government food subsidy programs evaluated at cost.
5/ Includes households eligible for Women, Infants and Children (WIC) program.

The objective of this report is to reconcile the difference between the estimates of the recipients' MPS's obtained using survey data and those obtained using experimental data. The approach taken in this report is to start with the food expenditure equations used in previous studies and determine whether the resulting estimates of the MPS's might differ even though the true marginal propensities are equal or nearly so.

Specific objectives are:

- To derive and estimate the MPS's from a food expenditure equation which is theoretically consistent and flexible, and to compare these MPS's with the MPS's obtained from specifications that are linear in the coefficients;
- To calculate the predicted change in food expenditures caused by cashing out the FSP for the food expenditure equations used in previous studies and for the proposed alternative;
- To calculate the effect of FSP regulations on the marginal impact of income on food expenditures; and
- To calculate the MPS's using levels of permanent income and food stamp benefits and to compare these estimates with estimates obtained using the reported levels.

Theoretical Derivation of the Food Expenditure Equation

The utility-maximizing food expenditure equation for food stamp recipients is derived. Necessary and sufficient conditions for the Southworth formulation are then obtained.

Food Expenditure Equation for Food Stamp Participants Based on a Generalization of Roy's Identity

The food expenditure equation is derived assuming that households maximize their utility with respect to four goods: (1) food bought with income for at-home consumption; (2) food bought with food stamps for at-home consumption; (3) food consumed away from home; and (4) a composite of all other goods. Utility is maximized subject to income and food stamp constraints. The maximization problem is denoted by:

$$\max L = U(F,S,A,X) + g_1(Y - pF - p_aA - p_oX) + g_2(S_o - pS), \tag{1}$$

where

F, S are food purchased for at-home consumption using income and food stamps, respectively;

A is food purchased for away-from-home consumption;

X is a composite of all other goods;

p, p_a are the prices for food at-home and food away from home, respectively;

p_o is the price of other goods;

Y is income;

S_o is the dollar value of food stamp benefits; and

g_1, g_2 are Lagrangian multipliers.

L is maximized with respect to the variables F, S, A, X, g_1, and g_2 given S_o, Y, p, p_a, and p_o. Note that this formulation of the utility function does not impose the prior restriction that food bought with food stamps or income provides the same utility. However, it does allow this as a special case.

From the Kuhn-Tucker conditions for utility maximization, it easily can be shown that if food expenditures exceed or are equal to food stamp benefits, then $g_2 > 0$ and an interior solution is obtained (Varian, p. 319). If food expenditures are less than S_o, then $g_2 = 0$ and no food for at-home consumption is purchased out of income.

If equation (1) is solved and the resulting optimal values are substituted back into this equation, the indirect utility function is obtained. It is represented as:

$$\underline{L} = U(\underline{F},\underline{S},\underline{A},\underline{X}) + g_1(Y - p\underline{F} - p_a\underline{A} - p_o\underline{X}) + g_2(S_o - p\underline{S}) \tag{2}$$

where underlining denotes an optimal value. The demand function for at-home food purchased with income can be defined using equation (2) and the envelope theorem (Varian, p. 327). The total differentials of the objective function with respect to changes in Y, p, and S_o are:

$$d\underline{L}/dY = g_1,$$

$$d\underline{L}/dp = -g_1\underline{F} - g_2\underline{S},$$

and

$$d\underline{L}/dS_o = g_2.$$

Rearranging terms, the demand function for at-home food purchased with income is:

$$\underline{F} = -(1/g_1)[d\underline{L}/dp + \underline{S}g_2]. \tag{3}$$

For households whose food expenditures exceed or are equal to their food stamps, this equation is a generalization of Roy's identity.[2]

Denote total demand for food at home as $\underline{D} = -(d\underline{L}/dp)/g_1$ and rewrite equation (3) as:

$$\underline{F} = \underline{D} - (g_2/g_1)(S_o/p). \tag{4}$$

The ratio g_2/g_1 is the household's marginal evaluation of food stamp benefits relative to income. This ratio normally is assumed to be less than or equal to one. Equation (4) implies that the food stamp benefits are equivalent to the quantity $(g_2/g_1)(S_o/p)$ of food bought with income. This quantity of food, previously bought with income, will be bought using food stamps. The more similar the marginal utilities of food bought with food stamps and with income are to each other, the greater will be the substitution of food stamps for food bought with income.

At-home food expenditures are obtained by multiplying equation (4) by the price of food and adding S_o to both sides:

$$\underline{E} = p\underline{D} + (1 - g_2/g_1)S_o. \tag{5}$$

Here, the fraction $(1 - g_2/g_1)$ is the proportion of S_o that results in new at-home food expenditures for a given level of at-home food demand.

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[2] In equation (2), the price of food bought with income and food stamps is assumed to be the same. This assumption could be relaxed and an equation similar to equation (3) can still be obtained providing the two prices are related. If the prices are independent, equation (3) does not hold.

The total food expenditure equation can be obtained in a similar manner by first defining the demand for food away from home by applying Roy's identity to equation (2). This demand function is converted to an expenditure function in the same way as equation (5) to give total food expenditures as:

$$\underline{TE} = p\underline{D} + p_a\underline{A} + (1 - g_2/g_1)S_o. \tag{6}$$

Necessary and Sufficient Conditions for the Southworth Formulation

The Southworth formulation is a special case of equation (1) in which the marginal utilities of at-home food bought with income or with food stamps are identically equal. This restriction on the marginal utilities implies that the utility maximization problem in equation (1) is reformulated as:

$$\max L = U(F + S,A,X) + g_1(Y - pF - p_aA - p_oX) + g_2(S_o - pS), \tag{7}$$

with the corresponding indirect utility function:

$$\underline{L} = U(\underline{F} + \underline{S},\underline{A},\underline{X}) + g_1(Y - p\underline{F} - p_a\underline{A} - p_o\underline{X}) + g_2(S_o - p\underline{S}). \tag{8}$$

The equivalence of the indirect utility function in equation (8) and the equality of the MPS's is demonstrated using the following lemma and theorem.

Lemma: $MU_F = MU_S$ iff $g_1 = g_2$.

Since equation (8) satisfies the first-order conditions, $MU_F = g_1p$ and $MU_S = g_2p$. It follows that if $g_1 = g_2$, then $MU_F = MU_S$.

Conversely, from equation (7), $MU_F = MU_S$. It follows directly from the first-order conditions that $g_1 = g_2$.

Theorem: $MPS(S_o) = MPS(Y)$ iff $g_1 = g_2$.

The marginal propensities are defined as:

$$MPS(S_o) = 1 - p|\delta\underline{F}/\delta S_o|, \text{ and}$$

$$MPS(Y) = p\delta\underline{F}/\delta Y. \tag{9}$$

Using these definitions and equation (3), the difference between the MPS's can be written as:

$$\begin{aligned} MPS(S_o) - MPS(Y) = {} & p(1/g_1)[F(\delta g_1/\delta Y - \delta g_1/\delta S_o) + (\delta g_1/\delta p - \delta g_2/\delta p) + S(\delta g_1/\delta S_o - \delta g_2/\delta S_o)] \\ & + (1 - g_2/g_1). \end{aligned} \tag{10}$$

If $g_1 = g_2$, equation (10) becomes:

$$MPS(S_o) - MPS(Y) = pF(1/g_1)(\delta g_1/\delta Y - \delta g_1/\delta S_o).$$

Since $MU_X/p_o = g_1$, then:

$$\begin{aligned} \delta g_1/\delta Y - \delta g_1/\delta S_o &= (1/p_o)(\delta MU_X/\delta Y - \delta MU_X/\delta S_o) \\ &= (1/p_o)\delta(MU_Y - MU_S/p)/\delta X) \\ &= (1/p)(1/p_o)\delta(MU_F - MU_S)/\delta X. \end{aligned} \tag{11}$$

From the lemma, if $g_1 = g_2$, then $MU_F = MU_S$. Equation (11) is zero and $MPS(S_o) = MPS(Y)$.

A proof by contradiction is used to show sufficiency. Suppose the MPS's are equal so that equation (10) is zero but $g_1 \neq g_2$. Both the second and third terms in brackets on the right-hand side of equation (10) and the term $(1-g_2/g_1)$ are, therefore, nonzero. From the lemma, $g_1 \neq g_2$ implies $MU_F \neq MU_S$. Thus, from equation (11), $\delta g_1/\delta Y - \delta g_1/\delta S_o \neq 0$.

Each term on the right-hand side of equation (10) is nonzero, which contradicts the assumption that the MPS's are equal. Thus, the equality of the MPS's is a sufficient condition for the equality of g_1 and g_2.

Combining the lemma and theorem, it follows that the MPS's are equal if and only if the marginal utilities of food bought with food stamps and income are equal.

Estimates of the MPS's consistently have been found to be unequal. As shown above, the implication of this fact is that the marginal utilities of food bought with food stamps and income are unequal, which is consistent with a stigma associated with the expenditure of food stamps.

Estimates of the Marginal Propensity to Spend from Income and Food Stamp Benefits Using Food Expenditure Specifications that Are Linear in the Coefficients

Estimates of the MPS's using previous functional forms of the food expenditure equation are presented. These estimates are later compared with estimates based on a consistent and more flexible functional form.

Low-Income Sample of the 1979-80 Nationwide Food Consumption Survey

Data from the 1979-80 Nationwide Food Consumption Survey, Low Income Sample (NFCS-LI) were available to estimate both at-home and total food expenditure equations. This survey was administered after the food stamp purchase requirement was eliminated.[3] Only households that received food stamps and with expenditures on food for at-home consumption exceeding the value of their food stamps were used. In addition, households were deleted if their at-home food expenditures in excess of food stamp benefits were greater than their average monthly income.[4] In all, 1,210 households were included in the estimating sample.

The survey obtained information on household characteristics and food use by a personal interview of the member most responsible for planning and preparing meals. The household was contacted at least 1 week in advance of the interview and asked to keep notes on food use and costs. During the actual interview, interviewers used prompts to aid recall. The recall data on the total money value of purchased food (less alcoholic beverages) used in the last 7 days are the basis of the food expenditure variable. Weekly expenditures were adjusted to a monthly basis to conform with the other variables. The money value of both alcoholic beverages and gifts of food were excluded from the analysis since they cannot, in principle, be purchased with stamps.

Estimates of the Marginal Propensities to Spend Using Previous Specifications of the Food Expenditure Equation

Estimates of the MPS's obtained from specifications of the food expenditure equation that are linear in the coefficients are reported and interpreted.

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[3] Before January 1979, the Food Stamp Program contained a purchase requirement. Under this program, all households of the same size received the same allotment of food stamps. However, the amount households paid for these stamps varied by household income.

[4] Approximately 11 percent of the households that received food stamps reported at-home food expenditure less than their food stamp benefits.

Table 2--Linear-in-the-coefficient specifications of the food expenditure equation and the corresponding ratio of the marginal propensities

Specification 1/	$MPS(S_o)/MPS(Y)$
Linear: $E = a + bY + cS_o$	c/b
Semi-log:2/ $E = a + b\ln(Y) + cS_o$	$(c/b)Y$
Double-log:2/3/ $\ln(E) = a + b\ln(Y) + cS_o/Y$	$(b/c - S_o/Y)^{-1}$

1/ E is expenditures and w is the food expenditure share out of money income.

2/ The versions of the semi-log specification used by Neenan and Davis and the double-log specification used by Senauer and Young were specified so that the expenditure equation of the nonparticipants could be estimated with the participants. However, previous studies have found no sample selection bias between the two groups (Devaney and Fraker, Ranney and Kushman).

3/ This version is called the double-log because it can be written $\ln(E) = a + b\ln(Y) + \ln(1 + cS_o/Y)$ using the approximation $\ln(1 + a) = a$ providing $|a| \leq 1$. It also follows that the double-log specification is nested within the translog specification.

Estimates of the Marginal Propensities to Spend

Previous estimates of the MPS's have used only specifications of the food expenditure equation that are linear in the coefficients. The most common has been the linear specification (Smallwood and Blaylock; Ranney and Kushman; Neenan and Davis; Chavas and Young; Huang, Fletcher, and Raunikar; and Benus, Kmenta, and Shapiro).[5] In some cases, variables measuring an interaction between income or food stamp benefits and other determinants have been included. In addition to the linear version, both a semi-log version (West and Price) and a double-log version (Senauer and Young) have been used.[6] However, only the linear specification can be derived from equation (3) and an admissible indirect utility function. Table 2 gives the expenditure equation and the ratio of the MPS's for each of these functional forms.

Estimating equations for the linear, semi-log, and double-log specifications were obtained from the expression in table 2 by modeling the effect of household demographics as linear explanatory variables and by adding a random error term. The error term is assumed to have a zero mean and a constant variance. Previous studies have found no self-selection bias between food stamp participants and nonparticipants in food expenditures (Ranney and Kushman; Devaney and Fraker, 1989).

[5] However, the specification estimated by Benus, Kmenta, and Shapiro applied a Box-Cox transformation to their initial specification.

[6] The versions of the semi-log and double-log specifications used by these authors were modified to avoid defining $\log(S_o)$ for nonparticipants. However, this report considers only food stamp participants. The food expenditure specification used by Huang, Fletcher, and Raunikar and by Senauer and Young are part of a Tobit specification. Also, footnote 3 in table 2 shows that the version used by Senauer and Young is approximated by the double-log specification.

Table 3 defines variables and their sample means. This list comprises variables found to be significant in explaining food expenditures in previous studies (Smallwood and Blaylock; Huang, Fletcher, and Raunikar).

Table 4 presents coefficient estimates of the linear, semi-log, and the double-log specifications for both total and at-home food expenditures. Table 5 presents the estimated mean ratios of the MPS's and their corresponding standard errors.

Table 3--Definitions of variables and values of sample means

Variable	Definition	Sample mean
N	Number of food stamp recipients	1,210
AH	At home food expenditures in excess of food stamps as a proportion of after-tax income	.34
Food	Monthly expenditure on food at home	$199.29
Total	Monthly expenditure on all food	$218.75
Y	Monthly household income after taxes	$358.17
PY	Monthly household permanent income after taxes	$358.17
S_o	Monthly value of food stamp benefits	$89.27
PS_o	Monthly permanent value of food stamp benefits	$89.27
Y/S_o	Income/food stamp benefits ratio	7.43
NUM	The number of household members	3.15
P1	The proportion of household members under age 3	.06
P2	The proportion of household members between ages 3 and 12	.17
P3	The proportion of households members between ages 13 and 19	.18
P4	The proportion of household members between ages 20 and 39	.11
RACE	Equals 1 if white; 0 otherwise	.40
REGION	Equals 1 if household located in the South; 0 otherwise	.66
U/R	Equals 1 if household is located in an urban area; 0 otherwise	.53
SLR	Equals 1 if household had school lunches at reduced prices; 0 otherwise	.41
GM	Number of guest meals served by the household	.60
ELD	Equals 1 if member of the household is 60 years or older; 0 otherwise	.37
WEL	Number of assistance programs other than food stamps	.73

Table 4--Estimates of at-home and total food expenditure equation using linear-in-the-coefficient specifications

Variable	At-home food expenditure equations			Total food expenditure equations		
	Linear	Semi-log	Double-log	Linear	Semi-log	Double-log
Y	0.08			0.10		
	(.01) 1/			(.01)		
ln(Y)		35.44	0.40		42.41	0.41
		(4.91)	(.04)		(5.82)	(.04)
S_o	.48	.50		.41	.44	
	(.05)	(.05)		(.06)	(.06)	
S_o/Y			.52			.51
			(.06)			(.06)
Constant	26.09	-145.12	2.18	26.63	-176.79	2.16
	(7.96)	(27.38)	(.20)	(9.41)	(32.42)	(.21)
P1	-9.23	-8.13	.12	-26.42	-25.59	.07
	(17.88)	(17.32)	(.09)	(20.53)	(20.50)	(.09)
P2	10.12	6.70	.24	-1.30	-5.23	.23
	(13.71)	(13.68)	(.07)	(16.91)	(16.19)	(.07)
P3	2.21	1.02	.09	9.13	28.24	.23
	(10.45)	(10.22)	(.05)	(4.21)	(12.10)	(.06)
P4	61.55	57.05	.43	70.83	65.49	.47
	(15.10)	(15.05)	(.08)	(17.82)	(17.82)	(.08)
RACE	10.09	9.02	.05	5.93	4.91	.03
	(9.99)	(4.48)	(.02)	(5.30)	(5.31)	(.02)
REGION	-11.70	-10.59	-.02	-10.54	-9.41	-.02
	(4.36)	(4.26)	(.02)	(5.16)	(5.31)	(.02)
U/R	18.35	17.48	.06	19.91	18.74	.06
	(4.27)	(4.26)	(.02)	(5.05)	(5.04)	(.02)
SLR	-5.20	-6.54	-.01	-9.70	-10.57	-.02
	(6.66)	(6.64)	(.03)	(7.89)	(7.86)	(.04)
NUM	25.60	24.37	.10	31.16	30.72	.11
	(1.95)	(1.98)	(.01)	(2.29)	(2.34)	(.01)
GM	10.65	10.51	.05	10.53	10.45	.05
	(1.22)	(1.21)	(.01)	(1.44)	(1.44)	(.01)
ELD	-3.57	-2.80	-.04	-7.46	-10.54	-.06
	(6.06)	(6.03)	(.03)	(7.16)	(7.14)	(.03)
WEL	5.13	4.50	.03	3.71	2.83	.02
	(3.46)	(3.45)	(.02)	(4.08)	(4.08)	(.02)

1/ Standard errors are given in parentheses.

Table 5--Mean value of the ratio $MPS(S_o)/MPS(Y)$ for at-home and total food expenditures using the linear-in-the-coefficient specifications 1/

Linear-in-the-coefficent specification	At-home food expenditures	Total food expenditures
Linear	6.09 (.96) 1/	4.14 (.69)
Semi-log 2/	5.06 (.68)	3.72 (.57)
Double-log	3.82 (.46) 3/	3.08 (.41) 3/

1/ Standard errors are given in parentheses unless otherwise indicated.
2/ Evaluated conditional on mean income.
3/ Standard error of the mean.

In this report, the ratio of the MPS's is chosen to measure the difference between the marginal propensities. The ratio is a better measure than, say, the difference between the MPS's, because it can capture correlation between the marginal propensities that might exist across households. This correlation is important, because it reflects how households adjust their food expenditures in response to changes in food stamp benefits and income.[7] For example, a positive correlation implies that the households with the largest $MPS(S_o)$ also have the largest $MPS(Y)$. If the FSP were converted to a cash-only program, then the households with the greatest reduction in their food stamp benefits would also be the ones with the greatest increase in food expenditures associated with the income transfer.

The estimated mean ratio of the MPS's for at-home food expenditures obtained using NFCS-LI are significantly greater than one, thus replicating the findings of previous studies. The values are, however, somewhat larger than values obtained by other studies using post-1979 data except for the estimate reported by Ranney and Kushman.

The mean ratios for total expenditures are smaller than the mean ratios for at-home expenditures, reflecting income's relatively greater effect on away-from-home food expenditures. Table 6 reports individual MPS's.

Interpretation of the Estimated Marginal Propensities to Spend

The predicted effect on food expenditures from cashing out the FSP provides the principal policy implication obtained from estimates of the MPS's. Cashing out food stamps would involve eliminating all food stamps while transferring to recipient households an amount of cash equal to the value of their food stamp benefits. It is tempting to use the ratio of the means of the MPS's as a measure of the proportional change in food expenditures resulting from cashing out the FSP. However, this measure is correct only for the linear expenditure equation. For specifications other than the linear, the ratio of the estimated MPS's does not provide a measure of how food expenditures would be affected. These other specifications have

[7] A correlation between the MPS's also implies that the mean ratio of the MPS's is the preferred measure compared to, say, the ratio of the mean MPS's. Only for the linear specification will these two ratios be equal. For other functional forms with nonlinear MPS's, the ratio of the means will not equal the mean ratio.

Table 6--Mean marginal propensities to spend for at-home and total food expenditures using linear-in-the-coefficient specifications

Linear-in-the-coefficient specification	At-home food expenditures		Total food expenditure	
	MPS(S_o)	MPS(Y)	MPS(S_o)	MPS(Y)
Linear	0.48	0.08	0.41	0.10
Semi-log 1/	.50	.10	.44	.12
Double-log 2/	.29	.09	.32	.11

1/ Evaluated at mean food expenditure levels.
2/ Evaluated at mean income, food stamp benefit, and expenditure levels.

nonlinear MPS's, so the effect of a cash-only program cannot be determined by evaluating the MPS's at any single point. Estimates of the change in food expenditures associated with cashing out the FSP are presented later in this report for the other linear-in-the-coefficient specifications.

The ratio of the MPS's for the linear expenditure equation implies a significant reduction in at-home food expenditures if the FSP were cashed out (see table 5). The reduction in at-home food expenditures is predicted to be six times the gain resulting from the income transfer. For total food expenditures, the loss would be approximately four times the gain. The magnitude of this estimated reduction is a principal reason some people oppose a cash-only program, even though such a program would increase the choices available to participants and would likely increase the total number of participants.

Estimates of the Marginal Propensities to Spend Incorporating Food Stamp Program Regulations

A food expenditure equation incorporating the influence of the FSP on the MPS out of income is estimated. The net effect of FSP regulations on the MPS out of income is calculated.

Exclusions and Deductions for Calculating Food Stamp Income

Food stamp benefits are calculated from food stamp income. This income equals before-tax income less certain adjustments for a variety of exclusions and deductions. Since only participating households are of interest, the asset and nonfinancial criteria that only affect food stamp eligibility will be ignored.

Most of the exclusions occur infrequently or are items not counted as income by most people. Items excluded from countable income are nonmonetary or in-kind benefits; irregular income less than $30 per quarter year; educational loans, grants, and scholarships if they are used for mandatory tuition and fees in postsecondary schools; all loans on which payment is deferred; reimbursements for expenses; third-party vendor payments; earned income of students under 18; nonrecurring lump sum payments; payments specifically excluded under other Federal statutes; and certain energy assistance payments.

An adjustment was made for the exclusion of earned income by students under 18. However, only 1.4 percent of the households in the sample had this source of income. Households with income from their own business or farm were deleted from the sample, because the exclusion of third-party vendor payments and/or business expenses cannot be measured with the information available in the NFCS-LI. Other than these adjustments, before-tax household income was taken to be income net of exclusions.

Food stamp regulations in 1980 allowed for the following deductions: (1) a standard deduction of $75 a month; (2) an earned income deduction equal to 18 percent of the combined earnings of household

members; (3) a dependent care deduction for children or other dependents while household members work or seek employment; (4) a medical deduction for households with elderly or disabled members equal to monthly medical expenses above $35 a month; and (5) an excess shelter deduction for shelter costs that exceed 50 percent of the household's income after all other deductions are taken.

The earned income and the excess shelter deductions are the only two deductions affected directly by changes in income. Calculating the effect of a change in income on food stamp income is complicated, however, because during the sample period covered by the NFCS-LI the total of the dependent care deduction and the excess shelter deduction could not exceed $90 a month except for households with elderly or disabled members. These households were allowed to deduct the full value of their excess shelter costs.

The marginal effect of before-tax income on food stamp income depends on the magnitude of both the excess shelter deduction and the dependent care deduction.

The shelter deduction can be written as D_s = Shelter - $0.5(Y_b - D)$ where D represents all other deductions and Shelter represents shelter expenditures. D_c represents the dependent care deduction and Y_b denotes before-tax income.

<u>Case 1</u>: $0 \leq D_s + D_c \leq 90$.

If $D_s \leq 0$, then shelter costs do not affect the level of deductions. Since $Y^s = Y_b - D - D_s$, it follows that:

$$\begin{aligned} \delta Y^s/\delta Y_b &= 1 - \delta D/\delta Y_b \\ &= 1 - (\delta D/\delta E)(\delta E/\delta Y_b) \end{aligned}$$

where $\delta D/\delta E = 0.18$ reflects the earned income deduction. If earned income is assumed to be the only available source of income for these households, at least at the margin, then $\delta E/\delta Y_b = 1$. Therefore, each additional dollar of before-tax income increases food stamp income by 82 cents.

If $D_s > 0$, the situation is different. In this case, an increase in income reduces D_s and, therefore, reduces the shelter/dependent care deduction.

Thus:

$$\begin{aligned} \delta Y^s/\delta Y_b &= 1 - \delta D/\delta Y_b - \delta D_s/\delta Y_b \\ &= 1 - \delta D/\delta Y_b - [-.5(1-\delta D/\delta Y_b)]. \end{aligned}$$

Assume, again, that, at the margin, all income comes from earnings. The value of $\delta Y^s/\delta Y_b$ equals 1.23, which implies that every $1.00 of before-tax income increases food stamp income by $1.23.

<u>Case 2</u>: $D_s + D_c \leq 0$.

Since $D_c \geq 0$, D_s is nonpositive. Changes in income do not affect the shelter/dependent care deduction. Therefore, $\delta Y^s/\delta Y_b = 0.82$.

<u>Case 3</u>: $D_s + D_c > 90$.

In this case, the full shelter/dependent care deduction is realized. A marginal increase in income would reduce the excess shelter deduction, but the full shelter/dependent care deduction is still realized. Therefore, $\delta Y^s/\delta Y_b = 0.82$.

Values of $\delta Y^s/\delta Y_b$ were calculated for the households in the sample using the above cases. A problem arises, however, for households with an elderly or disabled member. No information on medical expenses is included in the NFCS-LI, making it impossible to determine the size of the excess shelter deduction for these households. Because the marginal effect of income could not be determined for these households,

they were deleted from the sample. This left a sample of 820 households. Sixty-five percent of these households have a shelter/dependent care deduction unaffected by increases in income, so that $\delta Y^a/\delta Y_b$ = 0.82. For the remainder of the sample, $\delta Y^a/\delta Y_b$ = 1.23.

Estimates of the Net Marginal Propensity to Spend Out of Income

Previous studies do not model or otherwise account for the structural interrelationship between income and food stamp benefits. In the environment of the existing FSP, it is difficult to interpret the meaning of, say, the MPS out of income obtained from these studies because a change in income that holds food stamp benefits constant never occurs.

A food expenditure equation that includes food stamp income regulations is derived in this section. The resulting MPS out of income is, therefore, net of these regulations.

The rule determining food stamp benefits can be written as:

$$S_o = A(n) + S[Y^a(Y_b - D_t)] \tag{12}$$

where D_t denotes the combined level of food stamp deductions and exclusions. The variable A is the level of benefits if the household has no food stamp income. This level of benefits depends upon the number of household members, n.

Substituting equation (12) into the expenditure equation $E = E(Y,S_o)$ defines a new expenditure function that embodies food stamp restrictions:

$$\begin{aligned} E &= E(Y,A + S[Y^a(Y_b - D_t)]) \\ &= E'(Y,A,Y_b,D_t). \end{aligned} \tag{13}$$

A linear approximation to equation (13) is:

$$E = (\delta E'/\delta Y)Y + (\delta E'/\delta A)A + (\delta E'/\delta D_t)D_t \tag{14}$$

where

$$\delta E'/\delta Y = \delta E/\delta Y + (\delta E/\delta S_o)(\delta S_o/\delta Y^a)(\delta Y^a/\delta Y_b)(\delta Y_b/\delta Y),$$
$$\delta E'/\delta A = \delta E/\delta S_o,$$

and

$$\delta E'/\delta D_t = (\delta E/\delta S_o)(\delta S_o/\delta Y^a)(\delta Y^a/\delta D_t).$$

The term $\delta S_o/\delta Y^a < 0$ is the rate at which food stamp benefits are reduced when food stamp income increases. The absolute value of this term can be interpreted as the tax paid for each additional dollar of income. FSP regulations set its value at -0.30 in 1980. The term $\delta Y_b/\delta Y$ denotes the change in before-tax income needed for a dollar change in after-tax income.

The net-MPS(Y) defined from equation (13) illustrates the effect of income on food expenditures net of the influence of food stamp benefits. The value of the net-MPS(Y) is relevant for evaluating how the FSP affects food expenditures when income changes. In comparison, the traditional MPS(Y) measures the change in food expenditures for a change in income that holds food stamp benefits constant. Since $\delta S_o/\delta Y_b$ is negative, the net-MPS(Y) is always less than the MPS(Y).

The magnitude of the net-MPS(Y) can be calculated from equation (14) using estimates of the MPS's and estimated values for the remaining terms. Table 7 gives estimates of the MPS's using a traditional linear expenditure equation for the sample of households without an elderly or disabled member. The value of $\delta Y_b/\delta Y$ was approximated as the proportion of the household's before-tax income to its after-tax income.

Table 7--Estimates of at-home and total food expenditure equations for households without an elderly or disabled member using a linear specification

Variable	At-home food expenditure equation	Total food expenditure equation
Y	0.04	0.06
	(.02) 1/	(.02)
S_o	.50	.44
	(.07)	(.08)
Constant	35.77	32.14
	(12.35)	(14.19)
P1	-11.31	-26.60
	(23.23)	(26.68)
P2	26.11	16.04
	(18.96)	(21.77)
P3	-.51	23.65
	(14.64)	(16.81)
P4	77.06	86.25
	(21.56)	(24.78)
RACE	10.41	6.85
	(7.72)	(8.86)
REGION	-18.81	-15.93
	(6.82)	(7.83)
U/R	27.76	30.85
	(7.14)	(8.20)
SLR	-12.04	-14.08
	(9.36)	(10.76)
NUM	28.84	34.23
	(2.76)	(3.18)
GM	12.48	12.62
	(1.79)	(2.05)
ELD	na	na
WEL	3.11	3.33
	(5.17)	(5.94)

na = Not applicable.
1/ Standard errors are given in parentheses.

In the sample, this proportion averaged 1.03, but 90 percent of the households reported the same before-tax and after-tax income. A weighted average of $\delta Y^a/\delta Y_b$ was used in the calculations.

The calculated net-MPS(Y) is -0.114 for food at home. It is -0.070 for all food. These MPS's out of income are negative because the estimated MPS(S_o) is so much larger than the estimated MPS(Y). An increase in income initially increases food expenditures, but the increase in income also reduces food stamp benefits, which lowers food expenditures. The negative values of the net-MPS(Y) result because the reduction in food expenditures from the loss of food stamps is greater than the increase resulting from the larger income.

The negative value for the net-MPS(Y) implies that food stamp households with no income net of deductions and exclusions have the largest food expenditures, all else being constant. However, it would

be possible to adjust the food stamp tax on income to obtain a constant level of food expenditures for all food stamp recipients.

The value of the implicit food stamp tax (the reduction in benefits for higher income levels) that will generate constant food expenditures can be calculated by setting $\delta E'/\delta Y$ in equation (14) equal to zero and solving for the corresponding food stamp tax rate. Conditional on the values of the MPS's in table 7 and the mean values of $\delta Y_b/\delta Y$ and $\delta Y^a/\delta Y_b$, a food stamp tax of 0.07 would have resulted in constant at-home food expenditures for all participants. Total food expenditures would have been constant with a tax rate of 0.14.

Estimates of the Marginal Propensities to Spend Using Permanent Income

One possible explanation suggested by previous studies for the difference in the estimated MPS's is that reported income has been used instead of permanent income (see for example, Senauer and Young, pp. 41-42). Permanent income is the theoretically correct income measure to use when determining food expenditures. The distinction between the two types of income is likely to be important for households eligible for food stamps because of the variability in reported income they experience.

In this section, a linear food expenditure equation is estimated using permanent income instead of reported income. The coefficient estimates are then compared to those reported in table 4 in which reported income was used. Unobserved permanent income is obtained using an approach similar to one used by Deaton.

Errors-in-the-Variables Estimator of Permanent Income

Deaton's objective was to create panel data by combining independent cross-sectional surveys obtained from different samples of households. He did this by viewing similar cohorts in each survey as drawing from the same population. The method used in this section does not use the concept of a cohort, but instead uses the notion of an income-generating function to define households with the same permanent income.

Each household in the survey is assigned to a classification group according to the income-generating function. All households in a particular classification group are deemed to have the same permanent income. This income is estimated, subject to a measurement error, by the sample mean within the group.

The income-generating function was defined over nine demographic/economic household characteristics. These included the age, education, and race of the household head; presence of a male head; number of wage earners; home ownership; car ownership; geographic region; and urban/rural location. No classification group was used that had fewer than five households. A total of 64 classification groups were defined.

The true expression for food expenditure by the ith household in the jth classification group may be written as:

$$\begin{aligned} E_{ij} &= a_1 Y_j^p + a_2 Y_{ij}^t + a_3 S_{ij} + \underline{Z}_{ij}\underline{a}_4 + u_{ij} \\ &= \underline{X}_{ij}\underline{a} + u_{ij}. \end{aligned} \tag{15}$$

$\underline{Z}$ is a 1 x (k-3) matrix of other determinants and $\underline{a}_4$ is the corresponding (k-3) x 1 matrix of coefficients. (Underlining denotes a matrix.) The error terms $\{u_{ij} | i=1,\ldots,n_j\}$ are assumed to be normal, independent, and identically distributed random variables with variance σ_j^2. The number of households in the group j is n_j.

Permanent income for group j is estimated, with an error, by the sample mean $\bar{Y}_j$. The equations defining permanent and transitory income may be written as:

$$\bar{Y}_j = Y_j^p + e_j \tag{16}$$

and

$$Y_{ij}^p = Y_j + Y_{ij}^t, \tag{17}$$

where $V(e_j) = \sigma_j^2/n_j$ with $\sigma_j^2 = V(Y_{ij})$. The sample mean $\bar{Y}_j$ in equation (16) is equal to permanent income plus an error. This error results from using the sample mean as a proxy for permanent income. If the sample mean were substituted directly into equation (15) without accounting for this error, the resulting regression coefficients would be inconsistent.

Transitory income is estimated as:

$$\hat{Y}_{ij}^t = Y_{ij} - \bar{Y}_j$$

using equation (17):

$$\begin{aligned} \hat{Y}_{ij}^t - Y_{ij}^t &= -(\bar{Y}_j - Y_j^p) \\ &= -e_j, \end{aligned}$$

which on average is zero for each group.

Let $\underline{M}_{xx}$ and $\underline{m}_{ee}$ denote the sample moments matrices of $\underline{X}$ and E, respectively, and let $\underline{m}_{xe}$ denote the cross-product matrix. Denote Ω as the moment matrix of the regressors $\underline{X}$ when actual permanent and transitory income are used. The distribution of the group means is given by:

$$\begin{bmatrix} \bar{\underline{Y}}_j \\ \\ \bar{\underline{x}}_j \end{bmatrix} = N \left[\begin{array}{c|cc} \underline{Y}_j^p & \sigma_{oo} & \underline{\sigma}' \\ \\ \underline{x}_j^p & \underline{\sigma} & \underline{\Sigma} \end{array} \right]$$

where

$$\bar{x}_j' = (\bar{y}_j^p \;\; \bar{S}_{oj}^p).$$

From equation (15) and the above error structure:

$$E(\underline{M}_{xx}) = \underline{\Omega} + \underline{\Sigma},$$

$$E(\underline{m}_{xe}) = \underline{\Omega}\,\underline{a} + \underline{\sigma},$$

and

$$E(\underline{m}_{ee}) = \underline{a}'\underline{\Omega}\,\underline{a} + \sigma_{oo} + \sigma_u^2.$$

As n_j goes to infinity, the estimator $\hat{\underline{a}}$ is consistent:

$$\begin{aligned} \hat{\underline{a}} &= (\underline{M}_{xx} - \underline{\Sigma})^{-1} (\underline{m}_{xe} - \underline{\sigma}) \\ &= (\underline{X}'\underline{X} - n_j\underline{\Sigma})^{-1} (\underline{X}'\underline{E} - n_j\underline{\sigma}). \end{aligned} \tag{18}$$

The matrix $\underline{\Sigma}$ is the matrix of measurement errors for the regressor variables. The only exogenous variables subject to measurement error are income and food stamp benefits. This method can be generalized to include measurement errors in other regressors, if desired.

Following Deaton, equation (18) was estimated using a weighted average of the individual estimated Σ's across the groups. Deaton (p. 120) gives an expression for the variance-covariance matrix of $\hat{a}$.

Estimates of the Marginal Propensity to Spend Out of Permanent Income

Table 8 presents estimates of the food expenditure equation with permanent income and food stamp benefits as regressor variables. Variables are defined in table 3. Compared with the results in table 4 (which used measured values), the magnitudes of the MPS out of income and the MPS out of food stamp benefits in the permanent-income specification are substantially larger for both at-home food expenditures and total food expenditures. As expected, this result implies that food stamp recipients spend more on food out of permanent income than out of reported income. Yet, the ratio of the MPS's in the permanent-income specification is much larger than one. Accordingly, the implication of cashing out the

Table 8--Estimates of at-home and total food expenditure equations using permanent income and food stamp benefits, and a linear specification

Variable	At-home food expenditure equation	Total food expenditure equation
PY	0.21	0.29
	(.01)1/	(.01)
PS_o	.81	.72
	(.01)	(.02)
Constant	-140.16	-136.22
	(26.31)	(25.77)
P1	-44.42	-51.22
	(94.69)	(49.72)
P2	9.74	-.83
	(17.54)	(11.29)
P3	14.14	10.78
	(37.89)	(5.07)
P4	79.30	82.11
	(27.55)	(20.41)
RACE	18.66	8.14
	(10.03)	(7.74)
REGION	-10.97	-10.61
	(6.87)	(4.98)
U/R	41.98	38.12
	(18.11)	(15.96)
SLR	-27.64	-30.11
	(44.25)	(49.07)
NUM	5.29	15.40
	(.96)	(2.12)
GM	17.17	16.47
	(7.53)	(7.07)
ELD	9.48	10.44
	(17.61)	(12.11)
WEL	15.73	7.69
	(14.63)	(8.20)

1/ Standard errors are given in parentheses.

FSP is the same for the linear specification with either permanent or reported income; namely, a cash-only program would result in a large reduction in food expenditures.

The robustness of the above conclusion could be tested in two directions: (1) an estimator based on additional demographic/economic description, particularly more asset information, could obtain different results; (2) an alternative estimator of permanent income could be employed; for example, that by Hall and Mishkin. However, this latter method and others require the previous income history of the household, data not available in the NFCS-LI.

Effect of Functional Form on Estimates of the Marginal Propensities to Spend and Implications for Cashing Out the Food Stamp Program

A food expenditure equation is defined using a translog indirect utility function and the generalization of Roy's identity defined in equation (3). This specification of the food expenditure equation is compared with the specifications that are linear in the coefficients. In addition, the predicted effect on food expenditures of cashing out the FSP is calculated and compared for both the specifications that are linear in the coefficients and the translog specification.

An Alternative to Food Expenditure Specifications that Are Linear in the Coefficients

Few reasons, other than convenience in estimation, are given for choosing specifications that are linear in the coefficients over other specifications. However, there are reasons for not choosing them. One is that all known theoretically consistent systems of consumer demand functions of three or more commodities that are linear in the coefficients have the property of unitary income elasticity for all commodities (Lau). Therefore, if one wanted a food expenditure equation that was based on a theoretically consistent system of consumer demand, specifications that are linear in the coefficients should not be chosen.

A second reason for avoiding specifications that are linear in the coefficients is the prior restrictions they place on the MPS's. In particular, specifications that are linear in the coefficients are not flexible enough to estimate theoretically consistent MPS's.

This inflexibility can be illustrated for the MPS out of food stamp benefits. For example, the theoretically consistent expression for $MPS(S_o)$ on food for at-home consumption can be obtained from equation (4) as:

$$MPS(S_o) = 1 + p\delta D/\delta S_o - g_2/g_1(1 + \varphi) \geq 0 \qquad (19)$$

where φ is the elasticity of g_2/g_1 with respect to S_o. The $MPS(S_o)$ is measured relative to 1 since, by assumption, participating households spend all their food stamps. The second term in equation (19) represents the change in at-home food expenditures that results from the change in total at-home food demand caused by changes in food stamp benefits. The third term represents changes in at-home food expenditures that result from the relative change in the marginal value of food bought with food stamps compared with food bought with income.

Both the linear and semi-log versions used in previous specifications imply that $MPS(S_o)$ is constant. Such a parameterization provides a poor approximation to equation (19) because it requires that no change occur in the marginal value of food bought with food stamps relative to food bought with income and that any change in food stamp benefits has no effect on total at-home food demand.

In the double-log version, $MPS(S_o) = cw$ for scaler $c \geq 0$ and at-home food expenditure share out of income is denoted by w. If this share declines (for whatever reason), the MPS out of food stamp benefits falls. From equation (19), this can occur in one of two ways: (1) each additional dollar of food stamp benefits stimulates less total at-home food demand; or (2) each additional dollar of food stamp benefits replaces a greater amount of food bought with income.

However, a decline in the food share is consistent with food stamps replacing a smaller, rather than a larger, amount of food bought with income. Likewise, a declining share is also consistent with an increase in the marginal utility of food at home relative to the composite of all other goods. In both of these instances, a declining share would be associated with an increase in the MPS(S_o), a result at variance with the parameterization of the MPS(S_o) in the double-log specification.

The response of the MPS(S_o) to a change in an exogenous variable ultimately is determined by the substitutability in the household's utility function between food bought with income and food bought with food stamps and between total at-home food and all other goods.

The alternative expenditure equation considered in this report is based on a theoretically consistent and flexible demand equation. Compared with the specifications that are linear in the coefficients, a flexible functional form imposes fewer prior restrictions on the MPS's, and, therefore, can be used to judge how well the specifications that are linear in the coefficients fit the data. A theoretically consistent expenditure equation also provides coefficient restrictions.

The translog indirect utility function is used to derive a flexible food expenditure equation. This utility function is written as:

$$U(S_o,Y,p,p_s,p_o,Z) = -a_o - F(Z) - \ln x'a - (1/2)\ln x'A\ln x - \ln x'DZ \tag{20}$$

where F depends on Z, Z is a k x 1 vector of household attributes, and

$$\begin{aligned}\ln x' &= [\ln(S_o/Y)\ \ \ln(p/Y)\ \ \ln(p_s/Y)\ \ \ln(p_o/Y)] \\ &= [\ln x_1\ \ \ln x_2\ \ \ln x_3\ \ \ln x_4].\end{aligned}$$

In addition, a_o is a scaler, a is a 4 x 1 vector, $A = (a_{ij})$ is a 4 x 4 symmetric matrix, and D is a 4 x k matrix of coefficients corresponding to commodity-specific demographic effects.

Using the generalized version of Roy's identity that is defined in equation (3) and the indirect utility function shown in equation (20), one derives the demand for food at home purchased with income. Substituting this expression into the identity $E \equiv pF + S_o$ gives an at-home food expenditure equation that is consistent with utility maximization and is flexible. This food expenditure specification is represented by:

$$E = Y\cdot(h_1/h_2) + S_o \tag{21}$$

where

$$h_1 = a_1 + a_2 + \sum_j(a_{1j} + a_{2j}) \ln x_j + (D_p + D_s)Z$$

and

$$h_2 = \sum_j a_j + \sum_i \sum_j a_{ij} \ln x_j + (D_p + D_s + D_{ps} + D_{po})Z.$$

The corresponding equation for total food expenditure is:

$$TE = Y\cdot(t_1/t_2) + S_o \tag{22}$$

where

$$t_1 = a_1 + a_2 + a_3 + \sum_j(a_{1j} + a_{2j} + a_{3j}) \ln x_j + (D_p\ D_s\ D_{ps})Z$$

and

$$t_2 = h_2.$$

Estimates of the Marginal Propensities to Spend Using a Translog Food Expenditure Specification

The at-home food expenditure equation specified in equation (21) was estimated assuming that the cross-section prices are constant:

$$(E - S_o)/Y = eh_1/eh_2 \tag{23}$$

where

$$eh_1 = c + (SA1 - a_{134})\ln(S_o) - (SA1 + SA2)\ln(Y) + 2D'_{bo}Z$$

$$eh_2 = 1 + (SA1)\ln(S_o) - (SA1 + SA2 + SA3 + SA4)\ln(Y) + 4D'_{bo}Z$$

$$SAi = \sum_j a_{ij}$$

and

$$a_{i34} = a_{i3} + a_{i4}.$$

The term $\sum_j a_{ij}$ is normalized to 1 and:

$$c = a_1 + a_2 + (a_{23} + a_{13})\ln(p_a) + (a_{14} + a_{24})\ln(p_o) + (a_{12} + a_{22})\ln(p).$$

The lack of price variation in the cross-section precludes estimating the commodity-specific effects of the demographic variables identified by the D's in the at-home and total food expenditure equations. Instead, each demographic variable is assumed to have a common overall effect on each commodity. These effects are denoted by the k x 1 vector D_o.

The estimating equation for total food expenditures is:

$$(E + p_aA - S_o)/Y = et_1/et_2 \tag{24}$$

where

$$et_1 = c' + (SA1 - a_{14})\ln(S_o) - (SA1 + SA2 + SA3)\ln(Y) + 3D'_{to}Z$$

$$et_2 = 1 + (SA1)\ln(S_o) - (SA1 + SA2 + SA3 + SA4)\ln(Y) + 4D'_{to}Z$$

and

$$c' = a_1 + a_2 + a_3 + (SA2 - a_{24})\ln(p) + (SA3 - a_{34})\ln(p_a) + (SA4 - a_{14})\ln(p_o).$$

Both equations (23) and (24) were estimated using nonlinear least squares.[8] These estimates are given below with standard errors in parentheses. Demographic variables are defined in table 3.

<u>Food at-home</u>

c = 36.19	SA1 = 2.95	a_{134} = 4.06
(14.30)	(1.25)	(2.16)

[8] The estimation of equation (23) assumed that this equation was subject to a random linear error. This error was assumed to be independent and identically distributed across the households in the sample. Alternative assumptions may result in different estimates. However, this issue is not pursued in this study.

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$SA2 = 3.13 \quad SA3 + SA4 = -6.59$
(2.65) (3.58)

$D'_{to}Z = 2.82\ NUM + 3.35\ GM + 1.91\ U/R - 0.54\ REGION + 0.72\ RACE - 1.59\ SLR$
(.64) (.61) (.59) (.44) (.47) (.99)

$- 3.93\ P1 + 0.43\ P2 + 0.57\ P3 + 9.48\ P4 - 0.35\ ELD + 1.14\ WEL$
(2.18) (1.89) (1.02) (2.82) (.53) (.48)

Total food

$c' = 34.42 \quad SA1 = 0.42 \quad a_{14} = 1.89$
(22.51) (.67) (1.01)

$SA2 + SA3 = 4.85 \quad SA4 = -7.51$
(2.31) (3.06)

$D'_{to}Z = 1.53\ NUM + 0.85\ GM + 0.59\ U/R - 0.29\ REGION + 0.16\ RACE - 1.02\ SLR$
(.52) (.40) (.29) (.28) (.25) (.73)

$- 2.66\ P1 - 0.10\ P2 + 1.90\ P3 + 4.58\ P4 - 0.34\ ELD + 0.30\ WEL$
(1.72) (1.08) (0.85) (2.07) (.37) (.12)

Table 9 reports the mean ratios of the MPS's and their mean ratios for at-home and total food expenditures using the translog specification. Table 9 shows that the translog functional form has mean ratios for both total food expenditures and at-home food expenditures that are greater than one but less than the ratios calculated from the specifications that are linear in the coefficients. Based on two standard deviations, the difference is statistically significant for the linear and semi-log specifications but not for the double-log specification. Consequently, neither the linear nor the semi-log expenditure equation is supported by the data.

With the translog specification, the mean ratio of the MPS's is smaller than the ratio of the means, implying that households with large MPS(S_o) also have large MPS(Y). In particular, the mean ratio for at-home food expenditures is 2.7, while the ratio of the mean MPS's is 3.6.

From a policy viewpoint, this positive correlation between the MPS's implies that households with the greatest reduction in food expenditures from the loss of food stamps will also be the households

Table 9--Mean marginal propensities and their ratios for at-home and total food expenditures using the translog specification

Mean	At-home food expenditures	Total food expenditures
MPS(S_o)	0.69	0.82
MPS(Y)	.19	.23
Ratio: MPS(S_o)/MPS(Y)	2.70 (.51) 1/	2.11 (.45)

1/ Standard errors of the mean are given in parentheses.

experiencing the greatest increase in food expenditures with the corresponding cash transfer. The total reduction in food expenditures will be less than implied by the sum of the individual MPS's.

Because both the linear and semi-log versions imply that the marginal propensities are uncorrelated, the existence of a nonzero correlation with the translog specification is evidence of the failure of these functional forms to approximate the correct expenditure equation. The MPS's in the double-log version, on the other hand, are negatively correlated. In light of the positive correlation obtained with the more general translog specification, this negative correlation implies an unduly restrictive expenditure equation.

The marginal effects of the ith demographic variable, Z_i, on at-home and total food expenditures are, respectively:

$$\delta E/\delta Z_i = d_{hoi}\, E_d \quad \text{and} \quad \delta TE/\delta Z_i = d_{toi}\, TE_d$$

where

$$E_d = (Y/h_2)[2 - 4(h_1/h_2)] \text{ and } TE_d = (Y/t_2)[3 - 4(t_1/t_2)].$$

The h's and t's are defined in equations (21) and (22). The d_{oi}'s are the coefficients corresponding to the ith demographic variable. At mean levels, $E_d = 5.34$ and $TE_d = 9.06$.

Household size and age composition are the demographic variables that have the greatest effect on food expenditures. Both the specifications that are linear in the coefficients and the translog specification identify family size as a significant determinant of food expenditures. Both specifications also indicate that: (1) an increase in the proportion of family members under the age of 3 decreases food expenditures (however, the effect is not precisely estimated); (2) an increase in the proportion of family members between the ages of 20 and 39 increases food expenditures; and (3) the proportion of members between the ages of 13 and 19 increases total food expenditures but not at-home food expenditures.

Enrollment in other welfare programs (WEL) accounts for the major difference in the effect of the demographic variables between the translog specification and the specifications that are linear in the coefficients. The translog specification identified the effect of this variable as positive and significant in determining food expenditures. This result suggests the existence of a cross-program effect.

Variables generally found to be significant in all specifications were the number of guest meals (GM) and living in an urban area (U/R). Region was also identified to be a significant variable in the linear and the semi-log versions for at-home food expenditures.

Implications of the Estimated Marginal Propensities to Spend for a Cash-Only Food Stamp Program

A ratio of the MPS's greater than one has been cited as evidence that cashing out the FSP would result in a decline in food expenditures. However, the ratio of the MPS's can be used in this manner only if the functional form is linear. For the other functional forms, the MPS's are nonlinear and no single point can measure the effect of a cash-only program.

An estimated ratio of the MPS's consistently greater than one implies that the Southworth formulation is incorrect. As shown earlier in this report, a ratio of the MPS's greater than one is equivalent to unequal marginal utilities of food bought with food stamps and with income. In other words, there is a stigma associated with using food stamps.

The effect on food expenditures of cashing out the FSP is made up of two components. First, food expenditures decline because of the loss of food stamps. This decline in expenditures equals the integral of $MPS(S_o)$ over $[S_o,0]$, holding income constant. Equivalently, this decline in expenditures can be calculated from the expenditure function. Writing this function as determined by food stamp benefits and income, this decline is equal to $E(0,Y) - E(S_o,Y)$.

Table 10--Mean expenditure ratios for at-home and total food expenditures, by alternative functional form 1/2/

Functional form	At-home food expenditures	Total food expenditures
Linear-in-the-coefficient specification:		
Linear	6.09	4.14
	(.96) 3/	(.69)
Semi-log	5.58	4.10
	(.08)	(.06)
Double-log	1.46	1.38
	(.05)	(.04)
Translog specification	1.40	1.33
	(.08)	(.07)

1/ The expenditure ratio is the loss of food expenditures resulting from the loss of food stamp benefits relative to the gain in food expenditures resulting from the corresponding income transfer.
2/ The results reported in this table were calculated assuming a $10 minimum level of food stamp benefits. This quantity of benefits is guaranteed to all participants. The entries in this table are, therefore, within sample estimates that are consistent with the estimating sample of food stamp participants.
3/ Standard errors of the mean are given in parentheses.

Second, food expenditures increase, resulting from the income transfer equal to the value of the food stamps. This increase in food expenditures is given by $E(0,Y+S_o) - E(0,Y)$.

Expenditure levels obtained in calculating the effect of cashing out the FSP will depend on the degree of nonlinearity of the food expenditure function. For example, if the MPS(Y) is a nonlinear function of food stamp benefits and if income and food stamps are substitutes, then a change in food stamp benefits causes the household's MPS(Y) schedule to shift right. The marginal propensity to spend on food out of income would be, therefore, greater at every income level. In fact, nonlinear marginal propensities explain the difference between the implication for cashing out the FSP obtained from the ratio of the MPS's and the measure obtained by directly evaluating the change in food expenditures.

One way to measure the effect on food expenditures from cashing out the FSP was to calculate the reduction in food expenditures from the loss of food stamp benefits relative to the gain resulting from the income transfer.[9] The proportion calculated in this way was named the "expenditure ratio" and is comparable to the ratio of the MPS's in table 5. Values of the expenditure ratios for both at-home and total food expenditures and for each specification are given in table 10 and exhibit wide variation.

Specifications for at-home food expenditures show the widest variation. At one extreme, the linear food expenditure equation predicts the reduction in at-home food expenditures from the loss of food stamp benefits is six times the increase resulting from the cash transfer. At the other extreme, the food expenditure equation based on the translog indirect utility function predicts that the reduction in total food expenditures from the loss of food stamps would be only 1.4 times the gain from the cash transfer.

[9] Calculations in tables 10 and 11 assume a lower limit of $10 for food stamp benefits. This benefit level is the minimum guaranteed to all participating households. The estimates reported in tables 10 and 11 are, therefore, within sample estimates.

Table 11--Average dollar reduction in at-home and total food expenditures per dollar of food stamp benefits converted to income, by alternative functional form 1/

Functional form	At-home food expenditures	Total food expenditures
Linear-in-the-coefficient specification:		
Linear	0.40	0.31
	(.003) 2/	(.002)
Semi-log	.45	.36
	(.003)	(.003)
Double-log	.10	.09
	(.004)	(.004)
Translog specification	.11	.11
	(.009)	(.007)

1/ The results reported in this table were calculated assuming a $10 minimum level of food stamp benefits. This quantity of benefits is guaranteed to all participants. The entries in this table are, therefore, within sample estimates that are consistent with the estimating sample of food stamp participants.
2/ Standard errors of the mean are given in parentheses.

An alternative, or second, way to measure the effect on food expenditures of cashing out the FSP was arrived at by calculating the dollar reduction in food expenditures for each dollar of food stamp benefits converted to income. Table 11 presents these values and shows that the response varies significantly across functional form.[10] The average reduction in food expenditures for each dollar of food stamp benefits converted to income is approximately 10 cents for the double-log and the translog specifications. The average reduction for the linear and semi-log specification is approximately 38 cents per dollar of food stamp benefits converted to income.

Conclusion

This report evaluates the estimation of the marginal propensities to spend (MPS) on food out of income and food stamp benefits. Previous studies of low-income household food expenditures have reported an estimated MPS out of food stamp benefits that is much larger than the MPS out of income. This has led to the general belief that cashing out the Food Stamp Program (FSP) would result in a significant decline in food expenditures. I hypothesized in this report that estimating the MPS's using specifications that are linear in the coefficients generally overstates the effect of food stamp benefits relative to income, and, therefore, overstates the effect a cash-only food assistance program would cause.

This report shows the importance of functional form by comparing estimates of the MPS's obtained from the specifications that are linear in the coefficients and which were used in previous studies with a new specification of the food expenditure equation that is consistent with utility maximization and is based on the translog flexible functional form. The estimated mean of the ratio of the MPS's varied substantially over the different specifications, suggesting that the functional form used is, indeed, important in

[10] As previously noted, the ratio, $MPS(S_o)/MPS(Y)$, does not measure the consequences of a cash-only FSP except for the linear food expenditure equation. The divergence between the expenditure ratios in table 10 and the mean ratios of the MPS's in table 5 illustrates that the ratio gives an incorrect measurement of the effect of a cash-only program because of the nonlinearity of the MPS's.

explaining the differences in estimates. However, this conclusion holds only for households that are enrolled in the FSP and that spend all their stamps.

The ratio of the MPS's is commonly used as a measure of the effect on food expenditures if the FSP were cashed out, but this ratio is an accurate measure of this effect only if the food expenditure equation is linear. When the MPS's are nonlinear, the effect of cashing out the FSP must be determined by evaluating the food expenditure equation at the appropriate levels of food stamp benefits and income.

Two measures of the effect of cashing out the FSP based on calculated expenditure levels were made in this report. One measured the magnitude of the decline in food expenditures due to the loss of food stamp benefits relative to the gain resulting from the income transfer. This relative measure is comparable to the ratio of the MPS's. Values of this measure were calculated for each specification and show wide variation. At one extreme, the reduction in at-home food expenditures from the loss of food stamp benefits was predicted to be six times the increase resulting from the cash transfer. At the other extreme, the food expenditure equation based on the translog indirect utility function predicts that the loss of at-home food expenditures would be only 1.4 times greater than the gain.

A second measure of the effect of cashing out the FSP calculated the dollar reduction in food expenditures for each dollar of food stamp benefits converted to income. This measure also shows large divergence among the specifications and, again, illustrates the importance exerted by the choice of functional form. For the double-log and the translog specifications, the average reduction in food expenditures for each dollar of food stamp benefits converted to income is about 10 cents. For the linear and semi-log specifications, the average decline is about 38 cents for each dollar of food stamp benefits converted to income.

Even if food stamps and income had identical effects on food expenditures, any conversion of the FSP to a cash-only program would face other obstacles. For example, taxpayers have a strong preference for a program that is explicitly tied to food. In addition, the FSP, as a food program, can maintain a unique identity that distinguishes it from other cash welfare programs run by Federal agencies other than USDA. An important public policy consideration that has not been addressed in this report is the number of the currently eligible nonparticipants who would enroll if the FSP were changed to a cash-only program.

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