# Policy Implications for U.S. Agriculture of Changes in Demand for Food

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# Measuring the Price and Expenditure Effects of Food Assistance Programs

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Food assistance programs have proven successful at increasing food consumption of low-income households. However, these programs are known to have additional effects. For example, programs that donate commodities from government stocks, like the initial version of The Emergency Food Assistance Program (TEFAP), displace commercial sales, reduce the price of the donated good, and increase its consumption by nonrecipients.

Other food assistance programs issue coupons redeemable for food, such as the Food Stamp Program (FSP) and, in some instances, The Special Supplemental Food Program for Women, Infants, and Children (WIC). This type of program also affects more than just the food consumption of recipients. These programs increase food prices and reduce the food consumption of nonrecipients.

The effect of food assistance programs is not, however, limited to their effect on food markets. These programs also affect nonfood markets by changing prices and creating purchasing power.

This paper presents a model that characterizes how prices and expenditures for food and nonfood items are affected by a food assistance program. This model can characterize food assistance programs that either donate commodities or issue coupons. Two important features of this model are

(1) A systems approach is used that includes food and nonfood items. Estimates of the marginal propensity to spend on food out of food stamps implies that a dollar worth of food stamps results in 65 cents of additional expenditure on nonfood items. Clearly, it would be inappropriate to characterize a food assistance program without accounting for its effect on other goods.

(2) The value of the donation is determined by utility maximization. Evidence suggests that recipients of food assistance programs value benefits at less than market value. Instead of assigning the donation an arbitrary value, the value the recipient places on the donation when maximizing utility is used.

In the final section of this paper, the model is used to illustrate the impact of 1986 TEFAP cheese donations. This particular food assistance program was chosen in order to use data in *The Survey of TEFAP Recipients* (U.S. Department of Agriculture, 1986). In this illustration, the expenditure system consists of three goods: cheese, other foods, and nonfood items. The quantitative impact of TEFAP cheese donations on equilibrium prices and expenditures was calculated using published elasticities and other data. Policy implications are also discussed in this section.

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## The Effect of Food Assistance Programs on Recipient Expenditures

In this section, the effect of a food assistance program on recipients' expenditures is modeled. The program can be one in which commodities are donated directly to the recipients, such as TEFAP, or one in which recipients choose the foods they purchase, such as the FSP.

### Income Equivalent of Donation

A recipient household is assumed to maximize utility subject to both income and donation constraints. Foods bought with income or received as a donation are considered separate goods. Since this formulation will be used to illustrate the effect of TEFAP, the constrained utility maximization problem is written for a food donation program that donates a commodity directly to recipients:[1]

$$\max L = U(q_1,d,\underline{q}_{h-1}) + g_1(y - p_1q_1 - \underline{p}_{h-1}\underline{q}_{h-1}') + g_2(d_o - d) \qquad (1)$$

where underlining denotes a vector, and

U is the household's utility function, which depends on h goods bought with income plus the good donated by the assistance program

$q_1$ is the quantity of the donated good bought with income

$p_1$ is the price of $q_1$

$d_o$ is the quantity donated

d is the quantity of the donation consumed

$\underline{q}_{h-1}' = [q_2, \ldots, q_h]$ is an $h - 1$ column vector of quantities, other than $q_1$, bought with income

$\underline{p}_{h-1} = [p_2 \ldots p_h]$ is an $h - 1$ row vector of prices corresponding to the elements of $\underline{q}_{h-1}$

y is income

$g_1, g_2 \geqslant 0$ are Lagrangian multipliers.

Utility is maximized with respect to $q_1$, d, $\underline{q}_{h-1}$, $g_1$, and $g_2$ given $p_1$, $\underline{p}_{h-1}$, y, and $d_o$. Let a superscript * denote a solution to Eq. (1). The resulting indirect utility function is

$$L^* = U(q_1^*,d^*,\underline{q}^*_{h-1}) + g_1^*(y - p_1q_1 - \underline{p}_{h-1}\underline{q}^*_{h-1}) + g_2^*(d_o - d^*) \qquad (2)$$

Initially it will be assumed that $g_1^*, g_2^* > 0$. Define the level of income $y_o^*$ as follows:

$$y_o^* = (g_2^*/g_1^*)d_o \equiv g^*d_o \qquad (3)$$

The variable $g^*$ measures the marginal utility of the donations relative to the marginal utility of income. The income $y_o^*$ is, therefore, the equivalent of the donation $d_o$ in the sense that either $d_o$ or $y_o^*$ provides the recipient with the same level of utility.[2] To illustrate this proposition, substitute $g_1^*y_o^*$ for $g_2^*d_o$ in Eq. (2). This yields

$$L^* = U(q_1^*,d^*,\underline{q}_{h-1}^*) + g_1^*(y + y_o^* - p_1q_1^* - \underline{p}_{h-1}\underline{q}_{h-1}'^*) - g_2^*d^* \qquad (4)$$

Using a first-order Taylor's series approximation,

$$U(q_1^*,0,\underline{q}_{h-1}^*) - U(q_1^*,d^*,\underline{q}_{h-1}^*) = -\delta U/\delta d\,\Big|_{(q_1^*,d^*,\underline{q}_{h-1}^*)}(d^*) = -g_2^*d^*$$

[1]The utility maximization problem Eq. (1) can be specified for a food assistance program such as the Food Stamp Program by defining $q_1$ as the quantity of food for at-home consumption bought with income, the variable $d_o$ as the value of the food stamp benefits received, and the variable d as the quantity of food bought with food stamps.

[2]Ranney and Kushman (1987) write the income of a food-stamp-participating household as $y + d_o\mu$ where food stamp benefits are denoted by $d_o$ and $\mu$ is a parameter measuring the extent to which the food stamp allotment is cash equivalent. They assume this parameter is a logistic function of income, food stamp benefits, and prices. Equation (3) provides an economic interpretation of this parameter.

implies that Eq. (4) can be written as

$$L^*_a = U(q_1^*,0,\underline{q}_{h-1}^*) + g_1^*(y + y_o^* - p_1q_1^* - \underline{p}_{h-1}\underline{q}_{h-1}'^*) \quad (5)$$

To a first-order approximation, the indirect utility function in the food assistance regime Eq. (2) has a counterpart Eq. (5) in the regime with no food assistance programs. For empirical applications it is advantageous to use Eq. (5) since the donation's effect can be characterized using the income elasticity.

**Effect of Food Assistance Program on Recipient Expenditures**

Initially consider the effect of the donations on purchases of the donated good. The demand function of the donated good bought with income, $q_1$, can be obtained by applying Roy's identity to the indirect utility function Eq. (2):

$$q_1 = -(\delta L/\delta p_1)/g_1 = Q_1(p_1,\underline{p}_{h-1},y,d_o), \quad (6)$$

where the * notation has been dropped.

Equivalently, this demand can also be obtained by applying Roy's identity to the indirect utility function Eq. (5),

$$q_1 = -(\delta L_a/\delta p_1)/g_1 = Q_1(p_1,\underline{p}_{h-1},y + y_o,0) \quad (7)$$

which is a first-order approximation to the demand function Eq. (6). In Eq. (7) the donation increases demand by increasing income by the amount $y_o = gd_o$. The household realizes this income by substituting the donation for $y_o$ worth of $q_1$. This substitution means that expenditures on the donated commodity are equal to the value of the recipient's demand less the value placed on the donation. That is,

$$e_1 = p_1Q_1(p_1,\underline{p}_{h-1},y + y_o,0) - y_o \quad (8)$$

Expenditures on the other h – 1 goods are also affected by the income created by the donation. From the indirect utility function (Eq. 5), expenditures on these goods can be specified for i = 2, . .,h, as,

$$e_i = -p_i(\delta L_a/\delta p_i)/g_1 = p_iQ_i(p_1,\underline{p}_{h-1},y + y_o,0) \quad (9)$$

Denote $\text{dlog}(\underline{e})' = [\text{dlog}(e_1) \ldots \text{dlog}(e_h)]$, $\text{dlog}(\underline{p}) = [\text{dlog}(p_1), \text{dlog}(p_2) \ldots \text{dlog}(p_h)]$, $\text{dlog}(\underline{d}_o) = \text{dlog}(d_o)\underline{1}_h$, and $\text{dlog}(y) = \text{dlog}(y)\underline{1}h$ where $\underline{1}_h$ is a 1 x h vector of ones. Also define $\underline{N}' = [\underline{N}_1 \ldots N_h]$, where $N_i = [n_{i1}\ n_{i2} \ldots n_{ih}]$ is the 1 x h vector of own- and cross-price elasticities for the ith good. Denote $\underline{N}_y$ as the h x h matrix with income elasticities down the main diagonal and zero elsewhere. The expenditure system for the h goods defined by Eqs. (8)-(9) can be written in log-differential form as

$$\text{dlog}\ (\underline{e}) = \underline{\alpha}[(\underline{N} + I_h)\text{dlog}(\underline{p})' + \alpha_y\underline{N}_y\text{dlog}(\underline{y})' + [\alpha_{yo}\underline{N}_y - \underline{A}](1 + \mu)\text{dlog}(\underline{d}_o)'] \quad (10)$$

where

$\alpha = p_1q_1/p_1Q_1$ the expenditure share of the donated good bought with income

$$\underline{\alpha} = \begin{bmatrix} 1/\alpha & 0 \\ 0 & I_{h-1} \end{bmatrix}$$

$$\underline{A} = \begin{bmatrix} (1-\alpha) & 0 \\ 0 & 0_{h-1} \end{bmatrix}$$

$\alpha_y = y/(y + y_o)$ the proportion of income in "total" income (income plus the value of the donation)

$\alpha_{yo} + \alpha_y = 1$

$\mu = \text{dlog}(g)/\text{dlog}(d_o)$ the elasticity of the marginal value of the donation with respect to its level.

**Expenditures by Recipients Who Do Not Consume Entire Donation**

Up to now it has been assumed that $g_2 > 0$. This condition is equivalent to assuming that the recipient consumes the entire donation, $d^* = d_o$. If, instead, $g_2^* = 0$ then the marginal utility of the donation is zero. From Eq. (3) this means that $y_o = 0$. It follows from Eq. (2) that the amount of the donation actually consumed depends on income and prices. For the recipient with $g_2^* = 0$ the expenditure system for goods bought with income has the same structure as that of a nonrecipient.[3]

## Effect of Commodity Donation Program on Equilibrium Prices and Expenditures

Equilibrium prices and quantities are determined by setting the total expenditures by recipients and nonrecipients equal to the value of the goods supplied. The price and quantity effects of food assistance programs are specified in this section, assuming that the income of both recipients and nonrecipients remains unchanged. This assumption allows the analysis to concentrate on how the size of the donations affects prices and quantities. Recipients and nonrecipients are assumed to have the same constant price and income elasticities.

### Market Equilibrium Prices

Market equilibria for the h goods can be expressed in log differential form as

$$\underline{w}_r \mathrm{dlog}(\underline{e}_r) + (I_h - \underline{w}_r)\mathrm{dlog}(\underline{e}_{nr}) = \mathrm{dlog}(\underline{e}^s) \qquad (11)$$

where the subscripts r and nr denote recipients and nonrecipients, respectively. Let $\mathrm{dlog}(\underline{e}_r)' = [\mathrm{dlog}(e_{r1}) \ldots \mathrm{dlog}(e_{rh})]$ and $\mathrm{dlog}(\underline{e}_{nr})' = [\mathrm{dlog}(e_{nr1}) \ldots \mathrm{dlog}(e_{nrh})]$, where $e_{ri}$ and $e_{nri}$ are expenditures by the recipients and nonrecipients on the ith good. Define $\underline{w}_r$ as a h x h diagonal matrix whose ith diagonal element is the recipients' expenditure share on the ith good. Let $\mathrm{dlog}(\underline{e}^s)' = [\mathrm{dlog}(e^s_1), \ldots, \mathrm{dlog}(e^s_h)]$ denote the value of goods supplied measured in log-differential form.

Using the expenditure system for recipients Eq. (10) and assuming a conventional demand system for nonrecipients, the market equilibrium conditions (11) can be written as

$$\begin{aligned}&\underline{w}_r\{\underline{\alpha}[(\underline{N} + I_h)\mathrm{dlog}(\underline{p})' + (\alpha_{yo}\underline{N}_y - \underline{A})(1 + \mu)\mathrm{dlog}(\underline{d}_o)']\} \\ &\quad + (I_h - \underline{w}_r)(\underline{N} + I_h)\mathrm{dlog}(\underline{p})' = \\ &(\underline{S} + I_h)\mathrm{dlog}(\underline{p})', \end{aligned} \qquad (12)$$

where $\underline{S}$ is an h x h matrix of supply elasticities.

Solving Eq. (12) for the percentage change in prices gives

$$\begin{aligned}\mathrm{dlog}(\underline{p})' = &- [\underline{P}(\underline{N} + I_h) - (\underline{S} + I_h)]^{-1} \\ &\underline{w}_r\underline{\alpha}[(\alpha_{yo}\underline{N}_y - \underline{A})(1 + \mu)]\mathrm{dlog}(\underline{d}_o)'\end{aligned} \qquad (13)$$

where $\underline{P} = \underline{w}_r\underline{\alpha} + (I_h - \underline{w}_r)$.

### Effect of Donation When Measured Relative to Initial Consumption

In previous sections, the donation has been measured in terms of its percentage change. In this section, an expenditure system is specified in which the donation is measured relative to prior consumption. That is, the donation will be measured by $d_o/q_b$, where the denominator represents the quantity consumed before the start of the program. This specification is appropriate when one wishes to determine the program effect of the food assistance program relative to preprogram levels. This specification is used in the next section to calculate the effect of initiating the TEFAP commodity donation program.

The equilibrium percentage change in prices was obtained using a procedure similar to the one used in deriving Eq. (13). In addition, since there were no donations in the preprogram period $dy_o = y_o$,

$$\begin{aligned}\mathrm{dlog}(\underline{p})' = &[(\underline{Z}_r + \underline{Z}_{nr})(\underline{N} + I_h) - (\underline{S} + I_h)]^{-1} \\ &\underline{Z}_r[\alpha_{g}r_{p}\underline{N}_y - \underline{B}]\,(d_o/q_b)\end{aligned} \qquad (14)$$

where subscripts b and a are used to denote before and after the start of the food assistance program, and

$\underline{Z}_r = \underline{w}_r\underline{\beta}_r$; $\underline{\beta}_r$ is a diagonal matrix defined for recipients. For each good, the diagonal element is the quantity after TEFAP, evaluated at before TEFAP price, relative to expenditure before TEFAP. That is, $p_b q_a / p_b q_b$.

[3]There will be no purchases of the donated good when $g_2^* = 0$ only if the purchased and the donated goods have the same marginal utility schedules.

$\underline{w}_r$ is a diagonal matrix of the recipients' expenditure shares

$\underline{Z}_{nr} = (I_h - \underline{w}_r)\underline{\beta}_{nr}$; $\underline{\beta}_{nr}$ is similar to $\underline{\beta}_r$ except the expenditures are by nonrecipients

$\underline{r}_p$ is a diagonal matrix with the relative price after TEFAP, $p_a/p_b$, along the main diagonal

$\underline{B}$ is a 3 x 3 matrix with the (1,1) element equal to $gq_b/p_bq_a$ and zero elsewhere

$\alpha_g = gq_b/(y + y_o)$.

## Calculating Effect of TEFAP on Price and Quantities

In this section, changes in equilibrium prices and the expenditures caused by TEFAP are calculated. These calculations are made using published elasticities and other data sources, especially *The Survey of TEFAP Recipients* (U.S. Department of Agriculture 1986). A three goods expenditure system is used consisting of cheese, other food, and nonfood items.

### Calculating Value of TEFAP Donations

Calculating the effect of TEFAP on prices and expenditures using Eq. (14) requires an estimate of $y_o$, the value recipients place on the cheese donations. The most direct way to estimate this term is to use the estimated TEFAP "displacement rate" calculated in previous studies (U.S. Department of Agriculture 1987, Levedahl 1989, Zellner and Traub 1987). This rate is defined as the reduction in commercial sales of cheese caused by TEFAP as a proportion of total TEFAP donations. The value the recipient places on the donation, $y_o$, is defined in Eq. (3). From Eq. (8), we see this value is also the commercial sales of cheese replaced by the donation. Given an estimate of the average displacement rate and the market value of the average TEFAP donations, a value of $y_o$ can be calculated.

In this paper an alternative method of calculating the value of the donation is used. Let the subscripts b and a stand for the time periods before and after TEFAP. Denote expenditures by e and the value of demand as pQ. Since there are no donations prior to the program, $dy_o = y_o$ and $e_b = p_bQ_b$. Then Eq. (8) can be written as

$$e_a = e_b + d(pQ) - y_o = e_b(1 + dq/q_b + dp/p_b) - y_o.$$

Expanding $dq/q_b$, in terms of prices and income $y + y_o$ yields

$$e_a = e_b\,(1 + (\underline{N}_1 + \underline{D})\mathrm{dlog}(\underline{p}) + n_{y1}\{1 - \alpha_y[1 - \mathrm{dlog}(y)]\}) - y_o \qquad (15)$$

where $n_{y1}$ denotes the income elasticity of cheese and $\underline{D}$ is a 1 x 3 vector with a 1 in the (1,1) position and zero elsewhere.

Using data from *The Survey of TEFAP Recipients* (U.S. Department of Agriculture 1986) and from Boldin and Burghardt (1989), we calculated the average TEFAP annual donation from Eq. (15) to be worth \$58.40. This means that TEFAP cheese was valued, on average, by recipients at \$1.06 per pound (compared to a market price of \$2.60 per pound). These calculations imply a displacement rate of 0.406. This value is within the range of previous estimates.

### Data Definition

TEFAP cheese donations in 1986 were chosen to illustrate the impact of this program. This year was picked so that data available in *The Survey of TEFAP Recipients* (U.S. Department of Agriculture 1986) could be used. TEFAP began in 1982 but donations that year were only about 15 percent of the donations in 1983 and the following years. Because of the detailed information on expenditures reported by Boldin and Burghardt (1989) for 1982, it was decided to use this year as the preprogram period.

A three goods expenditure system was specified consisting of cheese, all other food, and nonfood items. Elasticities and shares were obtained from the literature or obtained from existing data sets. These data are discussed in the Appendix.

The generally accepted estimate of 5 million TEFAP households in 1986 was used. Data from Boldin and Burghardt (1989) was used to calculate the recipients' share of other food and nonfood items. Data from the TEFAP survey were used in calculating the recipients' shares of the cheese market.

**Demand and Income Elasticities**

Demand and income elasticities were obtained from Huang (1985). Elasticities were aggregated to coincide with the three goods system.

**Supply Elasticities**

Supply elasticities are more difficult to obtain. To be consistent with the demand elasticities, the supply elasticities must be measured at the retail level.

Estimates of own- and cross-supply elasticities at the farm level for fluid milk and various farm outputs are reported by Ball (1988). Farm-level supply elasticities for cheese and other food were calculated using these elasticities and assuming a fixed yield between cheese and milk. The farm-level elasticities for cheese and other foods were converted to retail level elasticities by assuming that farm output and marketing services were combined in fixed proportion to produce a retail product. In this case, the own-retail supply elasticity for, say cheese, is then given by

$$\epsilon_{cc} = [(\tau_c/\epsilon_{cc}^{f}) + (1-\tau_c)/\epsilon_{bb}]^{-1}$$

where $\epsilon_{cc}$ and $\epsilon_{cc}^{f}$ are the retail and farm-level own cheese elasticities of supply, and $\tau_c$ is the share of cheese in the retail product. Retail product shares for the individual goods are obtained from Dunham (1991) as the farmer's share of the retail price. The elasticity $\epsilon_{bb}$ is the supply elasticity of marketing services. Alternative values of this elasticity were used but they had little impact on the results.

The corresponding relationship for the cross-price supply elasticities at retail is

$$\epsilon_{ji} = [(\tau_i/\epsilon_{ji}^{f}) + (1-\tau_i)\epsilon_{ii}^{f}/\epsilon_{ji}^{f}\epsilon_{bb}]^{-1}$$

where i and j stand for any of the goods, $i \neq j$, $t_i$ is the farm share of the ith retail product.

The most difficult supply elasticities to identify are those associated with the aggregate nonfood category. Without estimates of these elasticities, the following procedure was used.

Let $p_c$, $p_{of}$, $p_{nf}$ denote the price of cheese, other food, and nonfood items, respectively. Denote the prices of inputs used in food and nonfood production by $\underline{r}_f$ and $\underline{r}_{nf}$ and assume that food and non-food production have no common inputs. Then, an additively separable profit function for food and nonfood implies

$$\pi(p_c,p_{of},p_{nf},\underline{r}_f,\underline{r}_{nf}) = \pi_1[g_f(p_c,p_{of},\underline{r}_f)] + \pi_2[g_{nf}(p_{nf},\underline{r}_{nf})], \qquad (16)$$

where $g_f$ and $g_{nf}$ are homothetic. Assuming the profit function Eq. (16) means that food and nonfood items are neither substitutes nor complements in production. The own supply elasticity for nonfood items was treated as a parameter and the effect of alternative values of this elasticity was evaluated.

**The Calculated Effect of TEFAP on Prices and Expenditures**

The equilibrium price vector is specified in Eq. (14). Substituting the appropriate parameter estimates into this equation gives the percentage change in the price of cheese, other food, and nonfood items (measured relative to their 1982 levels) in terms of the size of donation relative to the quantity of 1982 cheese consumption.

$$d\log(\underline{p})' = [-.017541 \; -.000026 \; .000031] \; d_o/q_b \qquad (17)$$

The average 1986 TEFAP donation was 1.93 times the recipient's prior consumption implying that 1986 TEFAP donations reduced the commercial price of cheese by 3.4 percent. There was also a small reduction in the price of other food and a small increase in the price of nonfood items.

The resulting percentage change in the expenditures by nonrecipients and recipients caused by TEFAP can be calculated using the price vector Eq. (17).

$$\mathrm{dlog}(\underline{e}_r)' = [-.4142280\ .0005537\ .0054080]\ d_o/q_b$$
$$\mathrm{dlog}(\underline{e}_{nr})' = [-.012006\ -.000098\ .000083]\ d_o/q_b \qquad (18)$$

As expected, TEFAP's effect on the recipient's expenditures for commercial cheese is large and negative. Approximately 80 percent of the recipient's expenditures on cheese are displaced by 1986 donations.

The cheese expenditures by recipients would be completely displaced by a donation 2.414 times prior consumption. This level of donation was calculated from Eq. (18) after setting the percentage change in recipient cheese expenditures equal to –1. A donation this size would reduce the price of cheese by 4.23 percent. At this donation level TEFAP realizes its maximum effect. Donations beyond this point have no effect on prices or expenditures because all the cheese bought by recipients would be displaced.

According to the results in Eq. (18), the recipients increased their expenditures on other food by $2.38 and on nonfood items by $55.56. This means that only about 5.0 percent of the income created by the donation was spent on food items. The sum of these expenditures is close to the donation value of $58.40 calculated in an earlier section (Calculating Value of TEFAP Donations).

Nonrecipients' expenditures on cheese fall because of the decline in the price of cheese. However, the quantity of cheese they consume actually increases by 0.5 percent.

The effect of TEFAP on other food expenditures is given in Eq. (18). For nonrecipients the donation reduces other food expenditures. This follows because cheese and other food are substitutes in demand. This substitution effect also affects other food expenditures by recipients; however, it is countered, to some degree, by the income effect created by the donation.

The net effect of TEFAP donations on other food expenditures can be calculated on a national basis. For the nonrecipients, the donation reduces annual expenditures on other food by $48.7 million. However, TEFAP recipients increase their other food expenditures by $12.0 million. The net effect on annual expenditures of other food is a loss of $36.7 million, which is about 0.01 percent of the United States off-premise food expenditures in 1986.

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## Appendix: Elasticities and Recipient Expenditure Shares

Demand and income elasticities for cheese, other food, and nonfood items were obtained from Huang (1985).

$$\underset{\sim}{N} = \begin{bmatrix} -.3319 & .1456 & -.4064 \\ .0044 & -.1292 & -.0494 \\ -.0038 & -.1964 & -.9875 \end{bmatrix}$$

$$\underset{\sim}{N}_y = \begin{bmatrix} 0.5927 & 0 & 0 \\ 0 & 0.1742 & 0 \\ 0 & 0 & 1.1873 \end{bmatrix}$$

Farm-level supply elasticities for cheese and other food were aggregated from elasticities given by Ball (1988).

$$\underset{\sim}{S}^f = \begin{bmatrix} .6420 & 3.162 \\ .4677 & 3.525 \end{bmatrix}$$

These elasticities were calculated assuming a pound of milk yields a fixed amount of cheese. The positive cross elasticities reflect the assumption that these products are complements in production. The farm-level supply elasticities were transformed to retail supply elasticities by using the formula given in the section called Supply Elasticities. In this conversion, the supply elasticity of marketing services was assumed to be equal to five; however, the size of this elasticity had made little or no effect on the results. An additively separable profit function for food and nonfood was also assumed. The calculated retail supply elasticities for cheese, other food and nonfood items are given as

$$\underset{\sim}{S} = \begin{bmatrix} 1.274 & 0.587 & 0 \\ 6.280 & 4.462 & 0 \\ 0 & 0 & 5 \end{bmatrix}$$

Recipients' shares were obtained using data from The Survey of TEFAP Recipients (U.S. Department of Agriculture 1986), Statistical Abstract of the United States (U.S. Department of Commerce 1988) and Boldin and Burghardt (1989).

$$\underset{\sim}{w}_r = \begin{bmatrix} .0533 & 0 & 0 \\ 0 & .0433 & 0 \\ 0 & 0 & .0289 \end{bmatrix}$$