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Economic Evaluation of Food Programs: The Case of the Farmers' Market Nutrition Program

Richard E. Just, *University of Maryland at College Park*
Quinn R. A. Weninger, *University of Maryland at College Park*

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Richard E. Just

and

Quinn Weninger

Department of Agricultural and Resource Economics
University of Maryland
College Park, Maryland

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Governmental food assistance for low-income consumers began with the New Deal and initially involved surplus commodity distribution with an important objective of raising farm income (Nelson and Perrin). In the current policy mix, these programs have evolved into the Food Stamp Program (FSP), the School Lunch Program (SLP), the Food Program for Women, Infants, and Children (WIC), and a host of smaller programs targeted mostly at children and the elderly. These programs, which now account for 65 percent of the total USDA budget, have the dual objectives of nutritional support for low-income households and reduction of agricultural surpluses. As these programs have become entrenched, however, they have tended to be evaluated as an income supplement (Hiemstra). A comprehensive economic evaluation needs to consider income and nutritional benefits for recipients as well as the market benefits for farmers and indirect effects on taxpayers and other consumers.

Many studies have evaluated specific aspects of the FSP and SLP such as their effects on nutrient intake (see, e.g., Basiotis, et al., on the FSP and Akin, et al., on the SLP). Several have estimated the marginal propensity to consume out of food grants (e.g., West and Price; Senauer and Young). Others examine distributional equity (Martin and Lane), price impacts (Belongia), and participation decisions (e.g., Capps and Kramer). Recently, evaluation efforts have estimated marginal propensities to consume associated with WIC Programs (Arcia, et al.). Findings are that food assistance programs increase food consumption and nutrient intake, but welfare effects are inequitable and price effects have been small. While behavioral aspects of these programs have been analyzed, a comprehensive economic welfare evaluation is both lacking and needed for identifying program improvement possibilities (Selowsky).

Economic welfare evaluation of these programs is difficult for four reasons. First, food assistance generally applies to a specific group of commodities that may not be as highly valued by recipients as by society (Thurow). Second, food assistance can be used only at specific markets (e.g., participating stores

or school lunch rooms) that may involve substantial transaction costs (transportation and/or time) or reduced substitution possibilities (e.g., milk for a child at school substitutes imperfectly for adult food intake at home). Third, because food assistance programs cannot be practically tailored to the individual tastes of recipients, empirical models must evaluate both inframarginal and extramarginal effects and determine which applies to each recipient (Southworth; Senauer and Young). Fourth, education or habit formation due to programs may change valuations of commodities by participants. These changes must be taken into account in evaluating program effects.

The purpose of this paper is to develop and demonstrate a methodology for analyzing food programs with these four difficulties. This is done in the context of the Farmers' Market Nutrition Program (FMNP) which represents a small share of both WIC and USDA food assistance programs. Since July 1992, the FMNP has been operated as a permanent feature of the WIC Program. The FMNP gives coupons to qualified single mothers that can be redeemed for fresh fruits and vegetables (F&V's) at farmers' markets (FM's) and in some cases also provides information on how to prepare F&V's. The stated purpose of the FMNP is to provide fresh, nutritious, unprepared foods from FM's to women, infants and children who are nutritionally at risk and to expand awareness and use of FM's by consumers.

The FMNP has been a growing program. In fiscal year 1993, 342,000 recipients in 11 states participated in the FMNP. In 1994, 24 states, the District of Columbia, and the Cherokee Nation of Oklahoma offered FMNP assistance. The 1994 FMNP program budget is comprised of $5.5 million of federally appropriated WIC funds representing 70 percent of total FMNP expenditures with the remaining 30 percent of costs matched by state agencies. The WIC participants receive three types of benefits: increased F&V consumption, increased valuation of F&V consumption, and increased purchasing power for other goods and services by diverting money otherwise spent on F&V's. Farmers participating in FM's benefit by selling more F&V's at marginally higher prices. These benefits must be compared to the

indirect effects on other groups including other consumers who must pay marginally higher prices, taxpayers who finance the program and other farmers who receive marginally higher prices.

Conceptual Framework

Food assistance increases demand for target commodities by altering their effective price (Belongia) and/or by providing education about nutrition and food preparation that enhances target commodity valuation by participants. Increased demand raises equilibrium prices for other consumers while inducing farmers to bring more to market. Because the amount of food assistance is small compared to total consumer expenditures, the price changes are small and perhaps imperceptible to market participants (e.g., Belongia reports several estimates that do not exceed .4 percent for the FSP). Nevertheless, the indirect impacts on other consumers can be substantial because the number of consumers affected is large.

To understand the calculation of benefits and costs by group, we analyze the effects of FMNP coupon distribution in a partial equilibrium framework. A partial equilibrium framework is adequate because price effects are small. For ease of exposition, consumer surplus is used as a consumer welfare measure.[1] Figure 1 represents market conditions of, say, F&V's in the aggregate. Supply is represented by S and demand in absence of the assistance program is D_0. Market equilibrium occurs where S is equal to D_0 at price P_0 and quantity Q_0. Now suppose assistance creates an additional demand increasing total demand to D_1. Then market equilibrium occurs at price P_1 and quantity Q_1. Where D^* represents the demand by non-recipients, their quantity purchased adjusts downward from Q_4 to Q_3. The corresponding welfare effect is a loss for non-recipient consumers of area A and an increase in quasi-rent for producers of area A+B+C (revenues increase by area A+B+C+E+F and costs increase by E+F).

The welfare effect for recipients is somewhat more difficult to determine. For participants who receive no more coupons than customary purchases of the target commodities in target markets (e.g., F&V's at FM's, or milk at school lunch rooms), the assistance is inframarginal; it simply replaces

customary purchases so expenditures displaced thereby can be allocated to other uses (Southworth). In this case, the assistance is equivalent to receiving the same amount in income and the income-equivalent welfare effect is measured by the amount of coupons received. No demand effect results.[2]

For participants who receive more coupons than customary purchases of target commodities, several outcomes are possible. First, they may not want to consume the target commodities or the transaction costs of the target markets may exceed the value to them of the assistance. In this case, no coupons will be redeemed so both the income equivalent effect and the demand effect are zero.

For others, the effects will be extramarginal. That is, purchases of target commodities at target markets will be greater when receiving assistance. The value to the individual of these additional purchases will be less than reflected by the market price. Otherwise, the same foods would be purchased in absence of assistance. For these participants, the income equivalent effect follows Figure 2.

First, consider the "no information" case where coupons are distributed without additional demand-enhancing instruction. Increased purchases of the target commodities are due entirely to participants facing an effective price below the market price. Let d represent an individual demand for the target commodities by a recipient receiving no demand-enhancing information. This corresponds to the components of aggregate demand to the right of D^* in Figure 1. At an initial price P_0, in absence of assistance, the individual buys quantity q_0 and total expenditure is area c+e. Now suppose the individual is given an amount of coupons equal to g^* of which only a smaller amount g_r are redeemed at the higher price P_1 which occurs with the assistance program. Some coupons are not redeemed because the recipient reaches a saturation point where further redemption is of no benefit even at a zero price. The quantity purchased is equal to $q_2 = g_r/P_1$ and the total value of coupons redeemed is represented by area a+b+c+e+f+g. Unredeemed coupons are equal to $g^* - g_r$ which is equal to area h+j+k+m.

The benefit of coupons to the individual can be evaluated as follows. First, the higher market price

for F&V's causes a welfare loss, hereafter referred to as the "price effect," equal to area a+b (summed across program participants, this loss corresponds to area B in Figure 1). Next, the individual receives an "income effect" of area a+c because the money that would have been spent on quantity q_1 is now displaced by coupons and can be spent on other consumption items. The additional consumption of target commodities that occurs because of coupons is $q_2 - q_1$ and is made possible by the remaining coupon expenditure (called the "coupon effect") equal to area b+e+f+g. However, of this expenditure, area g is of no benefit to the individual. The value of consumption of target commodities to the individual declines as the quantity consumed increases above what would be purchased in the market without coupons, quantity q_1. Thus, area g represents taxpayer expenditure that generates no value. Area g is an economic efficiency loss resulting because recipients do not value the program goods they receive as much as society.

The net welfare effect for the individual in this no instruction case is area c+e+f. This gain comes at a taxpayer expense of area a+b+c+e+f+g for coupon redemption (in the amount of P_1q_2). Coupon recipients plus taxpayers thus suffer a net loss of area a+b+g. The remaining program effects are to farmers and non-recipient consumers. While farmers gain more than non-recipient consumers lose in Figure 1, it can be shown that without the additional benefits of market-failure-correcting information, a net loss is incurred for society as a whole.[3]

Next, consider the case where coupon distribution is accompanied by preparation instruction and nutritional information that leads coupon recipients to value consumption of the target commodities more highly. Suppose this information increases individual demand to d′ in Figure 2 with the amount of coupons redeemed now represented by g_i where the subscript 'i' denotes information. The quantity purchased with coupons, $q_3 = g_i/P_1$, exceeds the amount purchased without information and increases the amount of coupons redeemed by $g_i - g_r$.

The economic benefits for the individual in this case are as follows. Again, the individual receives

an income effect of area a+c while suffering a price effect (loss) of area a+b. The additional consumption over this amount, now q_3 - q_1, is made possible by the remaining coupon expenditure (equal to area b+e+f+g+h+j+k). This increase in purchases can be divided into two effects. Area b+e+f+g+h is an "information effect" on consumption expenditures associated with the increase in consumption from q_1 to q_4. This effect of information would occur even if coupons were not received. Area j+k is a coupon effect that represents an expenditure that would not occur without coupons. Area j is a benefit received by recipients whereas area k is an efficiency loss representing an amount of coupons redeemed for which the individual gets no benefit.

Finally, area n is a "non-market effect" on individual benefits. This area represents an economic efficiency gain that is possible because participants receive information that is necessary to make informed choices which enhances their valuation of target commodities. Considering all of these effects, the individual with information gains area c+e+f+g+h+j+n at a cost of area a+b+c+e+f+g+h+j+k to the taxpayer (for coupon redemption in the amount of P_1q_3) for a net gain of area n - area a+b+k.

The various welfare effects can be quantified in a straightforward manner as follows. In absence of coupons, the market equilibrium price and quantity for F&V's satisfies

$$D(P_0,Y_0) = S(P_0) = Q_0 \tag{1}$$

where D and S are, respectively, aggregate demand and supply and Y_0 is per capita consumer income. Now suppose that total coupons equal in value to G^* are distributed to participants. Suppose that a smaller amount G are redeemed with an amount $G_i = \phi_i G$ redeemed by those who buy more F&V's and receive information, an amount $G_n = \phi_n G$ redeemed by those who buy more F&V's and do not receive information, an amount $G_s = \phi_s G$ redeemed by those who buy no more with coupons, and an amount $G_t = \phi_t G$ unredeemed by those who find transaction costs to be at least equal to the value of the coupons and thus do not use the coupons received. Note that those who do not redeem coupons because of transaction

costs are considered a subgroup of those who buy no more so that $\phi_i + \phi_n + \phi_s = 1$.

Also, let θ_i^i be the share of coupon redemption by those buying more and receiving information that is due to the information effect. If the individual demand in Figure 2 characterizes a representative program participant, then $\theta_i^i = (q_4 - q_1)/q_3$. Similarly, let $\theta_i^c = (q_3 - q_4)/q_3$ be the share of coupon redemption by those buying more and receiving information that is due to the coupon effect and let $\theta_n^c = (q_2 - q_1)/q_2$ be the share of coupon redemption by those buying more and not receiving information that is due to the coupon effect. Then market equilibrium with coupons can be represented by

$$D(P_1,Y_1) + (\theta_i^i + \theta_i^c)\frac{G_i}{P_1} + \theta_n^c\frac{G_n}{P_1} = S(P_1) = Q_1. \tag{2}$$

The income variables Y_1 and Y_0 differ by the amount of coupons redeemed by those who buy no more F&V's with participation, G_s, converted to a per capita basis.

The economic welfare effects in this framework are calculated as follows. The increased profits to farmers associated with higher prices and increased quantity of sales are approximated following Figure 1 by $W_f = (Q_1 + Q_0)(P_1 - P_0)/2$. The economic welfare loss from higher prices for consumers (the price effect), including coupon recipients, is approximated by $W_n = [Q_0 + \delta Q_0(P_0 - P_1)/(2P_0)](P_0 - P_1)$ where δ is the price elasticity of demand. If all consumers have the same elasticity of demand, then this loss is shared by all consumers according to the amounts of consumption in absence of coupons.

For FMNP participants, the income effect for those who buy no more with participation is G_s. For those who buy more, the calculations follow Figure 2. Assuming linearity, the quantities in Figure 2 for those receiving information are $q_1 = (1 - \theta_i^i - \theta_i^c)g_i/P_1$, $q_3 = g_i/P_1$, and $q_4 = (1 - \theta_i^c)g_i/P_1$ so the income effect (area a+c) is $(1 - \theta_i^i - \theta_i^c)g_i$, the information effect on coupon redemption (area b+e+f+g+h) is $\theta_i^i g_i$, the coupon effect on economic welfare (area j) is $\theta_i^c g_i/2$, the inefficiency loss (area k) is $\theta_i^c g_i/2$, the taxpayer cost (area a+b+c+e+f+g+h+j+k) is g_i, and the non-market welfare effect (area n) is $P_1(q_4^2 - q_1^2)/[2(q_3 - q_4)]$ or, equivalently, $[(1 - \theta_i^i)^2 - (1 - \theta_i^i - \theta_i^c)^2 g_i/(2\theta_i^c)$. The welfare effects for participants

receiving no information are quantified similarly with $q_1 = (1 - \theta_n^c)g_r/P_1$ and $q_2 = g_r/P_1$ so the income effect (area a+c) is $(1 - \theta_n^c)g_r$, the coupon effect on economic welfare (area b+e+f) is $\theta_n^c g_r/2$, the inefficiency loss (area g) is $\theta_n^c g_r/2$, and the taxpayer cost (area a+b+c+e+f+g) is g_r.

Spill Over Effects and the Appropriate Market Level for Analysis

An issue in evaluating welfare effects of increased local consumption is the extent to which price effects spill over into other regions. For example, does increased consumption of F&V's in a Vermont FM affect F&V prices only in that FM, or also in nearby FM's, perhaps across the entire state of Vermont, or across the whole nation? To consider these possibilities, the effects of the FMNP are analyzed at four different market levels: (1) the individual market level, (2) the local (area) market level, (3) the state market level, and (4) the national market level.

At the individual market level, the relevant market is assumed to be only the FM at which the coupons are redeemed. The increased demand is assumed to be enjoyed by both farmers accepting FMNP coupons and by farmers not accepting FMNP coupons in the participating market since arbitrage opportunities are assumed to equilibrate prices (after adjusting for quality differences). At the local market level, any price effects in the participating FM's are assumed to spill over into adjacent non-participating farmer's markets as non-recipient consumers seek out the lowest prices for their purchases. At the state market level, price effects are assumed to spill over into the F&V market beyond that represented by FM's. Price changes induce consumers to switch between grocery store and FM purchases and better price opportunities induce farmers to divert more of their production away from other markets. Finally at the national market level, price effects are assumed to spill over nationwide as interstate shipments respond to price differentials.

In comparing these different levels of analyses, the price impacts of the FMNP are reduced if broader markets are relevant. However, the aggregate magnitude of impacts remain similar because more

individuals are affected. Thus, certain aspects of the analysis are robust to the extent of spill over.

Data and Estimation

The basic data used for this study was developed by a comprehensive WIC Participants Questionnaire and a Farmers' Market Questionnaire administered by Price Waterhouse for the USDA Food and Nutrition Service during August-September, 1990. A comprehensive discussion of data, estimation techniques and results for all market levels across all states is not possible given space limitations. Instead, only the more salient aspects of the data and estimation are presented along with a subset of the empirical results.

The participants survey was administered in six states (IA, MA, PA, TX, VT, WA). Participant telephone numbers were selected randomly from all WIC participants. Interviewers called 5,543 women from which 2,725 successful interviews resulted. In remaining cases, interviews were not possible primarily because of disconnected and incorrect telephone numbers (2086), numbers were unanswered after up to 10 call backs (153), contact was made but the respondent was too busy to complete the interview and followup contact was unsuccessful (470), and the respondent refused to complete the interview (109). Of the successful interviews, 1,047 respondents were FMNP coupon recipients who spent some or all of their coupons and 1,222 respondents were non-recipients. While many calls resulted in unsuccessful interviews, the response rate is comparable to similar survey analyses. Furthermore, no compelling arguments suggest the reasons for non-response are correlated with the results of interest except possibly in the relationship of transaction costs to the response of being too busy to complete the interview. Possibly the share of the sample with transaction costs exceeding the benefits of coupons is underestimated.

The WIC Participants Questionnaire included questions determining whether participants spent more on F&V's when receiving coupons, the value of coupons received, the value of coupons redeemed, whether participants intended to spend more coupons, whether information was received, and the average number of servings per day of F&V's. The sample includes both coupon recipients and non-coupon recipients who

both received information and did not receive information. Other questions determined reasons for not redeeming coupons or not intending to redeem more coupons.[4]

Using the survey information, the amounts and shares of coupons (G_i, G_n, G_s, G_t, ϕ_i, ϕ_n, ϕ_s, ϕ_t) associated with each behavioral regime represented in Figure 2 can be calculated directly except for the demand effect of information.[5] The extent of the demand shift that occurs when recipients receive information is estimated using the linear regression,

$$\begin{aligned} Y = {} & \underset{(15.14)}{6.35} + \underset{(2.17)}{.471}\,NPI + \underset{(5.90)}{1.31}\,PIM + \underset{(2.90)}{.897}\,PNIM + \underset{(1.56)}{.680}\,PA + \underset{(1.61)}{.736}\,MA \\ & + \underset{(.71)}{.344}\,IA + \underset{(.94)}{.412}\,TX + \underset{(2.30)}{1.24}\,WA\,, \end{aligned}$$

where Y is the number of daily servings of F&V's, NPI is a dummy variable reflecting non-participation with information, PIM is a dummy variable representing those who buy more with participation and information, PNIM is a dummy variable representing those who buy more with participation and no information, and the remaining variables are state dummy variables. The constant term corresponds to non-participation with no information in Vermont. Numbers in parentheses are t-statistics. Apparently, both participation and information have positive and significant effects on nutrition as measured by F&V consumption and the effects are similar whether or not they occur in combination.

Using these regression results, the share of coupon redemption by those buying more and receiving information due to information, θ_i^i, was estimated by dividing the information effect estimated in the above regression by average daily servings of those buying more and receiving information. The share of coupon redemption in this group due to coupons, θ_i^c, was estimated by similarly dividing the estimated participation effect. The share of coupon redemption by those buying more and not receiving information due to the coupon effect, θ_n^c, was estimated by dividing the estimated participation effect by average daily servings of those buying more and not receiving information.

The Farmers' Market Questionnaire was administered in 24 FM's chosen at random from among those which officially accept WIC FM coupons. An equal number of non-participating markets that closely resembled participating markets in terms of location, size, variety of products, and demographic composition of clientele were also surveyed. The FM survey was administered to 411 farmers of whom 266 were participants (accepted coupons), 140 were non-participants, 3 refused to respond and 2 did not know. The FM survey contained questions determining market size, numbers of participants using FMNP coupons, numbers of participants not using FMNP coupons, data on the total days open during the season, the average sales per day by farmers, and average daily coupon redemption. This data was then combined with survey information collected at non-participating markets to estimate the quantity effects of the FMNP at the local market level. Efforts to identify price differentials directly by comparing participating and non-participating markets proved unsuccessful (as expected) due to sampling error and the small price effects of the program. Alternatively, price effects are estimated from quantity effects of the FMNP using elasticities of supply and demand.

At both the individual and local market levels, the statewide average responses to the WIC Participants Questionnaire are assumed to apply to estimation of the share of FMNP participants in each regime of behavior. For estimation of effects at the state and national levels, the survey data are supplemented by state and national data on F&V sales, consumer income, and FMNP numbers of recipients and coupon redemption all of which are available from government sources.[6] For the state and national analysis, the shares and relative effects suggested by the WIC Participants Questionnaire are assumed to extend to all participating states.[7]

For the empirical analysis, supply and demand elasticities are required to estimate aggregate market price effects. The calculations below are based on a price elasticity of demand for F&V's of -.5 and an income elasticity of demand of .25. These elasticity assumptions are roughly consistent with demand

estimates in the literature.[8] Although estimated supply elasticities of F&V's in the literature vary considerably among studies and crops, most are between .1 and .4 in the short run and between .2 and 1.1 for the long run.[9] To consider this range of possibilities, welfare effects were evaluated with supply elasticities of both .2 and 1.0. The gain by farmers and loss to non-FMNP consumers approximately doubles when the supply elasticity is changed from 1.0 to .2. However, these effects are of equal magnitude and offset one another, so that net FMNP effects are robust with respect to supply elasticity. Thus, only results for a supply elasticity of 1.0 are reported.

Empirical Results

Empirical results for the state and national market levels are given in the upper portion of Table 1. The first column gives the percentage effects of the FMNP on market price and quantity (at a supply elasticity of 1.0 these changes are equal). Not surprisingly, the percentage price effect at the state level is small because FMNP coupon redemption is small relative to the total value of F&V's. Only in Iowa, where few F&V's are produced, are the price or quantity effects in excess of one percent. Nevertheless, these small effects are imposed across a large number of consumers and farmers so total welfare effects are not small relative to coupon redemption when evaluated at the state or national levels. For instance, farmers' profits increase approximately 8 percent of coupon redemption at the state level and non-participating consumers lose roughly the same amount as farmers' gain.

All welfare effects are aggregated in the net effect column. This includes the benefit to recipients, the increased profits by farmers, the loss to non-FMNP consumers, and the cost incurred by government as an outlay for the redeemed coupons. The overall net gains are between 20 and 30 percent of coupon redemption (except for Vermont, see below).

The striking result in Table 1 is that the gains by FMNP participants are considerably more than the market value of the coupons. The reason is that about one-third of the increase in consumption is due

to information (in terms of Figure 2, area n is substantial). Approximately 60 percent of coupon redemption is by those who buy more and receive information. For these individuals, information increases the value attached to normal levels of F&V consumption beyond the market price. This effect is beneficial because information corrects a market failure.

In several respects, results for local market levels are similar to those for the state level. Results for five selected farmer's markets are reported in the middle portion of Table 1. Coupon recipients again benefit by more than the total amount of coupons redeemed because of the beneficial effect of information. In each market, farmers' profits increase by about the same amount that non-participating consumers' welfare is reduced. Furthermore, when prices are diffused only in the local market area, the gain to farmers, non-FMNP recipients, and coupon recipients is almost identical (as a percentage of coupon redemption) to state level gains. The major difference is that the market price and quantity effects are larger because the impact is not as widely diffused. This results in a somewhat greater divergence of the farmers' and non-FMNP consumers' effects. Also, the gains to farmers are shared by the smaller number of farmers involved in the local market and so represent a greater relative effect. Overall, the net effect of the program is still a gain in the range of 20 to 30 percent of coupon redemption.

The relative magnitudes of results are interesting given the relatively larger price effects and suggest a considerable robustness of the general conclusions. Some of the price effects at the local market level are large because FMNP participation in some local market areas is high. For example, coupon redemption accounted for 20 percent of sales in the Crossroads FM and 56 percent of sales in the Holyoke FM. Without spill-over, it is not surprising that price effects can be as much as 2 to 5 percent. A price effect of this magnitude would likely induce farmers to divert some sales from other markets which would attenuate the price effect and, thus, cause the ultimate outcome to tend toward the state market level case.

The results for the individual market level are presented in the bottom portion of Table 1. While

some of the relative price effects are somewhat higher—because coupon redemption becomes more concentrated—the conclusions about the relative magnitude of economic welfare effects remain similar. Farmers gain about 7 to 9 percent of the amount of coupon redemption and non-participating consumers lose a similar amount. Coupon recipients benefit more than the value of coupon redemption because of the market correcting effect of information. The net gain in economic welfare for society as a whole is again between 20 and 30 percent.

To illustrate the importance of information in obtaining overall program benefits in more detail, Table 2 gives the breakdown of welfare effects for the three groups of coupon recipients discussed above as a percentage of total coupon redemption. Only state and national market levels are reported because of the similarity of results among market levels. The first two columns of Table 2 give the price effects (area a+b in Figure 2) and income effects (area a+c in Figure 2) for those who buy no more with FMNP coupons. The price effect is minor because the price changes are small. The sum of these two effects is less than the total amount of coupons redeemed although the inefficiency loss is small.

The next five columns of Table 2 give the breakdown of effects on those who buy more and receive information. Again, small price changes cause small price effects. The income effect is about 83 to 85 percent of the amount of coupons redeemed. Both the education and coupon effects (area b+e+f+g+h and area j in Figure 2, respectively) are about 5 percent of the amount of coupons redeemed. This means that the inefficiency loss (area k in Figure 2) is also about 5 percent of coupons redeemed. However, the non-market benefit of information is substantial amounting to about 49 percent of the group's coupon redemption. Thus, the efficiency gain for this group is a little over 40 percent of its coupon redemption.

Finally, the last three columns of Table 2 give the breakdown of effects for those who buy more with coupons and receive no information. The price effect is small. The income effect is about 89 percent of the group's coupon redemption. The coupon effect is about 6 percent of coupon redemption. The

inefficiency loss (area g in the no information case of Figure 2) is also about 6 percent of redemption.

The comparison of these three groups reveals that the FMNP is much more effective when coupons are supplemented with information. Because effects are highly stable across states, the results suggest that program efficiency is largely determined by the relative sizes of the three groups. This has important implications for program design because instructional activity can be altered. Making sure that all participants receive sufficient information eliminates one inefficient group. Reduction of size of the inefficient group that buys no more when receiving coupons may be more difficult but the losses among this group are not large.

The importance of increasing information is underscored by comparison of the Vermont results with other states. Vermont's net benefit (see Table 1) is only 14 percent of coupon redemption, whereas Iowa's net benefit is about 30 percent, Washington's is 28 percent, and most other state's are about 20 percent. This variation is explained by the lower proportion of coupon recipients receiving information in Vermont's FMNP; less than 40 percent of coupon redemption was by those who buy more and receive information as compared to 80 percent in Iowa, 70 percent in Washington, and about 55 percent in other states. Apparently, the effectiveness of various states in providing information is the single most important determinant of social efficiency.

Considering these results, it is not surprising that both FMNP coupon recipients and farmers favor the program. Both are positively affected. Nevertheless, the benefits per farmer and per coupon recipient are small as shown by Tables 3 and 4. The results in Table 3 show that the effects per farmer may be quite small. Even if price effects do not spill over beyond local markets, the average farmer does not benefit by more than about $100. In the case of statewide or nationwide price effects, the benefits per participating farmer are inconsequential amounting to only a few pennies or a few dollars per year. These results, however, are not unreasonable given the small price effects and the large numbers of farmers

involved in state and national markets.

To determine whether price effects of the FMNP are diffused to the state or national levels, the prices of F&V's were compared among participating FM's, non-participating FM's, and grocery stores. Results showed no significant differences with respect to participation or redemption levels of FM's and no significant variation in the relationship to grocery store prices either within or across states with widely differing levels of participation and redemption. These results imply that the nationwide or at least the statewide level of analysis is appropriate (subject to the caveat below).

The WIC Participants Questionnaire was used to measure effects on individual coupon recipients. The amount of coupons received annually per recipient (both women and children) is less than $28 on average in all states (see the first column of Table 4). Table 4 also gives the estimated annual amount of coupon redemption. Redemption rates vary from a low of 68 percent in Washington to about 80 percent in Texas and Vermont.

The results in Table 4 show that the benefit per household receiving coupons is less than coupons redeemed for those who buy no more F&V's and ranges from $10.95 to $14.50 per household for the six states reported. For individuals receiving information, the benefits range across states from $16.20 to $28.99 per household which is substantially greater than the amount of coupons redeemed. For those not receiving information, the benefits range from $10.63 to $18.78. Table 4 demonstrates that the benefits received from participation vary considerably among households. The two most important determinants of this variation are coupons redeemed per household and whether information is received. Recipients in Iowa, for example, redeem almost twice the value of coupons as recipients in Texas. Most of this difference is explained by the amount of coupons received in the two states. Similarly, those who receive information receive about half again as much benefit as recipients who do not. Apparently much of the inequity among recipients' benefits can be reduced by reducing inequity in the amount of coupons received

and by providing uniform information.

Further Consideration of Transaction Costs Associated with Farmers' Markets

Although not stated explicitly, prices at FM's and other F&V markets have been assumed to be equal to this point in the analysis. The two prices could be different because of transaction costs of using FM's (inconvenience and travel time/expense) or quality differences in produce. To investigate this possibility, prices at FM's were compared with nearby grocery store prices (also collected as part of the FM survey). On average, prices at participating FM's were 86 percent of grocery store prices and prices at non-participating FM's were 85 percent of grocery store prices. However, the hypothesis of no difference in prices could not be rejected at any standard significance level. This conclusion is further corroborated by responses to qualitative questions in the Farmers' Market Questionnaire where about 5 percent of respondents reported the program had increased prices, 5 percent reported a decrease, and the rest were uncertain. On the basis of these results, the assumption of equal prices used to this point is reasonable.

If, however, FM prices are discounted because of transaction costs or quality differences, then modified calculations are suggested. This section considers the effect of such modifications. Because prices at FM's appear to be lower and because the participants survey suggests transaction costs rather than quality differences (see footnote 4), the discussion will be so characterized even though the modifications apply in both cases.

For simplicity, suppose all consumers face the same per unit transaction costs so that in equilibrium the difference in prices between the FM and all other markets (grocery stores) is just equal to per unit transaction costs. In Figure 3, the (grocery store) demand in absence of FM's is given by d whereas FM demand if F&V's were not available elsewhere is given by d_f. The vertical distance between d and d_f is the transaction costs incurred in buying at FM's. Aside from this difference, F&V's from the two sources are assumed perfectly substitutable. Prices at the FM and elsewhere are respectively P_0^f and P_0 in absence

of the food assistance program and P_1^f and P_1 when the food assistance program is in effect.

In this case, the net benefit received by the consumer in either market is the area to the left of the demand curve and above price. The price effect for those not using FM's is area a*+b* and for those using the FM is area a+b. These effects are identical because both the demand curves and prices differ by the same per unit transaction cost.[10] The income effect for participants, however, is area a+c and not area a*+c*+a+c. The reason is that even though a quantity of goods worth $P_1q_1^*$ in other markets is received, the participant must incur a transaction cost of area a*+c* to get them (equivalently, the transaction cost is measured by the area between demands d and d_f and left of quantity q_1^*). Similarly, the coupon effect on participant welfare is area b+e+f following the demand curve d_f because transaction costs associated with the difference in demands d and d_f must be incurred to obtain the additional quantity $q_2^* - q_1^*$. Accordingly, the inefficiency loss is area g and the value of unredeemed coupons is area m. Similar considerations imply that areas in Figure 2 associated with the information case also should be evaluated at price P_1^f rather than P_1.

To see how these modifications affect the analysis, note first that the prices used for the calculations related to Figure 2 are government price data corresponding essentially to grocery store prices. However, expenditures of coupons must now be valued at the lower FM price which means the quantity of F&V's purchased with coupons and without information is $q_2^* = g_r/P_1^f$ rather than $q_2 = g_r/P_1$ or similarly with information is $q_3^* = g_i/P_1^f$ rather than $q_3 = g_i/P_1$. Let the ratio of the relevant prices be represented by $\alpha = P_1/P_1^f$. Then, all quantity estimates corresponding to Figure 2 must by increased by a factor α because they are estimated as ratios of q_2 and q_3, i.e., $q_i^* = \alpha q_i$, i = 0,1,2,3,4.

The next step is to correct the estimated price impact, $P_1 - P_0$. Let the correction of this impact be represented by $P_1^* - P_0^* = \beta(P_1 - P_0)$. Then it can be shown that $\beta < \alpha$. To see this, note that the price impact is derived by comparing the market equilibrium equations (1) and (2). The correction is obtained

by replacing P_1 in the last two left-hand-side terms by $P_1^f = P_1 - t$ where t is the per unit transaction cost. This effectively multiplies the last two left-hand-side terms by α. If all of the price impact were due to these two terms, this would simply multiply the price impact by α so $P_0^* = \alpha P_0$. However, some of the price impact is due to the income effect in the first left-hand term and only that portion associated with the last two left-hand-side terms increases proportional to α. Note that the first left-hand term will decrease because the income effect decreases from area a*+c*+a+c to area a+c. Clearly, β is less than α.

Considering these two corrections, the price effect (area a*+b* = area a+b) reported in Table 2 is underestimated by a factor $\alpha\beta$. If FM prices are 85 percent of grocery store prices, then $\alpha\beta$ is less than 1.384 [= $(1/.85)^2$] which means that the price effects in Table 2 should be increased by as much as 38 percent. Because the price effects are so small, this adjustment is inconsequential.

The income effect reported in Table 2 is unchanged. The reason is that while the quantity q_1 should be larger by a factor α, the FM price, P_1^f, is smaller than P_1 by a factor α. Thus, the product of the two is the same. Similarly, no error occurs in the estimates of the coupon effect. Again, if transaction costs are ignored in inferring quantities from coupon data, then the quantities are all underestimated by a factor α but the appropriate price, P_1^f, is overestimated by a factor α when P_1 is used instead. Similar arguments show that no error occurs in estimating the information and non-market effects in the information case. In conclusion, the estimates in Table 2 are correct for all components other than the price effect where errors are minor. Thus, the results in Table 2 appear to be quite robust with respect to the weak estimates of transaction costs for participants.

Other Sensitivity Analysis

The analysis of this paper is subject to several other types of errors. First, functional forms for supply and demand may not follow the forms assumed herein. At the aggregate level, these errors are inconsequential unless supply or demand is kinked because price changes induced by the program are small. For example,

changing aggregate supply and/or demand between linear and log-linear forms has essentially no effect on the implied price change calculated according to equations (1) and (2).

The results are more sensitive to the functional form assumed for demands by program participants because these demands must be extrapolated to the axes. To see how welfare estimates are affected, imagine non-linear demand curves in Figure 2 where the quantities remain unchanged (the survey permits observations of demand at prices P_1, P_0, and zero although P_0 itself is not observed). Imposing a convex demand curve upon this data reduces the estimate of P_0, likely increases the price effect (area a+b), leaves the income effect unchanged (area a+c), reduces the coupon effect (area b+e+f or area j), and leaves the information effect unchanged (area b+e+f+g+h). The change in the non-market effect (area n) is not clear. If demands are either horizontally or vertically parallel, it increases; but if the two demands have the same intercept, it can decrease. If a concave demand curve is imposed on the data, the effects are opposite. This analysis reveals the following about the results reported in Table 2: under the most extreme non-linearity, the price effect is bounded between zero and the income effect, the income effect is correct regardless of non-linearity, the coupon effect is bounded between zero and twice the coupon effect reported in Table 2, and the information effect is correct regardless of non-linearity.

Another consideration in interpreting the data of this study is that participants who buy more with coupons may run out of coupons before reaching the equilibrium depicted in Figure 2. In other words, the demand curve d may intersect the vertical line at q_2 above zero or similarly for demand d′ at q_3. A substantial share of respondents in the survey had, in fact, spent all of their coupons (35 percent in PA, 36 percent in MA, 21 percent in IA, 65 percent in TX, 29 percent in WA, and 33 percent in VT). For this group, there is no information to determine the marginal valuation of F&V's beyond the bounds given by prices zero and P_1. Correcting this error increases the coupon effect anywhere from zero to 100 percent for these individuals (for example, as the demand curve rotates counter-clockwise about the demand at price

P_1, area b+e+f increases and area g decreases until area g = 0). Thus, the coupon effects in Table 2 could be underestimated by as much as the state-level percentages above.

The only other results in Table 2 affected by this correction are the non-market effects which decline because the demands move closer together vertically as they are rotated counter-clockwise about their intersections with P_1. At the extreme, if individuals who have spent all coupons have perfectly elastic demands, then their non-market effect is zero (other individuals are unaffected). Thus, the non-market effect could be overestimated by as much as the state-level percentages given above.

Concluding Remarks and Implications of Nationwide Expansion

Taxpayers and non-participants pay for the FMNP through government outlays for coupon redemption and higher F&V prices. Their net loss considering both of these costs is about 107 to 118 percent of the amount of total coupon redemption. Not surprisingly, few complaints are heard because these costs are so widely diffused. The cost per consumer including tax burden in the case where spill-over effects diffuse nationwide is less than $0.02 annually.

The overall benefit of the FMNP hinges on its ability to provide information that corrects a market failure. Participants benefit directly through increased consumption opportunities and indirectly by greater valuation of all F&V consumption. Other indirect benefits not weighed in this study should also be considered. Because the target population of this program is women in poverty who have children and, thus, limited work potential, the value to society of transferring income to this group may be high. Second, improved nutrition and diet associated with increased consumption of F&V's may provide, through habit formation, long term health benefits to program participants. If so, additional benefits such as reduced health care costs (perhaps borne by taxpayers) are also relevant.

Before 1992, the FMNP was operated only in 11 states and at varying levels. For example, coupons were received by 10.8 individuals per 1000 in Connecticut but only 1.5 individuals per 1000 in

Washington. Coupons received by participating individuals also varied considerably as illustrated in Table 4. To consider a nationwide scale-up of the FMNP and the likely effect of expansion in the program that is currently underway, suppose the program is operated nationwide at the same level as in Massachusetts. Apparently, the program has been operating longer in Massachusetts than in any other state while it is quite recent and possibly farther from equilibrium in other states. Scaling coupon distribution and redemption rates observed in Massachusetts up to a national level implies total coupon redemption of $14.1 million nationwide by 1.76 million coupon recipients. Using these figures in the nationwide model implies the following effects assuming a supply elasticity of 1.0. Coupon recipients gain $17,036,510, farmers gain $1,108,573 and other consumers lose $1,107,421. The net effect considering taxpayer expense of coupon redemption is a gain of $2,937,660.[11] Thus, society gains about 20.8 percent of the program outlay.

While this payoff is very high (most government programs that aid the disadvantaged cause economic inefficiency), several recommendations are evident from the analysis of this paper. First, information should be provided to all coupon recipients. If this were done and coupons were otherwise dispensed at the same rates, the net benefits of the program scaled up to the national level could be raised to $4,313,600 with most of the gain in net benefits going to coupon recipients.

Alternatively, a better approach from the standpoint of economic efficiency would be to eliminate the parts of the program associated with inefficiency and scale up those not associated with inefficiency. This would call for eliminating coupon distribution but providing information to all those that would otherwise receive coupons. Coupons distort markets by inducing consumption beyond levels that represent the value of F&V's to recipients. Information helps participants make informed consumption decisions. This gain can be captured without a coupon program if participants are willing to accept information without receiving coupons. If this change is implemented and scaled up to the national level, estimates show that program benefits could be increased to $5,434,700.

Footnotes

[1] More appropriately, consumer welfare calculations should be based on compensating or equivalent variation (see Just, Hueth, and Schmitz). For the problem of this paper, however, the price changes are so small that consumer surplus does not err by even one cent according to Willig bounds.

[2] Senauer and Young report results where some food stamp recipients appear to increase food consumption more in response to food stamps than an equal amount in income even when the amount is less than customary purchases. Their result may be due to temporal aggregation of data as they explain. This possibility does not apply here because the case of no increase is determined directly from the data.

[3] To illustrate this point simply, assume that Figure 2 represents the aggregate of all participants who buy more F&V's with coupons. Then area a+b in Figure 2 is equal to area B in Figure 1. Thus, the net effect depends on the comparison of area g in Figure 2 with area C in Figure 1. Note that the horizontal difference in demands D_0 and D_1 in Figure 1 is equal to $q_2 - q_1$ in Figure 2. Thus, both areas are triangles with the same "base" but the "height" of area g is clearly greater than $P_1 - P_0$, the "height" of area C.

[4] Most reasons suggested transaction costs, e.g., "the farmers' market is too hard to get to" or "the farmers' market is not open when I want to shop" or "I do not have the time to go to the farmers' market."

[5] The national level estimates are ϕ_i=.60, ϕ_n=.20, ϕ_s=.20, ϕ_t=.02, θ_i^i=.06, θ_i^c=.10 and θ_n^c=.11.

[6] Fresh fruit and vegetable data is from *Annual Vegetables*, National Agricultural Statistics Service, USDA, June, 1990; fresh fruit data is from *Fruit and Tree Nuts: Situation and Outlook Report Yearbook*, ERS/USDA, August, 1990; income data is from the *Survey of Current Business*, Bureau of Economic Analysis, U.S. Department of Commerce, April, 1990; and national FMNP and coupon redemption data was provided by the USDA Food and Nutrition Service.

[7] Each participating state not included in the survey is immediately adjacent to a state that was. For each such state, WIC participant responses in neighboring states are assumed to be representative.

[8] Most studies estimate elasticities for specific F&V's and must be aggregated to represent F&V's. For example, weighting elasticities estimated by George and King according to quantity obtains a price

elasticity for F&V of -.5091 and an income elasticity of .2451. While these estimates are old, they are more plausible than Huang's estimates which imply a negative income elasticity for fresh fruits (-.0871) and a larger income elasticity for fresh vegetables (.1804), both of which are questionable. By comparison, George and King's estimates imply an income elasticity of .3139 for fresh fruits and .1295 for fresh vegetables. Wohlgenant and Haidacher have also estimated a price elasticity of demand for fresh vegetables of -.22. George and King estimates imply price elasticities of -.6394 for fresh fruits and -.2904 for fresh vegetables, the latter of which corresponds closely to Wohlgenant and Haidacher. Huang's estimates imply a price elasticity for fresh vegetables of -.0806 which is considerably lower.

[9] For supply elasticity estimates, see Nerlove and Addison, Shumway and Chang, and Hammig.

[10] More formally, with perfect substitution, any combination of purchases of a given quantity from the two markets yields the same welfare as long as the prices differ by a constant per unit transaction cost.

[11] With a supply elasticity of 0.2, coupon recipients gain $17,035,230, farmers gain $2,360,950, other consumers lose $2,358,621, and the net effect after taxpayer expense is a gain of $2,937,564.

Table 1. Estimated Effects of the FMNP at Various Market Levels

Market	Percent Change in Price and Quantity	FMNP Coupons Redeemed	Economic Welfare Effects (% of Coupons Redeemed)			
			FMNP Participants	Farmers	Non-FMNP Consumers	Net Effect
National Market Level	<0.01	$2,560,108	122.76	7.88	-7.88	22.76
State Market Level						
IA	1.52	365,000	128.89	9.15	-7.84	30.20
MA	0.02	336,000	123.01	7.26	-7.24	23.02
PA	0.01	252,000	119.93	7.56	-7.54	19.94
TX	0.02	448,528	123.00	7.65	-7.63	23.02
VT	0.03	28,000	114.20	8.13	-8.11	14.22
WA	<0.01	48,280	128.32	8.34	-8.34	28.32
Local Market Level						
Crossroads, IA	1.88	135,000	128.60	9.14	-7.53	30.21
Holyoke, MA	4.25	594,000	119.50	7.11	-3.51	23.10
West Erie, PA	0.12	4,400	119.83	7.55	-7.44	19.94
Central, TX	0.87	126,000	122.26	7.62	-6.94	23.03
Port Orchard, WA	0.01	240	128.31	8.24	-8.23	28.32
Individual Market Level						
Crossroads, IA	1.88	27,000	128.60	9.14	-7.53	30.21
Holyoke, MA	4.25	99,000	119.50	7.11	-3.51	23.10
West Erie, PA	0.12	2,200	119.83	7.55	-7.44	19.94
Central, TX	0.87	63,000	122.26	7.62	-6.84	23.03
Port Orchard, WA	0.05	240	128.27	8.23	-8.18	28.32

Source: Estimated

Table 2. Disaggregation of Recipient Welfare Effects (as Percent of Coupons Redemption)

	Those Who Buy No More		Those Who Buy More and Receive Information					Those Who Buy More and Receive No Information		
State	Price Effect	Income Effect	Price Effect	Income Effect	Information Effect	Coupon Effect	Non-Market Effect	Price Effect	Income Effect	Coupon Effect
IA	-1.48	100.00	-0.14	83.61	5.89	5.25	48.58	-1.31	88.18	5.91
MA	-0.02	100.00	-0.01	84.38	5.62	5.00	48.93	-0.02	88.76	5.62
PA	-0.01	100.00	-0.01	84.27	5.65	5.04	48.89	-0.01	88.68	5.66
TX	-0.02	100.00	-0.01	83.75	5.84	5.20	48.64	-0.02	88.28	5.86
VT	-0.03	100.00	-0.03	82.88	6.16	5.48	48.24	-0.02	87.62	6.19
WA	-0.00	100.00	-0.00	85.26	5.30	4.72	49.34	-0.00	89.42	5.29
US	>-0.01	100.00	>-0.01	84.09	5.67	5.12	48.09	>-0.01	88.50	5.75

Source: Estimated

Table 3. Annual Benefits Per Participating Farmer

Farmers' Market	Extent of Market Spill Over Effect			
	Individual	Local	State	National
Crossroads, IA	$68.53	$68.52	$11.92	$0.14
Holyoke, MA	305.87	132.73	3.25	0.28
West Erie, PA	18.44	12.30	4.85	0.55
Central, TX	90.53	70.56	4.55	0.38
Port Orchard, WA	0.80	0.08	0.01	0.05

Source: Estimated

Table 4. Annual Benefits Per Coupon Recipient

State	Coupons Received	Redemption Per Household	Those Who Buy No More: Benefit Per Dollar	Those Who Buy No More: Household Benefit	Those Who Buy More and Receive Information: Benefit Per Dollar	Those Who Buy More and Receive Information: Household Benefit	Those Who Buy More and Receive No Information: Benefit Per Dollar	Those Who Buy More and Receive No Information: Household Benefit
IA	$27.73	$20.24	.72	$14.50	1.43	$28.99	.93	$18.78
MA	14.37	11.50	.96	11.03	1.44	16.55	.94	10.85
PA	20.32	14.22	.86	12.25	1.44	20.46	.94	13.42
TX	14.12	11.30	.97	10.95	1.43	16.20	.94	10.63
VT	16.81	13.45	1.00	13.44	1.43	19.19	.94	12.61
WA	23.08	15.69	.78	12.28	1.45	22.70	.95	14.86

Source: Estimated

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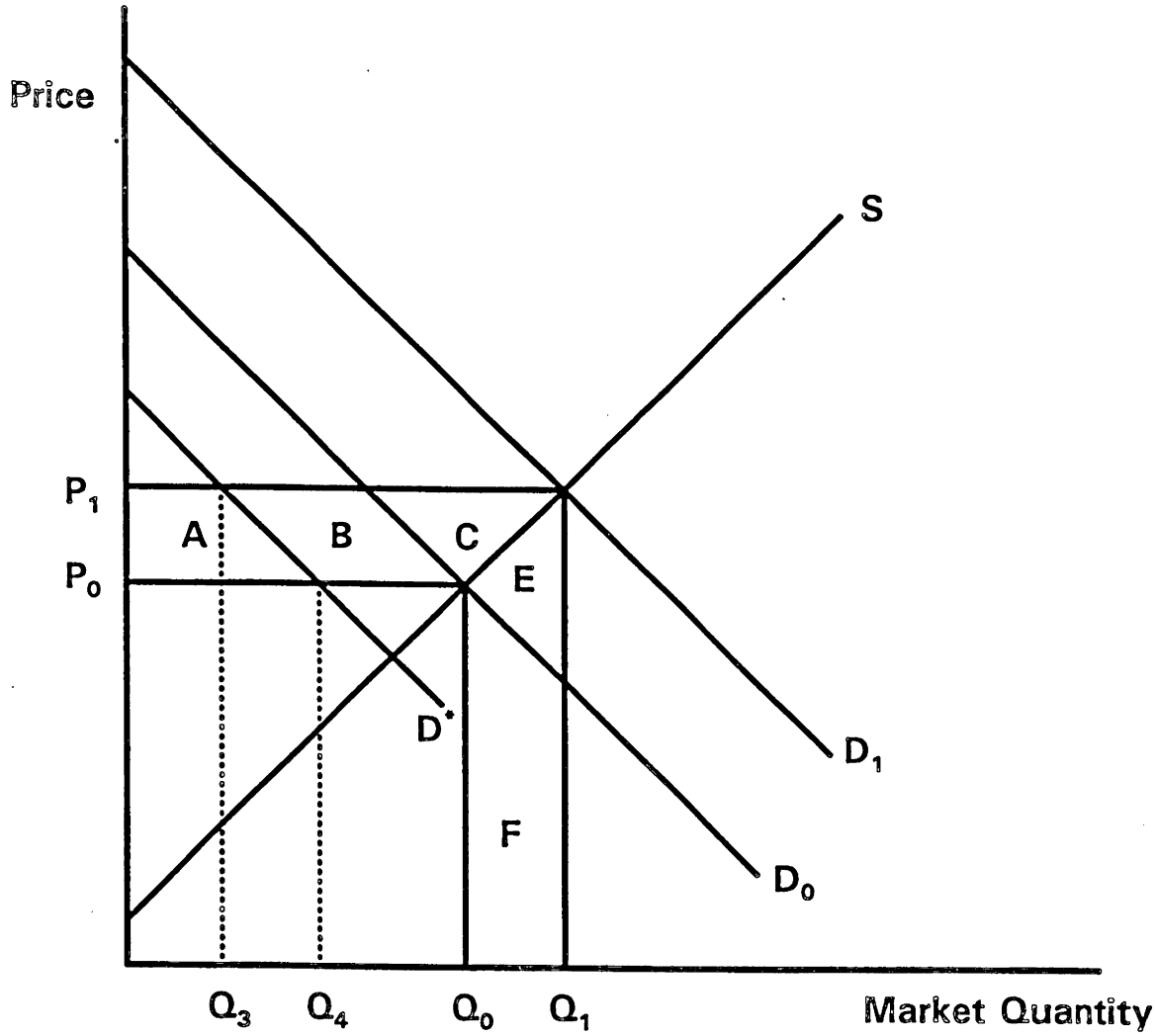

Figure 1. Aggregate Market Effects of Food Assistance

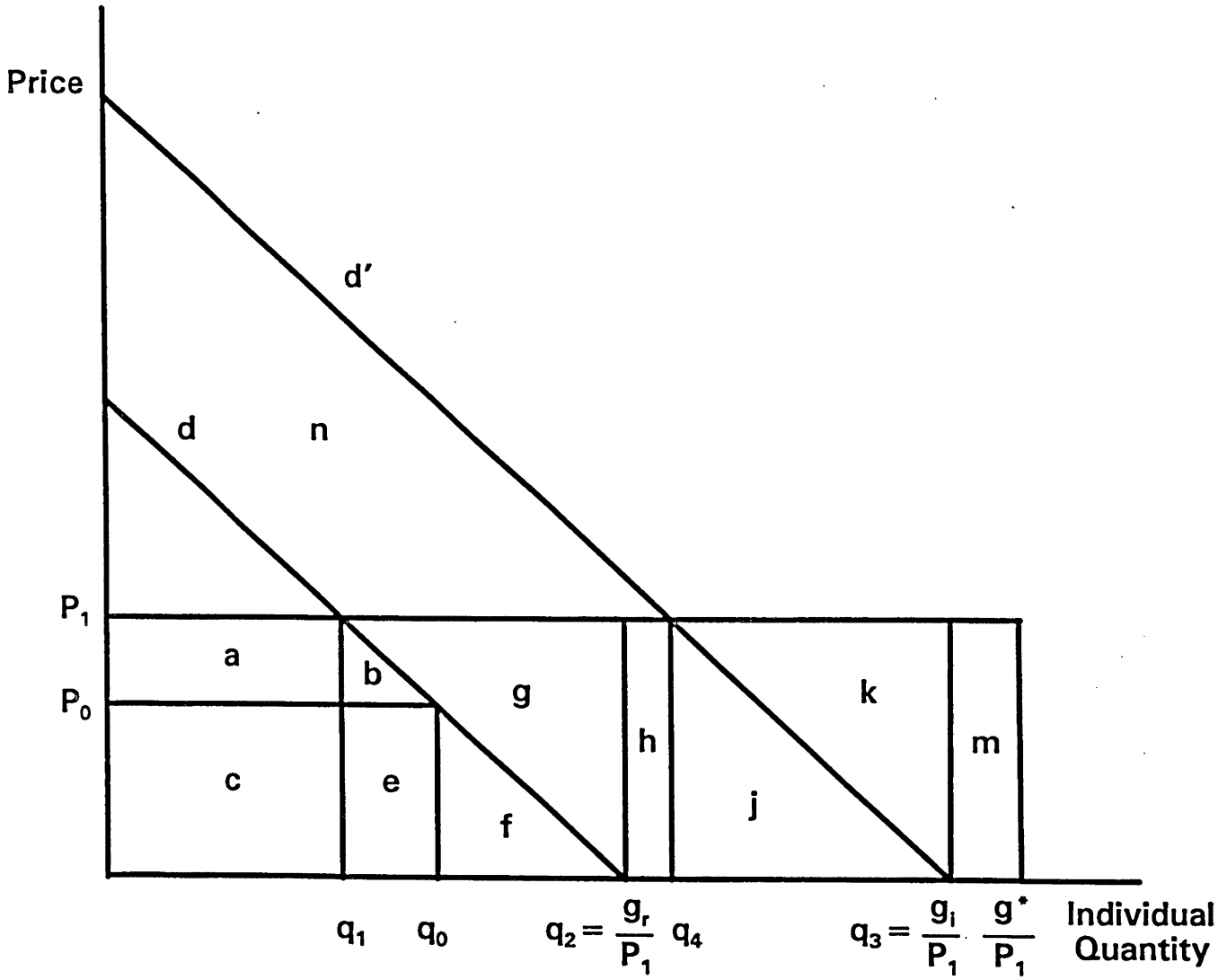

Figure 2. Individual Effects of Food Assistance

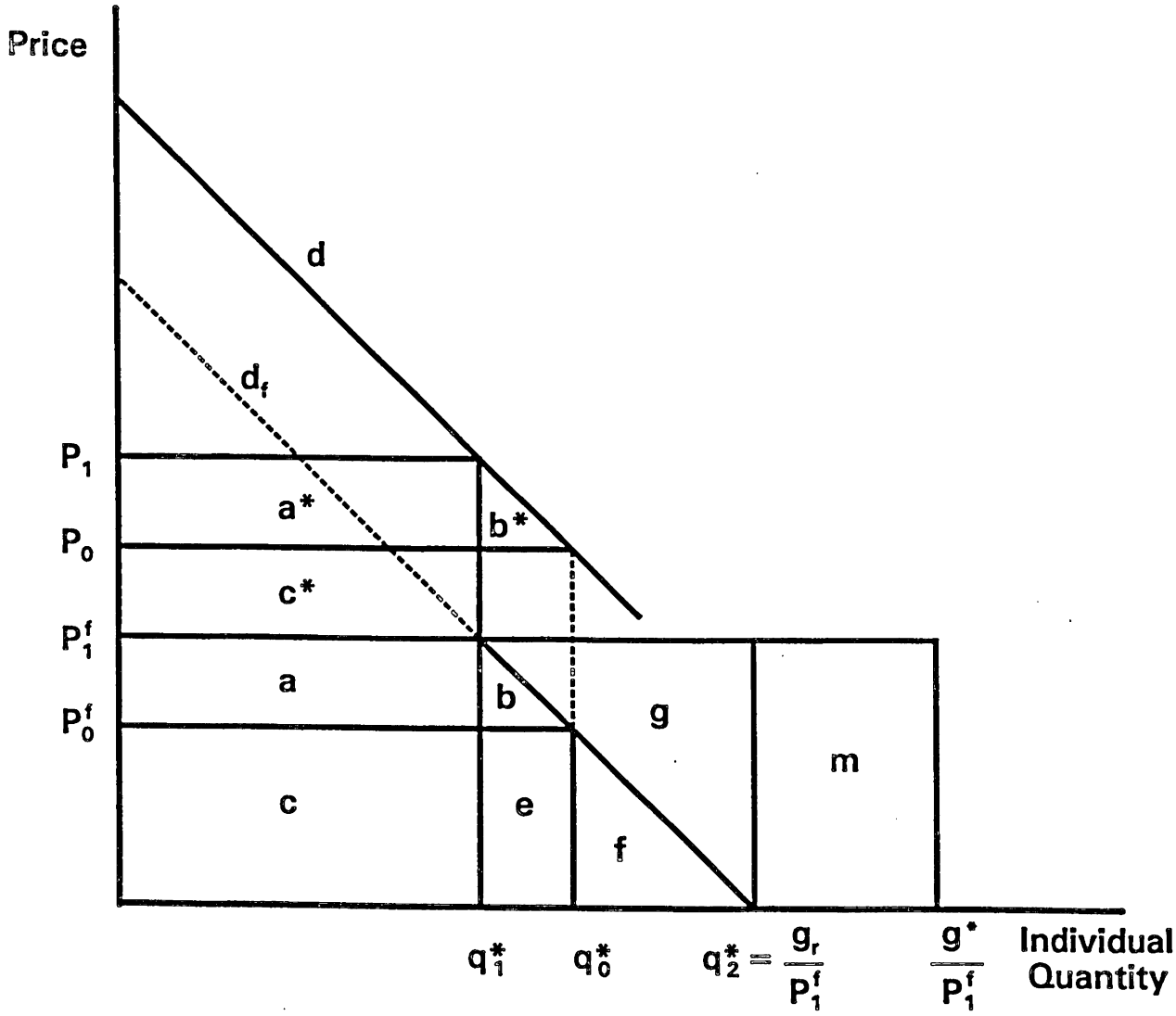

Figure 3. Individual Effects with Transaction Costs