THE EFFECTS OF COMMODITY DONATION PROGRAMS ON COMMERCIAL MARKETS*

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Commodities have long been an important part of federal food programs, accounting for 40 percent of their expenditures as recently as 1970. However, as the food stamp program has expanded to all counties, commodities have declined as a share of expenditures. They made up only 8 percent of federal food assistance dollars in 1982, but rose to nearly 13 percent in 1983 as dairy product donations grew substantially.

The extent of commercial displacement resulting from government commodity donations has been an issue whenever they have been used in food programs, but the concern has become more acute the past four years. Since December, 1981 the USDA has been distributing surplus commodities, particularly dairy products, through the Temporary Emergency Food Assistance Program (TEFAP). The distribution of American-type, primarily processed, cheese began at a modest level but within less than a year reached nearly three times the normal per capita consumption of the target population (17). By early 1983 the commercial disappearance of American-type cheese was down 15 percent from the previous year, raising concerns over the affect of donations on commercial sales. Donations were subsequently scaled back to 25-35 million pounds per month, a level which still exceeded normal consumption of the target population by more than 50 percent.

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In this paper we explore the theoretical rationale for expecting that such donation programs will result in some displacement of commercial sales. We hypothesize a model of behavior for anticipating the effects of such donation programs for two of the products currently in surplus, cheese and butter, and estimate the effects of the cheese and butter donation programs of the past 30 years on commercial sales using aggregate data. In addition to the effects on commercial markets we explore the impacts of such large-scale donation programs on empirical estimates of demand parameters.

Commodity Removal and Donation Programs

Commodity distribution programs of the USDA were originally designed to enhance farm prices. The Agricultural Marketing Act of 1929 established the Federal Farm Board with a revolving fund of $500 million (2). The fund was to be used to control any surplus through purchase operations. While unsuccessful in controlling surpluses and raising farm prices the effort provided the first surplus commodities for public distribuition to the needy.

By 1933 USDA had developed several programs to serve the dual purpose of feeding the needy and disposing of surplus commodities. The direct distribution program began with donations of surplus pork in 1933, and was supplemented with school lunch, milk and food stamp programs. The early food stamp program was designed to deal simultaneously with hunger and surplus problems. Stamps of one color could be used only for specified surplus commodities while other stamps were usable for all eligible foods. After World War II the distribution of surplus commodities, through the National School Lunch Program and directly to needy households, became the mainstay

of the federal food assistance program.

Impacts of Commodity Donations

Economic theory can give us some useful, though limited, insights into the likely effects of food commodity donations. While convexity of indifference curves is sufficient to assure that some displacement will result from donations, a simple diagrammatic example is instructive. In figure 1 we illustrate an individual's choices between two goods, x and y. Assuming an initial budget constraint Y1X1 indicating the available combinations of x and y, the consumer chooses bundle 1. If a quantity of good x is now made available free, and critically, if we assume that good x cannot be used as a medium of exchange, the budget constraint becomes Y1aX2, ignoring all transactions costs. All previous quantities of good y are available given the consumer's budget and in addition at each level of y, an additional X1X2 units of good x are available.

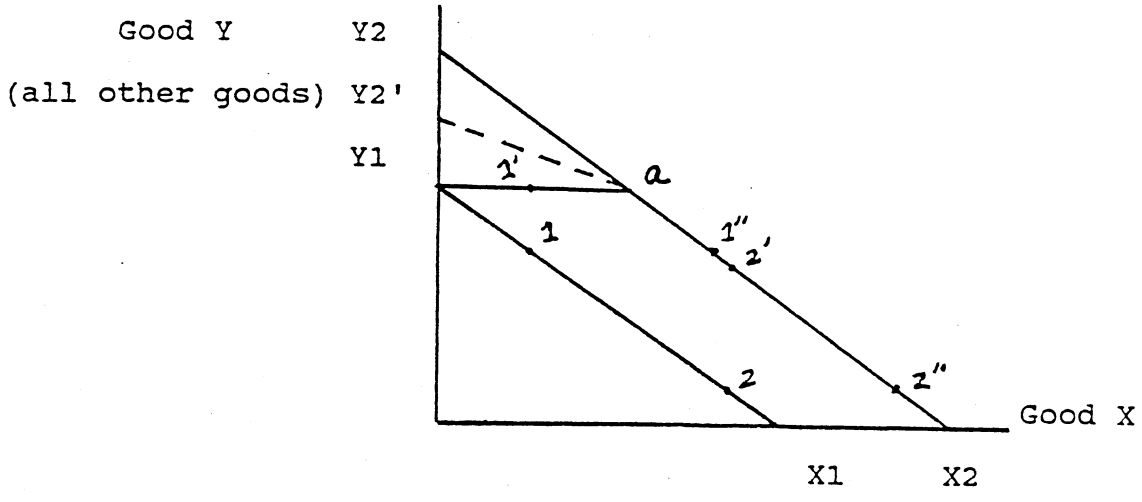

Figure 1

If a positive quantity of good x is purchased at a positive price prior to the donation program, point 1 in Figure 1, the marginal utility of the last unit of good x exceeds zero. There are several possible effects of the donation program, but also several which can be ruled out immediately. If we begin at point 1, the

choice of bundle 1" when donations are introduced implies the income elasticity of good y (all other goods) is zero, which is unlikely, thus we rule out the case of zero displacement. At the other extreme we can analyze point 1'. Bundles of x and y along line segment (1'a) are theoretically possible outcomes only if the marginal utility of cheese equals zero (its price), which is impossible under convexity, though these points may be possible, or even reasonable, under the strict assumptions of non-tradability at a positive price. However, if re-trading or even re-donations are allowed, points to the left of a may be ruled out. Hence for the case where the donations of a commodity exceed the normal consumption we conclude that displacement of commercial sales must occur and it could reach 100 percent.

It is useful to examine cases where donations are at levels smaller than typical per capita consumption of recipients, point 2 in Figure 1. The donation program makes all points on or within budget constraint Y1aX2 available to the consumer. We may again rule out the no displacement cases, points 2" to X2 since they imply negative income elasticity for all other goods. Alternatives 2' to 2" remain feasible, implying displacement up to 100 percent. Points from Y1 to a are infeasible for the same reasons cited above. Points along the segment a to 2' would be consistent with cases where the donated commodity was an inferior good and the other good(s) were income elastic, cases which may make sense among the poor as a donation program may free up income to purchase preferred consumption bundles.

The assumption of non-tradability makes the portion of the

opportunity set from point a to Y2 unattainable. If retrading occurs it seems reasonable to assume that any cheese so used would be valued at substantially less than its purchase price if bought in a store. Hence it may be reasonable to construct a budget constraint assuming retradability as Y2'aX2 in Figure 1. The potential to re-trade the donated commodity then results in a case similar to that discussed just above where the donated commodity is an inferior good and other goods and services are highly desired by the recipient.

TEFAP Donations And Recipients' Consumption Patterns

During the past four years the annual TEFAP donations of American cheese have averaged 395 million pounds (355 million natural equivalent) per year. Butter donations averaged about 115 million pounds. It is not known exactly how many persons have received the donated cheese and butter. USDA's Food and Nutrition Service, (FNS), has estimated that 23 million persons received TEFAP commodities in September, 1984. During the four years TEFAP has been in place, about 35 million persons were living in households with income below the poverty level. Donations per eligible person, assuming 35 or 23 million recipients were 11.3 or 17.2 pounds of cheese and 3.3 or 5.0 pounds of butter. Over this same period the average consumer ate 9.2 pounds of American cheese and 3.9 pounds of butter (13). The target population is not average. Low income persons consume about 94 percent as much American cheese as the average consumer, and 77 percent as much butter (14). Low income persons consume about the same amount of margarine and approximately 95 percent as much spread as the general population.

TEFAP cheese donations have included only American cheese, primarily processed, with a small amount of natural cheddar. Low income households consume 30 percent less "other" cheese; French, Italian and Swiss types (14). A reasonable argument can be made that donations of American cheese will displace sales of American cheese. Two alternative arguments have been made: One that donations will adversely affect all cheese consumption, another that donation of American cheese results in increased purchases of other types of cheese by low income consumers. This hypothesis appears to stem from the fact that the sales of "other" cheese have risen quite rapidly over the 30 year period under study and have continued to rise in the face of large TEFAP donations. We present some empirical findings on these arguments below.

The per capita American cheese consumption figures referred to above (9.2 pounds) come from USDA disappearance data (13), the only available source of longitudinal data on food disappearance. Totals include cheese eaten as an ingredient in processed food, cheese consumed in restaurants, and packaged cheese purchased in grocery stores. Donated cheese seems most likely to displace packaged cheese sales, hence it is necessary to estimate the portion of cheese consumption which "disappeared" as packaged product. Direct sales of packaged product appear to account for about 70 to 80 percent of total cheese sales. This estimate is obtained by utilizing data on production, imports, exports, inventory change, and specialization ratios, from the Census of Manufacturers (15, 16), and a proprietary survey of warehouse product removals.

Empirical Estimates

An estimate of the aggregate impacts of donation programs on commercial disappearance (sales) requires estimating a demand function for each commodity. Sales are hypothesized to be related to own price, the price of substitutes, consumer income and donations 1/. The relationships estimated were:

$$Xit = f(Pit, Pjt, It, Dit, e) \text{ , where:}$$

Xit = Per capita commercial disappearance of good i in period t,
Pit = Price of good i in period t,
Pjt = Price of close substitutes, j, to good i in period t,
It = Per capita disposable personal income in period t,
Dit = Per capita government donations of good i in period t,
e = error term.

Dairy program support prices, and lagged product prices both influence the supply of cheese and butter at the farm and processor levels and present a reasonable way to deal with the econometric problem of the simultaneous determination of market prices and quantities. The demand equations can be estimated consistently using two-stage least squares including the support price and lagged product price as pre-determined variables from the supply side.

The Data

The quantity data used in this analysis was the USDA per capita consumption (disappearance) series from 1955-1985. The ideal data for analyzing the effects of donation programs would be longitudinal diary data gathered from commodity recipients. Such data are not available, however. The USDA disappearance data are in concept commodity or production based. Data are not gathered on the

1/ LaFrance and deGorter (8) hypothesized a habitual/partial adjustment model for dairy demand. We found no evidence of such behavior in testing a partial adjustment form of the model.

consumption or disappearance of retail foods. Hence, the quantity data available are for cheese or butter which enters all end uses, including that sold as a packaged product, an ingredient in prepared foods, or sold through a restaurant (3).

The price data are obtained from the Bureau of Labor Statistics. These data are gathered monthly for retail food items and are not therefore a perfect correspondence for the quantity data available. Real retail prices for cheese, butter, and margarine were used for own price in the equations. Butter and margarine were the obvious substitutes for one another, but there is no obvious intuitive choice of a close substitute for cheese. Huang (5) found in estimating a complete demand system that the best substitute for cheese, as measured by cross price elasticity, was other meat, which includes franks, bologna, liverwurst and other lunch meats, lamb and organ meats. We therefore, included the real price of other meat in the cheese demand equation to represent the price of a close substitute.

Income was real personal disposable income per capita. Two donation variables, traditional donations, which were made during each of the 30 years under observation, mostly to school lunch programs, and TEFAP donations, made only during the last four years, primarily to households were used.

Initial estimates of the demand equations for cheese, butter and margarine indicated autocorrelation in the disturbance terms for all three products. Two-stage least squares, with a first order Cochrane-Orcutt autoregressive process, was subsequently used to estimate the equations.

Implications for Donation Programs

The results of estimating the demand equations discussed above appear in Table 1. In the American cheese model, the own and cross price coefficients have the expected signs, though neither is significantly different from zero. The coefficient on income is also insignificant, and negative. A more detailed rationale for these findings is discussed in the next section. The two donation coefficients are both negative and significantly different from

Table 1. Parameter estimates and standard errors for models.
(Estimation period; 1955-1985)

Independent Variable	Model				
	Cheese (Amer)	Cheese (Tot.)	Cheese (Other)	Butter	Marg.
Constant	25.98***	44.136***	16.916***	5.165**	3.966
	(6.38)	(10.682)	(5.658)	(2.067)	(3.376)
Income	-.00106	.0004	.00149**	-.0003	.0008*
	(-.00099)	(.0015)	(.0007)	(.0004)	(.00045)
Price	-2.437	-4.938	-2.546*	-.758	1.054
	(-2.160)	(3.214)	(1.534)	(1.183)	(1.016)
Price of Substitute	.563	.232	-.352	.248	4.169**
	(1.081)	(1.614)	(.772)	(.382)	(1.740)
Other Donations	-.857***	-.933***	-.077	-.335**	-.353
	(-.236)	(.352)	(.168)	(.159)	(.341)
TEFAP Donations	-.614***	-.554*	.065)	-.086	-.911**
	(-.203)	(.303)	(.145)	(.255)	(.390)
Rho	.979***	.983***	.986***	.904***	.825***
	(.038)	(.0134)	(.031)	(.081)	(.107)
DW	2.29	1.932	1.237	2.314	1.991

*,**,*** denote significance at the 10%, 5% and 1% levels, respectively.

zero. The coefficient on the traditional donation variable suggests that for every pound of cheese donated .857 pounds of cheese that would otherwise have been purchased is displaced.

Since TEFAP cheese donations exceed normal consumption levels of the target population, the coefficient on the displacement variable in the cheese equation, -.614, must be interpreted with caution. Unlike the traditional donation coefficient we cannot interpret the TEFAP coefficient as the change in purchases which would result from a one pound increase in donations. Since donations exceed normal consumption levels such an interpretation could be quite misleading. For example, consider the hypothetical case where sales to the target population are in fact displaced on a pound for pound basis, but where donations are at twice their normal consumption level. Even though sales are displaced one for one, the observed displacement coefficient using national aggregate data would be -.5. If interpreted in the normal manner it would suggest that sales would fall one-half pound for each additional pound of cheese donated. Of course, in this example, since all sales to the recipients would have been displaced, further donations would have no effect whatever on sales.

The assumption that only packaged cheese sales are affected also complicates interpretation of the TEFAP coefficient. If our estimate that 70 to 80 percent of cheese is sold as cheese were applied to the above example, that is if the target population normally purchased .70 to .80 pounds of packaged cheese but donations of two pounds were received, the observed displacement coefficient in our hypothetical example would be -.35 to -.40,

instead of -.5 as described above.

It is not possible to derive an algorithm for converting the coefficient estimated with national aggregate data into the unobservable true relationship between donations to the target population and changes in their cheese purchases, because we have no data to suggest how their behavior might differ if donations had been made at different levels. We can, though, use the information we have to estimate the coefficient we would expect to observe if all sales to the target low income population had been displaced.

The maximum amount of sales which could be displaced is the estimated normal sales of packaged cheese to the recipient population. Utilizing the values discussed above; per capita low income population consumption of 8.65 pounds, 70 to 80 percent of sales as packaged cheese, and low income population of 23 to 35 million; the normal sales would be between 139 and 242 million pounds. With annual TEFAP donations averaging 355 million pounds natural cheese equivalent over the four years, if all sales to low income persons were displaced we would expect to estimate a displacement coefficient using national aggregate data of between -.39, (139/355) and -.68, (242/355). We cannot reject that the TEFAP coefficient in equation 1 is as large as -.68, nor as small as -.39, hence we cannot reject the hypothesis that total cheese purchases of the low income recipient population have been displaced by TEFAP.

One way that more cheese than what is normally consumed by eligible recipients could be displaced, is for a non-recipient's purchases to be displaced. If the coefficient were significantly larger in absolute value than -.39, and particularly if the

coefficient significantly exceeded -.68, our results might suggest that retrading or redonations had taken place. Even if our results were consistent statistically with such behavior, it would not be possible to make a strong statement on the existince of redonations since a larger coefficient could also obtain if consumption of cheese containing foods, or cheese consumption in restaurants was reduced as a result of cheese donations.

The total cheese demand and other cheese demand models were estimated to determine what affects, if any, the donation program had on other types of cheese. The donation coefficients in the total cheese model were essentially unchanged from the American cheese model, suggesting that whatever effect donations had on cheese sales came through American cheese sales. As further evidence, the other cheese model shows that neither type of donation had a significant affect on "other" cheese sales over the period.

From the butter demand model, we see that butter donations to schools appeared to displace butter sales, but by significantly less than pound for pound. TEFAP butter donations had no significant impact on butter sales. The coefficient on TEFAP donations in the margarine model, -.911, which is not significantly less than unity, suggests that margarine sales were displaced pound for pound by TEFAP butter donations. A pound of butter donated to the schools reduced margarine sales by .353 pounds, though the coefficient was not significantly different from zero.

The findings suggest that a high level of displacement of commercial sales of both cheese and margarine has resulted from the TEFAP program. Traditional donation programs, widely used in the

past to dispose of surplus commodities, also appear to have resulted in displacement. These findings cast some doubt on the effectiveness generally of programs designed to enhance final demand through the free distribution of surplus commodities which have been removed from the commercial marketplace.

The 1985 Farm Bill has provisions for a whole herd buyout to deal with dairy surpluses. The requirement that the Secretary of Agriculture purchase an additional 200 million pounds of beef for domestic distribution to schools and needy persons was apparently intended to neutralize the adverse impacts of the slaughter of dairy cows on the beef industry. However, to the extent that there is displacement in any of the disposal channels, that adverse impact would not be offset.

Not only may the donations adversely impact domestic commercial sales of the donated commodity, but as evidenced by the butter/margarine case, donations of a commodity can adversely impact the sales of closely related goods. While no attempt was made to measure it, the large donations of cheese in excess of normal consumption levels may well have displaced sales of other protein products, in addition to displacing sales of cheese.

Implications for Demand Analysis

USDA's annual disappearance data are often used in demand analysis. For many commodities disappearance is a good proxy for sales, however, Government donations, particularly of Sections 32 and 416 commodities to the school lunch program have accounted for a significant portion of the total disappearance of several commodities (10). The addition of the TEFAP program has resulted in

donations accounting for over 20 percent of total American cheese and butter consumption. Such a large portion of aggregate demand for these commodities unaffected by changes in prices and income may explain our findings that prices and income were not significant factors explaining variations in demand for American cheese, butter and margarine.

The estimates of price and income response for other cheese, which we hypothesized was unaffected by donations, were considerably more significant. About 40 percent of other cheese sales is mozzarella, the primary pizza cheese. If a large portion of this cheese is used in foodservice, as we suspect, the positive and more significant income coefficient is reasonable, particularly since many studies have indicated that away from home eating is quite income responsive. Also, the price coefficient is negative and significant at the .10 level.

To further test the effects on estimates of price elasticity of failing to account for donations we estimated demand models of per capita consumption, when donations were not taken into account. In table 2 we report the results of models for American cheese and butter for the period 1955-85. We also report results for the period 1955-81 for each commodity, which allow comparisons between estimates of price elasticity before TEFAP was initiated. All models were estimated using per capita consumption, rather than commercial disappearance as the dependent variable. This is the way most researchers utilize the data. This also ensures comparability of elasticity estimates between the two approaches, since the use of commercial disappearance as the dependent variable implicitly

Table 2. Cheese price elasticities estimated from demand models using two different assumptions about donations.

Model	Estimation Period	
	1955-1985	1955-1981
Total Cheese Cons. (Donations Ignored)	-.473 (.039)a	-.330 (.169)
Total Cheese Cons. (Donations Accounted For)	-.371 (.139)	-.158 (.514)
Butter (Donations Ignored)	-.267 (.328)	+.029 (.919)
Butter (Donations Accounted For)	-.126 (.528)	-.103 (.638)

a=The number in parentheses is the significance level of regression coefficient from which elasticity is calculated.

recognizes the existence of donations, since they are subtracted from consumption to measure commercial sales, whereas using consumption data does not.

The cheese price elasticities estimated when donations were accounted for were smaller than those estimates which ignored donations in both the 1955-81 and 1955-85 periods. When donations were included, price was less significant in each period. For butter the elasticities were smaller when donations were accounted for during 1955-85, and for the 1955-81 period, failure to account for donations resulted in a positive own price elasticity estimate. The price coefficients were not significant in either time period for either donation assumption.

These results reinforce the earlier findings of the importance of donations in determining factors influencing market sales of these products. The results also suggest that care should be taken, especially when estimates are to be used for forcasting or policy analysis, to assure that the demand equation estimated measures the relationships of interest, usually sales, rather than consumption. Failure to account for donations is likely to be more important for cheese and other dairy products, where donations account for a significant portion of total consumption. Donations are also important, for beef, pork, and poultry, especially turkeys, though they do not account for as large a portion of total consumption as in the case of dairy products.

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