Impact of National Generic Dairy Advertising on Dairy Markets, 1984-96

by

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- Enhance both public and private policy maker's understanding of the economics of commodity promotion programs.

- Facilitate the development of new theory and research methodology.

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Preface

Harry M. Kaiser is an associate professor in the Department of Agricultural, Resource, and Managerial Economics at Cornell University, and director of the National Institute for Commodity Promotion Research and Evaluation (NICPRE).

This report is published as a NICPRE research bulletin. The mission of NICPRE is to enhance the overall understanding of economic and policy issues associated with commodity promotion programs. An understanding of these issues is crucial to ensuring continued authorization for domestic checkoff programs and to fund export promotion programs.

Each year, NICPRE provides an updated analysis of the national dairy advertising program. This bulletin summarizes the independent evaluation of the National Dairy Promotion and Research Board. This report should help farmers, policy makers, and program managers in understanding the economic impacts of generic dairy advertising on the national markets for milk and dairy products. The report should also be useful for current legal debates on the effectiveness of commodity promotion programs in enhancing the profitability of farmers.

Executive Summary

The purpose of this study was to analyze the impacts of generic dairy advertising by the National Dairy Promotion and Research Board on retail, wholesale, and farm dairy markets. A disaggregated industry model of the retail, wholesale, and farm levels with markets for fluid milk, frozen products, cheese, and butter was developed to conduct the analysis. An econometric model of the dairy industry was estimated using quarterly data from 1975 through 1996. The econometric results were then used to simulate market conditions with and without the NDPRB.

The results indicate that NDPRB had a major impact on market conditions at all levels of the dairy industry, particularly the fluid market. For example, over the period 1984-96, on average, the NDPRB had the following market impacts compared to what would have occurred in the absence of this national program:

☞ An increase in the national farm milk price of almost 3 percent and an increase in milk production of 0.6 percent.

☞ An increase in dairy producer revenue of 3.5 percent.

☞ A rate of return of 5.27, i.e., an additional dollar invested in generic advertising resulted in a return of $5.27 in dairy producer revenue.

☞ An increase in overall demand for milk of 0.7 percent, including a 2.1 percent increase in fluid milk demand. The NDPRB had virtually no impact on cheese, butter, and frozen product demand.

☞ An overall increase in retail prices for milk and dairy products. The national advertising program had the largest effect on increasing retail fluid milk prices (11.4 percent). Retail frozen product, cheese, and butter prices increased by 1.2 percent, 0.4 percent, and 0.5 percent, respectively, due to NDPRB advertising efforts.

☞ An increase in all wholesale prices for milk and dairy products. The national advertising program had the largest effect on increasing wholesale fluid milk prices (7.7 percent). Wholesale frozen product, cheese, and butter prices increased by 1.7 percent, 2.6 percent, and 0.7 percent, respectively, due to NDPRB advertising efforts.

☞ A decrease in government purchases of dairy products under the Dairy Price Support Program of 1.7 percent.

Consequently, it is clear that dairy farmers benefitted from the presence of the NDPRB since farm

prices and producer revenues were positively impacted. Dairy wholesalers and retailers also benefitted from this program since prices and sales were positively effected by the NDPRB advertising effort. Tax payers also benefitted because government purchases and costs of the Dairy Price Support Program were lower.

Introduction

Dairy farmers pay a mandatory assessment of 15 cents per hundred pounds of milk marketed in the continental United States to fund a national demand expansion program. The aims of this program are to increase consumer demand for milk and dairy products, enhance dairy farm revenue, and reduce the amount of surplus milk purchased by the government under the Dairy Price Support Program. Legislative authority for these assessments is contained in the *Dairy and Tobacco Adjustment Act* of 1983. To increase milk and dairy product consumption, the National Dairy Promotion and Research Board (NDPRB) was established to invest in generic dairy advertising and promotion, nutrition research, education, and new product development.

Each year, the Cornell Commodity Promotion Research Program (CCPRP) estimates the impact of the NDPRB generic advertising effort on the U.S. dairy industry. U.S. dairy industry data are updated each year and used with a dairy industry model to measure the impact of generic advertising on prices and quantities of milk and dairy products. The model used is based on a dynamic econometric model of the U.S. dairy industry estimated using quarterly data from 1975 through 1996, and is unique from previous models of the U.S. dairy sector in its level of disaggregation. For instance, the dairy industry is divided into retail, wholesale, and farm markets, and the retail and wholesale markets separately include fluid milk, cheese, butter, and frozen products. Econometric results are used to simulate market conditions with and without the national program.

The results of this study are important for dairy farmers and policy makers alike given the dairy industry has the largest generic promotion program of all U.S. agricultural commodities. Over $200 million is raised annually by the checkoff on dairy farmers, and the majority of this is invested in media advertising of milk and dairy products. Farmers certainly want to know whether their advertising investment is paying off.

Consequently, the annual measurement of generic dairy advertising is an important objective of the CCPRP.

Background

Prior to 1984, there was no national mandatory checkoff for dairy advertising and promotion. However, many states had their own checkoff programs, which were primarily used for promoting and advertising fluid milk. Because of the huge surplus milk problem which began in the early 1980s, Congress passed the *Dairy and Tobacco Adjustment Act* in 1983. This Act was designed to reduce milk surplus by implementing a voluntary supply control program (Milk Diversion Program) and authorizing a mandatory checkoff for demand expansion. The mandatory checkoff program, which was subsequently approved by dairy farmers in a national referendum, resulted in the creation of the NDPRB.

The generic advertising effort of the NDPRB initially emphasized manufactured dairy products, since 10 of the 15 cents of the checkoff went to state promotion programs which were primarily fluid programs. This is evident in Figure 1, which shows quarterly generic fluid advertising expenditures in the United States from 1975-96, deflated by the media cost index. At the national level, generic fluid advertising expenditures did not significantly change immediately following the creation of the NDPRB. In fact, it was not until the mid-1990s that there was a significant increase in generic fluid milk advertising expenditures, which occurred after the NDPRB merged with the United Dairy Industry Association (UDIA). Subsequently, the amount of fluid advertising has increased significantly.

Figures 2-4 show quarterly generic cheese, butter, and frozen dairy product advertising in the United States from 1975-96. It is clear from Figures 2-4 that the NDPRB initially focused on generic advertising of manufactured dairy products. Generic cheese, butter, and frozen product advertising increased substantially after the creation of the NDPRB. However, since the mid-1980s, generic advertising of these products has been steadily declining in favor of generic fluid advertising. This trend is likely due to the fact that dairy farmers received a higher price for milk going into fluid products. Hence, increasing the

Figure 1. Deflated generic fluid milk advertising expenditures, 1975-96.

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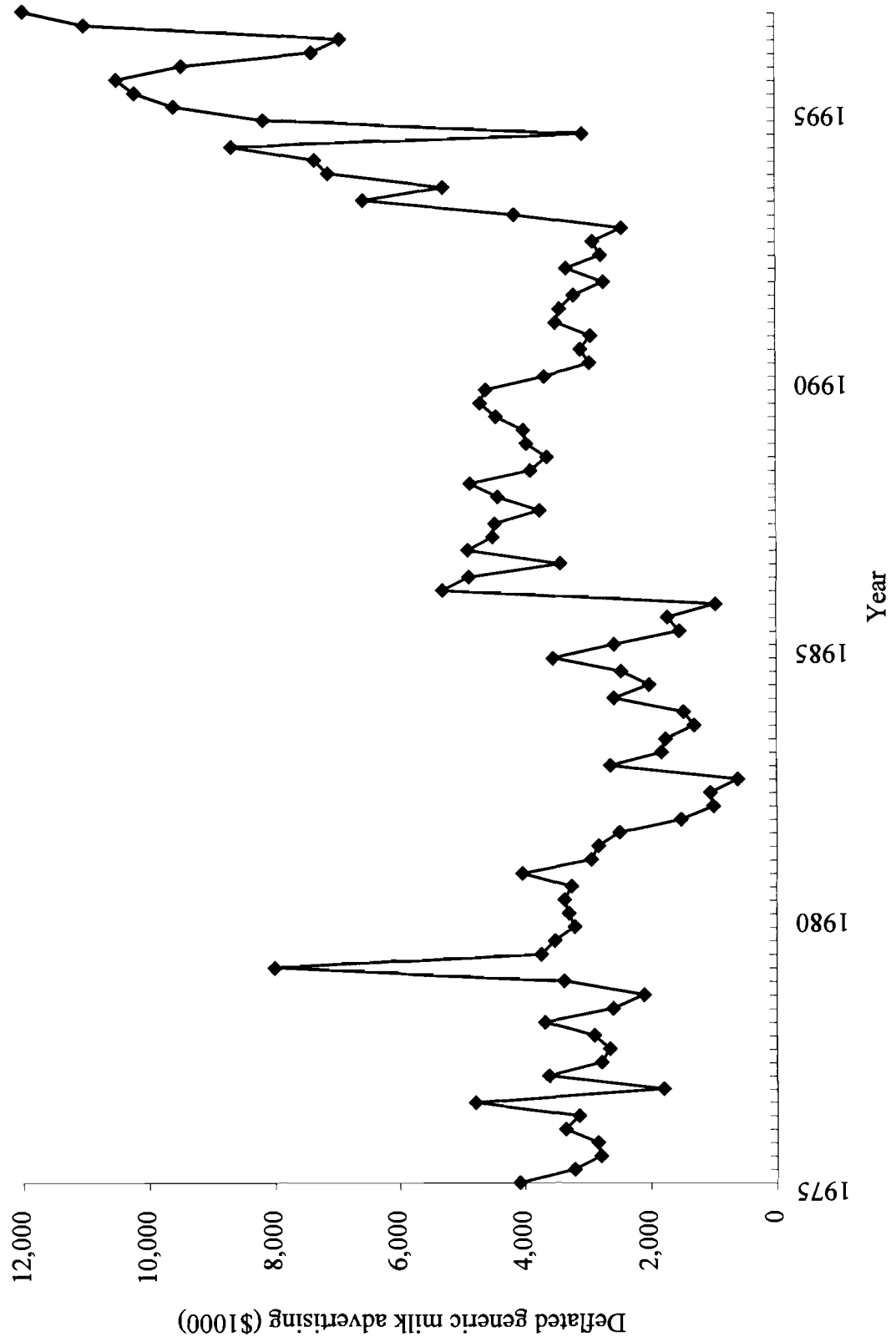Figure 2. Deflated generic cheese advertising expenditures, 1975-96.

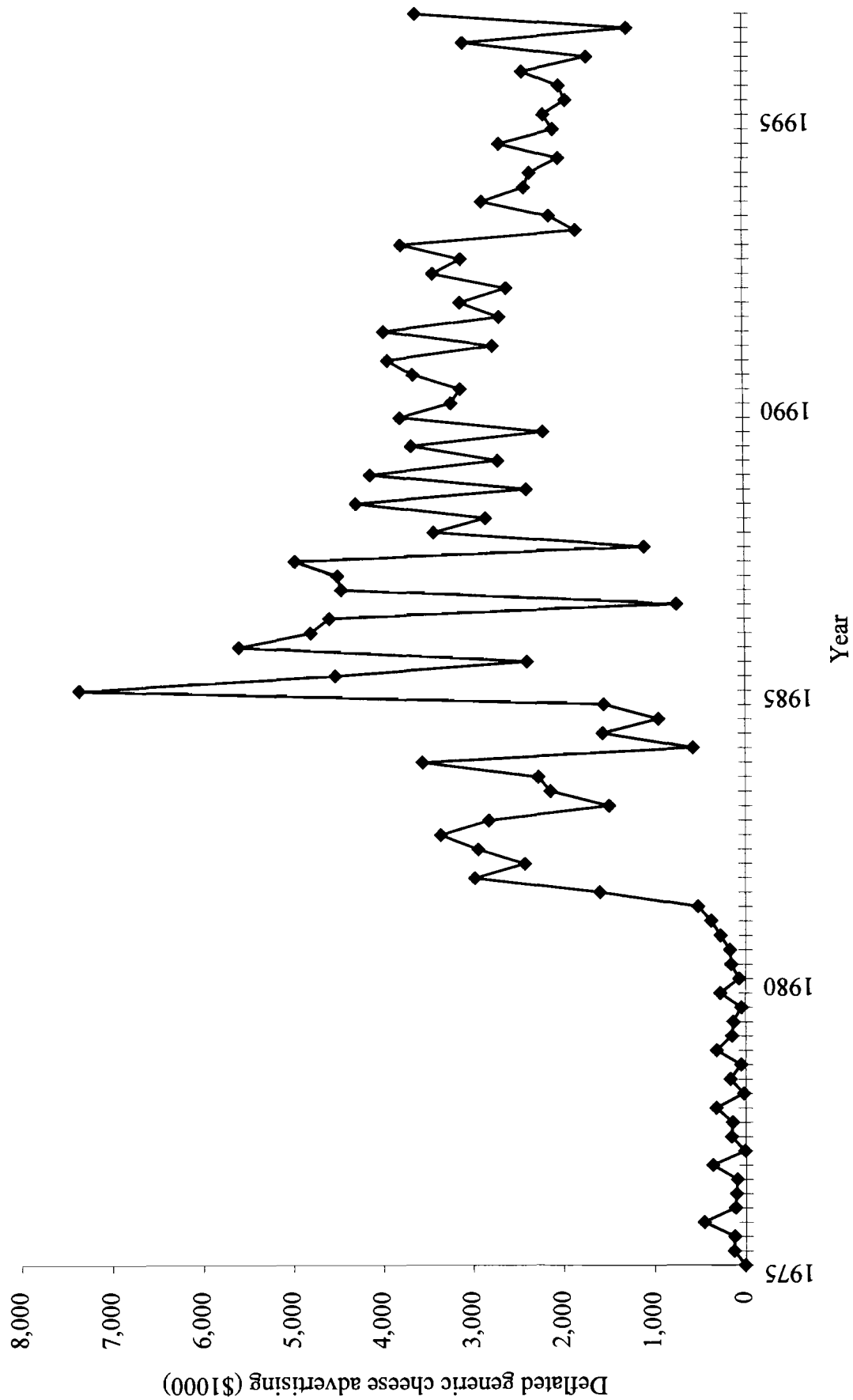Figure 3. Deflated generic butter advertising expenditures, 1975-96.

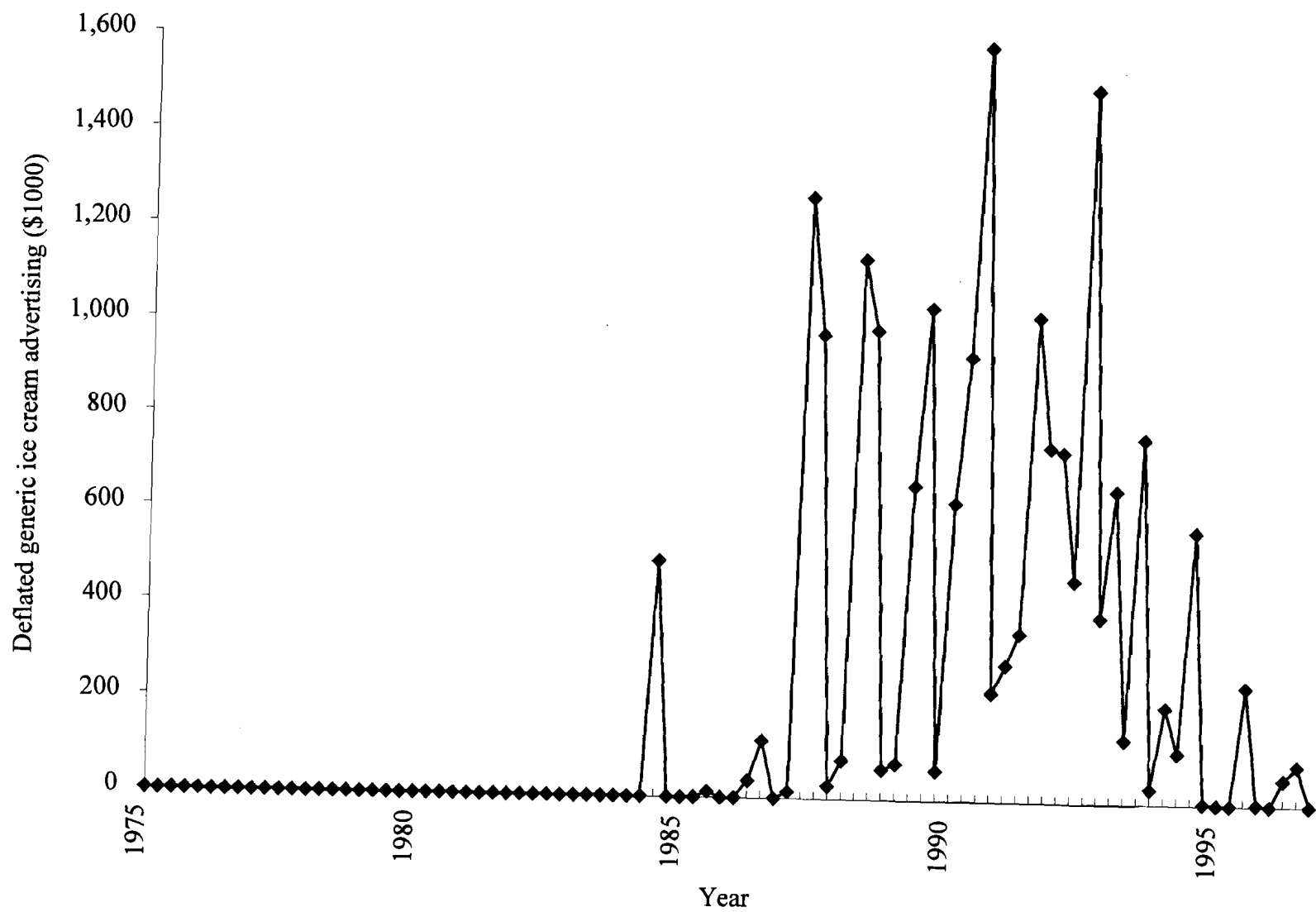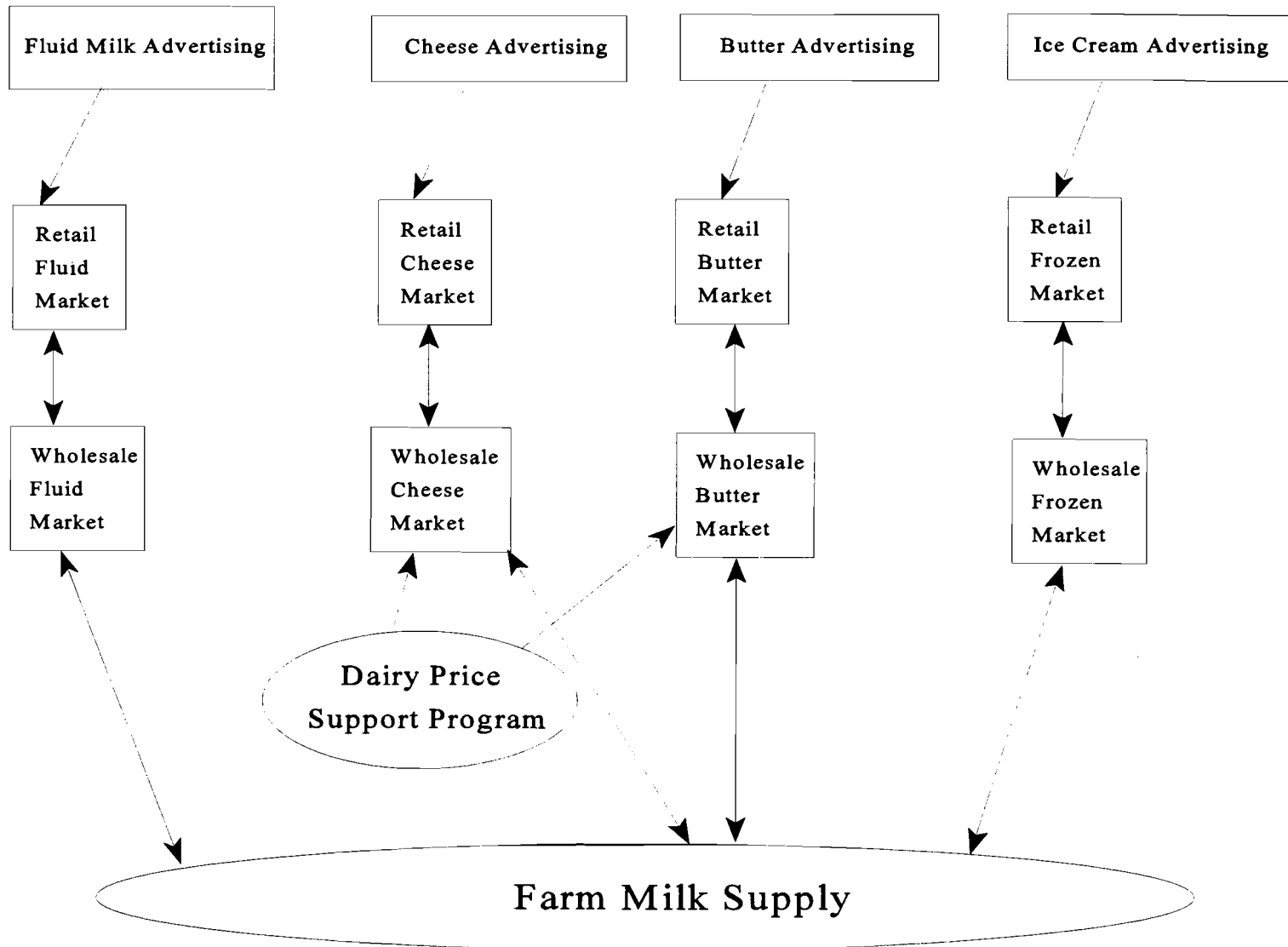Figure 4. Deflated generic ice cream advertising expenditures, 1975-96.

Figure 5. Conceptual overview of U.S dairy industry model.

utilization of milk into fluid products is an effective way to increase the average farm price.

Conceptual Model

There has been a lot of research on the impacts of generic dairy advertising. For example, in an annotated bibliography of generic commodity promotion research, Ferrero et al. listed 29 economic studies on dairy over the period, 1992-96. Some of this research has been at the state level with New York state being studied extensively (e.g., Kinnucan, Chang, and Venkateswaran; Kaiser and Reberte; Reberte et al.). These studies have used single equation techniques to estimate demand equations, usually for fluid milk, as functions of own price, substitute price, income, population demographics, and advertising. There have been several recent national studies done as well (e.g., Blisard and Blaylock; Liu et al. (1990); Cornick and Cox; Suzuki et al.; Wohlgenant and Clary). Of these, the most disaggregated in terms of markets and products was Liu et al. (1990), who developed a multiple market, multiple product dairy industry model to measure the impacts of fluid milk and manufactured dairy product generic advertising.

The econometric model presented here is similar in structure to the industry model developed by Liu et al. (1990, 1991). Both Liu et al. (1990, 1991) and the current model are partial equilibrium models of the domestic dairy one category (Class III), the present model disaggregates manufactured products into three classes: frozen products, cheese, and butter. This greater degree of product disaggregation provides for additional insight into the impacts of advertising on individual product demand, e.g., cheese, butter, and frozen product demand.

In the farm market, Grade A (fluid eligible) milk is produced by farmers and sold to wholesalers. The wholesale market is disaggregated into four submarkets: fluid (beverage) milk, frozen products, cheese, and butter.[1] Wholesalers process the milk into these four dairy products and sell them to retailers, who then sell the products to consumers. The model assumes that farmers, wholesalers, and retailers behave competitively in the market. This assumption is supported empirically by two recent studies. Liu, Sun, and Kaiser estimated the market power of fluid milk and manufacturing milk processors, concluding that both behaved quite competitively over the period 1982-1992. Suzuki et al. measured the degree of market imperfection in the fluid milk industry and found the degree of imperfection to be relatively small and declining over time.

It is assumed that the two major federal programs regulating the dairy industry (federal milk marketing orders and the Dairy Price Support Program) are in effect. Since this is a national model, it is assumed that there is one federal milk marketing order regulating all milk marketed in the nation. The federal milk marketing order program is incorporated by restricting the prices wholesalers pay for raw milk to be the minimum class prices. For example, fluid milk wholesalers pay the higher Class I price, while cheese wholesalers pay the lower Class III price. The Dairy Price Support Program is incorporated into the model by restricting the wholesale cheese and butter prices to be greater than or equal to the government purchase prices for these products. With the government offering to buy unlimited quantities of storable manufactured dairy products at announced purchase prices, the program indirectly supports the farm milk price by increasing farm-level milk demand. A conceptual overview of the model is presented in Figure 5.

Retail markets are defined by sets of supply and demand functions, in addition to equilibrium conditions that require supply and demand to be equal. Since the market is disaggregated into fluid milk, frozen products, cheese, and butter, there are four sets of these equations, with each set having the following general specification:

$$(1.1) \quad RD = f(RP|S^{rd}),$$
$$(1.2) \quad RS = f(RP|S^{rs}),$$
$$(1.3) \quad RD = RS \equiv R^*,$$

where: RD and RS are retail demand and supply, respectively, RP is the retail own price, S^{rd} is a vector of retail demand shifters including generic advertising,

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[1] All quantities in the model are expressed on a milkfat equivalent (me) basis. Consequently, nonfat dry milk was not considered in the model.

S^{rs} is a vector of retail supply shifters including the wholesale own price, and R* is the equilibrium retail quantity.

The wholesale market is also defined by four sets of supply and demand functions, and equilibrium conditions. The wholesale fluid milk and frozen product markets have the following general specification:

(2.1) $WD = R^*$,

(2.2) $WS = f(WP|S^{WS})$,

(2.3) $WS = WD \equiv W^* \equiv R^*$,

where: WD and WS are wholesale demand and supply, respectively, WP is the wholesale own price, and S^{WS} is a vector of wholesale supply shifters. In the wholesale fluid milk supply equation, S^{WS} includes the Class I price, which is equal to the Class III milk price (i.e., the Basic Formula price) plus a fixed fluid milk differential. In the frozen products, cheese, and butter wholesale supply functions, S^{WS} includes the Class III price, which is the most important variable cost to dairy processors. Note that the wholesale level demand functions do not have to be estimated since the equilibrium conditions constrain wholesale demand to be equal to the equilibrium retail quantity. The assumption that wholesale demand equals retail quantity implies a fixed-proportions production technology.

The direct impacts of the Dairy Price Support Program occur at the wholesale cheese and butter market levels. It is at this level that the Commodity Credit Corporation (CCC) provides an alternative source of demand at announced purchase prices. In addition, cheese and butter can be stored as inventories, which represent another source of demand not present with the other two products. Consequently, the equilibrium conditions for the butter and cheese wholesale markets are different than those for the fluid milk and frozen wholesale markets. The wholesale cheese and butter markets have the following general specification:

(3.1) $WD = R^*$,

(3.2) $WS = f(WP|S^{WS})$,

(3.3) $WS = WD + \Delta INV + QSP \equiv Q^W$,

where: WD and WS are wholesale demand and supply, respectively, WS is the wholesale own price, S^{WS} is a vector of wholesale supply shifters including the Class III milk price, ΔINV is change in commercial inventories, QSP is quantity of product sold by specialty plants to the government, and Q^W is the equilibrium wholesale quantity. The variables ΔINV and QSP represent a small proportion of total milk production and are assumed to be exogenous in this model.[2]

The Dairy Price Support Program is incorporated in the model by constraining the wholesale cheese and butter prices to be not less than their respective government purchase prices, i.e.,:

(4.1) $WCP \geq GCP$,

(4.2) $WBP \geq GBP$,

where: WCP and GCP are the wholesale and government purchase prices for cheese, respectively, and WBP and GBP are the wholesale and government purchase prices for butter, respectively.

Because of the Dairy Price Support Program, four regimes are possible: (1) WCP > GCP and WBP > GBP; (2) WCP > GCP and WBP = GBP; (3) WCP = GCP and WBP > GBP; or (4) WCP = GCP and WBP = GBP. In the cheese and butter markets, specific versions of equilibrium condition (3.3) are applicable to the first regime, which is the competitive case. In the second case, where the cheese market is competitive but the butter market is not, the wholesale butter price

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[2] Certain cheese and butter plants sell products to the government only, regardless of the relationship between the wholesale market price and the purchase price. These are general balancing plants that remove excess milk from the market when supply is greater than demand, and process the milk into cheese and butter which is then sold to the government. Because of this, the quantity of milk purchased by the government was disaggregated into purchases from these specialized plants and other purchases. In a competitive regime, the "other purchases" are expected to be zero, while the purchases from specialty plants may be positive. The QSP_c and QSP_b variables were determined by computing the average amount of government purchases of cheese and butter during competitive periods, i.e., when the wholesale price was greater than the purchase price for these two products.

is set equal to the government purchase price for butter and the equilibrium condition is changed to:

$$(3.3b) \quad WBS = WBD + \Delta INV_b + QSP_b + GB \equiv WB,$$

where: GB is government purchases of butter which becomes the new endogenous variable, replacing the wholesale butter price. For the third case, where the butter market is competitive but the cheese market is not, the wholesale cheese price is set equal to the government purchase price for cheese and the equilibrium condition is changed to:

$$(3.3c) \quad WCS = WCD + \Delta INV_c + QSP_c + GC \equiv WC,$$

where: GC is government purchases of cheese, which becomes the new endogenous variable replacing the wholesale cheese price. Finally, for the last case where both the cheese and the butter markets are not competitive, the wholesale cheese and butter prices are set equal to their respective government purchase prices and the equilibrium conditions are changed to (3.3b) and (3.3c).[3]

The farm raw milk market is represented by the following milk supply equation:

$$(5.1) \quad FMS = f(E[AMP]|S^{fm}),$$

where: FMS is commercial milk marketings in the United States, E[AMP] is the expected all milk price, S^{fm} is a vector of milk supply shifters. As in the model developed by LaFrance and de Gorter, and by Kaiser, a perfect foresight specification is used for the expected farm milk price.

The farm milk price is a weighted average of the class prices for milk, with the weights equal to the utilization of milk among products:

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[3] Because the market structure is different under each of these four regimes, using conventional two-stage least squares to estimate equations (1.1) through (4.2) may result in selectivity bias. Theoretically, a switching simultaneous system regression procedure should be applied (see Liu et al. (1990, 1991)). This procedure was not used here because it was beyond the scope of the project. Applying it to the level of disaggregation of this model's manufactured product market would have been extremely cumbersome, and the costs of doing so were judged to be greater than the potential benefits.

$$(5.2) \quad AMP = \frac{(P3 + d)\, WFS + P3\, (WFZS + WCS + WBS)}{WFS + WFZS + WCS + WBS}$$

where: P3 is the Class III price, d is the Class I fixed fluid milk differential (therefore the Class I price is equal to P3 + d), WFS is wholesale fluid milk supply, WFZS is wholesale frozen product supply, WCS is wholesale cheese supply, and WBS is wholesale butter supply.

Finally, the model is closed by the following equilibrium condition:

$$(5.3) \quad FMS = WFS + WFZS + WCS + WBS + FUSE + OTHER,$$

where FUSE is on-farm use of milk and OTHER is milk used in dairy products other than fluid milk, frozen products, butter, and cheese. Both of these variables represent a small share of total milk production and were treated as exogenous.

Econometric Estimation

The equations were estimated simultaneously using an instrumental variable approach for all prices and quarterly data from 1975 through 1996. Specifically, all prices were regressed using ordinary least squares on the exogenous variables in the model, and the resulting fitted values were used as instrumental price variables in the structural equations. The econometric package used was EViews (Hall, Lilien, and Johnston). All equations in the model were specified in double-logarithm functional form. Variable definitions, data sources, and estimation results are presented in the Appendix. In terms of statistical fit, most of the estimated equations were found to be reasonable with respect to R^2. In all but two equations the adjusted coefficient of determination was above 0.89. The two equations that were the most difficult to estimate were the retail butter demand and supply equations, which had the lowest R^2 (0.55 and 0.55, respectively).

The retail market demand functions were estimated on a per capita basis. Retail demand for each product was specified to be a function of the following variables: 1) retail product price, 2) price of substitutes, 3) per capita disposable income, 4) quarterly dummy variables to account for seasonal

demand, 5) a time trend variable to capture changes in consumer tastes and preferences over time,[4] 6) a dummy variable for the quarters that bovine somatotropin was approved, and 7) generic advertising expenditures to measure the impact of advertising on retail demand. In all demand functions, own prices and income were deflated by a substitute product price index. This specification was followed because there was strong correlation between the substitute price and own price for each dairy product. The consumer price index for nonalcoholic beverages was used as the substitute price in the fluid milk demand equation, the consumer price index for meat was used as the substitute price in the cheese demand equation, the consumer price index for fat was used as the substitute price in the butter demand equation, and the consumer price index for food was used as the substitute price in the frozen product demand equations. To measure the advertising effort of the NDPRB, generic advertising expenditures for fluid milk and cheese were included as explanatory variables in the two respective demand equations.[5] Generic advertising expenditures for butter and frozen products were not included for two reasons. First, the NDPRB has not invested much money into advertising these two products. Second, including generic butter and frozen product advertising expenditures in an earlier version of the model resulted in highly statistically insignificant estimated coefficients. Branded advertising expenditures were also included in the fluid milk and cheese demand equations, but not the butter and frozen dairy product demand equations for reasons similar to those cited for not including generic butter and frozen product advertising.

To capture the dynamics of advertising, generic advertising expenditures were specified as a second-order polynomial distributed lag. The length of the lag was initially varied between one and six quarters and the final specification was chosen based on goodness of fit. Finally, a first-order moving average error structure was imposed on the retail fluid milk

demand equation, a first-order autoregressive error structure was imposed on the retail cheese demand equation, and a second-order autoregressive error structure was imposed on the retail butter and frozen product demand equations to correct for autocorrelation.

Based on the econometric estimation, generic fluid milk advertising had the largest long-run advertising elasticity of 0.039 and was statistically different from zero at the 1 percent significance level. This means a 1 percent increase in generic fluid advertising expenditures resulted in a 0.039 percent increase in fluid demand on average over this period, which is higher than previous results. For example, based on a similar model with data from 1975-95, Kaiser estimated a long-run elasticity of 0.021 for generic milk advertising. Other studies have found comparable estimates, e.g., Kinnucan estimated a long-run fluid milk advertising elasticity of 0.051 for New York City; and Kinnucan, Chang, and Venkateswaran estimated a long-run fluid milk advertising elasticity of 0.016 for New York City. Generic cheese advertising was also positive and statistically significant from zero at the 1 percent significance level and had a long-run advertising elasticity of 0.010, which is slightly lower than the previous estimate of 0.016 by Kaiser.

The retail supply for each product was estimated as a function of the following variables: 1) retail price, 2) wholesale price (representing major variable costs to retailers), 3) producer price index for fuel and energy, 4) average hourly wage in the food manufacturing sector, 5) time trend variable, 6) quarterly dummy variables, and 7) lagged retail supply. The producer price index for fuel and energy was used as a proxy for variable energy costs, while the average hourly wage was used to capture labor costs in the retail supply functions. All prices and costs were deflated by the wholesale product price associated with each equation. The quarterly dummy variables were included to capture seasonality in retail supply, while the lagged supply variables were incorporated to represent capacity constraints. The time trend variable was included as a proxy for technological change in retailing. Not all of these variables remained in each of the final estimated retail supply equations due to statistical significance and/or wrong sign on the coefficient. Finally, a first-order autoregressive error

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[4] Several functional forms were specified for the time trend, including linear, log linear, and exponential forms. The form yielding the best statistical results was chosen for each equation.

[5] All generic and branded advertising expenditures came from various issues of *Leading National Advertisers*.

structure was imposed on the retail frozen product supply equation, a second-order autoregressive error structure was imposed on the retail cheese supply equation, and a third-order autoregressive error structure was imposed on the retail fluid milk supply equation.

The wholesale supply for each product was estimated as a function of the following variables: 1) wholesale price, 2) the appropriate class price for milk, which represents the main variable cost to wholesalers, 3) producer price index for fuel and energy, 4) average hourly wage in the food manufacturing sector, 5) time trend variable, 6) quarterly dummy variables, 7) lagged wholesale supply, and 8) two dummy variables for the cheese and butter demand functions corresponding to the Milk Diversion and Dairy Termination Programs, which were two supply control programs implemented over part of this period. The producer price index for fuel and energy was included because energy costs are important variable costs to wholesalers, while the average hourly wage was used to capture labor costs in the wholesale supply functions. All prices and costs were deflated by the price of farm milk, i.e., class price. The quarterly dummy variables were used to capture seasonality in wholesale supply, lagged wholesale supply was included to reflect capacity constraints, and the trend variable was incorporated as a measure of technological change in dairy product processing. Not all of these variables remained in each of the final estimated wholesale supply equations due to statistical significance and/or wrong sign on the coefficient. Finally, a first-order autoregressive error structure was imposed on the wholesale fluid milk and frozen product supply equations.

For the farm milk market, the farm milk supply was estimated as a function of the following variables: 1) ratio of the farm milk price to feed ration costs, 2) ratio of the price of slaughter cows to feed ration costs, 3) lagged milk supply, 4) intercept dummy variables to account for the quarters that the Milk Diversion and Dairy Termination Programs were in effect, 5) quarterly dummy variables, and 6) time trend variable. Feed ration costs represent the most important variable costs in milk production, while the price of slaughtered cows represents an important opportunity cost to dairy farmers. Lagged milk supply was included as biological capacity constraints to current milk supply.

Market Impacts of the NDPRB

To examine the impacts that the NDPRB had on the market over the period 1984.3-1996.4, the model was simulated under two scenarios based on generic advertising expenditures: 1) historic scenario, where advertising levels were equal to actual generic advertising expenditures, and 2) no-NDPRB scenario, where quarterly values of generic advertising expenditures were equal to quarterly levels for the year prior to the adoption of the NDPRB, i.e., 1983.3-1984.2 (note that as previously mentioned, there was generic dairy advertising prior to the enactment of the NDPRB at the state level). A comparison of these two scenarios provides a measure of the impacts of the NDPRB on dairy markets. Table 1 presents the quarterly averages of price and quantity variables for the period, 1984.3-96.4.

It is clear from these results that the NDPRB had an impact on the dairy market for the period 1984.3-96.4. The generic advertising effort of the NDPRB resulted in a 2.14 percent increase in fluid sales and a 11.36 percent increase in retail fluid price compared to what would have occurred in the absence of this national program. Note that since the own price elasticity of fluid milk demand was estimated to be quite inelastic (-0.1), the modest increase in fluid sales due to advertising caused a sizable increase in price. The increase in fluid sales also caused the wholesale fluid price to increase by 7.74 percent.

Generic advertising by the NDPRB resulted in a 0.73 percent increase in the overall demand for milk used in all dairy products compared to what would have occurred in the absence of this national program. It is interesting that the entire increase in dairy consumption from generic dairy advertising was due to increases in fluid milk demand. In fact, demand for cheese, butter, and frozen dairy products was marginally lower in the NDPRB scenario. This is due to the impact that higher generic dairy advertising had on retail prices, which were higher for all products in the NDPRB scenario because the overall demand for milk used in all products was higher. The net result was that the negative effect of higher retail prices outweighed the positive effect of advertising on the demand for cheese, butter, and frozen products. Specifically, the increase in advertising expenditures due to the NDPRB resulted

Table 1. Simulated quarterly values for market variables with and without the NDPRB, averaged over 1984.3-96.4.

| Variable | Unit | 1984.3-96.4 Average | | | Confidence interval | |
		with NDPRB	without NDPRB	Percent change	Low bound (percent)	High bound (percent)
Fluid demand/supply	bil lbs me[a]	13.53	13.24	2.14	0.71	3.79
Frozen demand/supply	bil lbs me	3.15	3.16	-0.27	-0.07	-0.59
Cheese demand	bil lbs me	13.15	13.17	-0.14	-0.04	0.11
Cheese supply	bil lbs me	13.19	13.20	-0.10	-0.10	0.12
Butter demand	bil lbs me	5.37	5.37	-0.11	-0.03	-0.28
Butter supply	bil lbs me	6.58	6.61	-0.49	-0.13	-0.99
Total demand	bil lbs me	35.20	34.94	0.73	0.22	1.51
Retail fluid price	1982-84=100	131.25	116.34	11.36	3.97	19.77
Retail frozen price	1982-84=100	136.50	134.82	1.23	0.33	2.57
Retail cheese price	1982-84=100	137.73	137.26	0.35	0.07	1.41
Retail butter price	1982-84=100	99.28	98.83	0.46	0.10	1.22
Wholesale fluid price	1982=100	131.44	121.27	7.74	2.56	14.21
Wholesale frozen price	1982=100	133.97	131.71	1.68	0.45	3.49
Wholesale cheese price	$/lb	1.63	1.59	2.61	0.73	5.14
Wholesale butter price	$/lb	1.10	1.10	0.67	0.13	1.93
Class III price	$/cwt	14.22	13.79	2.98	0.80	6.10
All milk price	$/cwt	15.15	14.71	2.89	0.79	5.92
CCC cheese purchases	bil lbs me	0.04	0.03	12.48	3.67	63.90
CCC butter purchases	bil lbs me	1.23	1.25	-2.14	-0.52	-5.13
CCC purchases	bil lbs me	1.26	1.28	-1.72	-0.95	-4.90
Milk supply	bil lbs	37.15	36.92	0.63	0.17	1.34
Producer surplus	bil $	5.22	5.03	3.54	0.96	7.25
Rate of return	$	5.27			1.23	14.91

[a] The notation "me" stands for milk equivalent.

in a 0.35 percent, 0.46 percent, and 1.23 percent increase in retail cheese, butter, and frozen product prices, respectively, and a 0.14 percent, 0.11 percent, and 0.27 percent decrease in retail cheese, butter, and frozen product sales, respectively. Wholesale cheese, butter, and frozen product prices were 2.61 percent, 0.67 percent, and 1.68 percent higher, respectively, due to the NDPRB advertising effort.

Cheese and butter supplies were marginally lower due to the NDPRB advertising effort. Cheese supply, on average, was 0.10 percent lower, while butter

supply was 0.49 percent lower. This was due to the fact that the increase in generic advertising under the NDPRB scenario resulted in higher raw milk costs (see discussion below) to dairy processors, and the net impact was a slight reduction in cheese and butter supply.

The NDPRB also had an impact on purchases of cheese and butter by the government. The decrease in cheese demand due to NDPRB advertising was larger than the decrease in cheese supply, which resulted in a 12.48 percent increase in cheese purchased by the

government, on average, over this period. While this increase is significant in percentage terms, it is very small in actual magnitude, averaging less than 10 million pounds per quarter. While butter demand was slightly lower (0.11 percent), the 0.49 percent decrease in butter supply due to generic advertising by the NDPRB caused butter purchases by the government to decrease by 2.14 percent, on average, over the period. Total dairy product purchases by the government were 1.72 percent lower in the NDPRB scenario.

The introduction of the NDPRB also had an impact on the farm market over this period. The Class III and farm milk prices increased by 2.98 percent and 2.89 percent under the national program due to an increase of 0.73 percent in total milk demand. Farm supply, in turn, increased by 0.63 percent. Farmers were better off under the NDPRB since producer surplus averaged 3.54 percent higher with the program. One bottom-line measure of the net benefits of the NDPRB to farmers is the rate of return, which gives the ratio of benefits to costs of the national program. Specifically, this rate of return measure was calculated as the change in producer surplus, due to the NDPRB, divided by the costs of funding this program. The cost of the program was measured as the 15 cents per hundredweight assessment times total milk marketings. In the year prior to the program, farmers voluntarily contributed 6.3 cents per hundredweight. Therefore, the difference in cost due to the national checkoff was assumed to be the difference between 0.0015 times milk marketings (in billion pounds) under the NDPRB scenario minus 0.00063 times milk marketings under the no-NDPRB scenario. The results showed that the rate of return from the NDPRB was 5.27 over this period. This means that an additional dollar invested in generic advertising would return $5.27 in profits to farmers. The farm level rate of return was higher than estimates of 4.77 by Liu et al. (1990) for the period 1975.1 through 1987.4, 4.60 by Kaiser and Forker for the period 1975.1 through 1990.4, and 3.40 for the period 1975.1 through 1995.3 by Kaiser.

Because there is some error associated with any statistical estimation, a 95 percent confidence interval was calculated for these impacts. The 95 percent confidence interval provides a lower and upper bounds where each of these random variables should be 95 percent of the time. The lower and upper bounds for

each market variable were estimated by resimulating the two scenarios by setting the fluid milk and cheese advertising coefficients in the retail demand equations to the lower and upper bounds of a 95 percent confidence interval. The estimated lower and upper limits of the 95 percent confidence interval for all variables are presented in the last two columns of Table 1. As an example of the interpretation of this, consider the impact of the NDPRB on fluid demand. As mentioned above, the average impact of NDPRB advertising was a 2.14 percent increase in fluid milk demand. The 95 percent confidence interval demonstrates that one can be "confident" 95 percent of the time that the impact of NDPRB advertising on fluid milk demand lies between 0.71 percent, on the low side, and 3.79 percent, on the high side. The lower and upper limits of the 95 percent confidence interval for the rate of return are 1.23 and 14.91, respectively. Since even the low bound of this confidence interval is above 1.0, this provides substantial evidence that the benefits of generic advertising are larger than the costs.

Conclusion

The purpose of this study was to analyze the impacts of generic dairy advertising by the National Dairy Promotion and Research Board on retail, wholesale, and farm dairy markets. The results indicated that the NDPRB had a major impact on retail, wholesale, and farm markets for the dairy industry. The main conclusion of the study is that farmers are receiving a high return on their investment in generic dairy advertising.

Given the current legal debate over mandatory commodity checkoff programs, evidence from this study can be used to demonstrate that generic advertising does have a significant impact on the market. The impacts of advertising tend to be more profound in increasing price than quantity, which is due to the inelastic nature of demand for milk and cheese. These estimated impacts need to be compared with other options producers have for marketing their product (e.g., nonadvertising promotion, research, new product development, etc.) in order to determine the optimality of the current investment of advertising. Consequently, these results should be viewed as a first step in the evaluation process.

While there are advantages to the industry model used in this study, there are also some shortcomings that need to be pointed out. One limitation is that advertising impacts may be overstated due to the assumption of fixed proportions. As Kinnucan pointed out, the fixed proportions assumption does not allow for input substitution, which may cause derived-demand elasticities for farm output to be understated and profits from advertising to be overstated. Another limitation is that the model did not include several other activities of the NDPRB such as nonadvertising promotion and research. While advertising is by far the largest investment by the NDPRB, these other activities may also have an impact on demand for milk and dairy products. Unfortunately, these data could not be obtained for this study.

There are two directions that could be useful for future research. Obviously, inclusion of other marketing activities by the NDPRB would be useful because the model could then be used to determine the optimal allocation of dairy farmer checkoff funds across marketing activities. In addition, spatial disaggregation of the model into several regions of the United States, particularly for fluid milk, would be valuable. Although manufactured dairy products are well-represented as a national market, fluid milk markets tend to be regional in scope, and fluid milk marketing orders cause different price surfaces for fluid milk. Regional disaggregation of fluid milk markets would also make the model a valuable tool in examining dairy policy questions on such issues as federal milk marketing order consolidation.

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Appendix

This appendix contains the estimated econometric model of the U.S. dairy industry. Appendix Table 1 provides the variable definitions and data sources. This is followed by the 13 estimated equations.

Appendix Table 1. Variable definitions and sources.*

RFD = per capita retail fluid milk demand (milkfat equivalent basis), from <u>Dairy Situation and Outlook</u>,

RFPBEV = consumer retail price index for fresh milk and cream (1982-84 = 100), divided by consumer retail price index for nonalcoholic beverages, both indices from <u>Consumer Price Index</u>,

INCBEV = per capita disposable personal income (in $1,000), from <u>Employment and Earnings</u>, divided by consumer retail price index for nonalcoholic beverages,

T = time trend variable for the retail and wholesale-level equations, equal to 1 for 1975.1,....,

BST = intercept dummy variable for bovine somatotropin, equal to 1 for 1994.1 through 1996.4; equal to 0 otherwise,

DUMQ1 = intercept dummy variable for first quarter of year,

DUMQ2 = intercept dummy variable for second quarter of year,

DUMQ3 = intercept dummy variable for third quarter of year,

GFAD = generic fluid milk advertising expenditures (in $1,000), deflated by the media price index, from <u>Leading National Advertisers</u>,

BFAD = branded fluid milk advertising expenditures (in $1,000), deflated by the media price index, from <u>Leading National Advertisers</u>,

MA(1) = moving average 1 error correction term,

RCD = per capita retail cheese demand (milkfat equivalent basis), computed as commercial cheese production minus government cheese purchases by the Commodity Credit Corporation minus changes in commercial cheese inventories (from <u>Cold Storage</u>),

RCPMEA = consumer retail price index for cheese (1982-84 = 100), divided by consumer retail price index for fat (1982-84 = 100), both indices from <u>Consumer Price Index</u>,

TSQ = time trend squared,

GCAD = = generic cheese advertising expenditures (in $1,000), deflated by the media price index, from <u>Leading National Advertisers</u>,

BCAD = branded cheese advertising expenditures (in $1,000), deflated by the media price index, from <u>Leading National Advertisers</u>,

Appendix Table 1. Variable definitions and sources--continued.

AR(1) = AR 1 error correction term,

AR(2) = AR 2 error correction term,

AR(3) = AR 3 error correction term,

RBD = per capita retail butter demand (milkfat equivalent basis), computed as commercial butter production minus government butter purchases by the Commodity Credit Corporation minus changes in commercial butter inventories (from Cold Storage),

RBPFAT = consumer retail price index for butter (1982-84 = 100), divided by consumer retail price index for fat (1982-84 = 100), both indices from Consumer Price Index,

RFZD = per capita retail frozen dairy product demand (milkfat equivalent basis), from Dairy Products Annual Summary,

RFZPFOO = consumer retail price index for frozen dairy products (1982-84 = 100), divided by consumer retail price index for food (1982-84 = 100), both indices from Consumer Price Index,

RFS = retail fluid milk supply (bil. lbs. of milkfat equivalent), RFS=RFD*POP (where POP = U.S. civilian population),

RFPWFP = consumer retail price index for fresh milk and cream, divided by wholesale fluid milk price index (1982 = 100) from Producer Price Index,

PFEWFP = producer price index for fuel and energy (1967 = 100), from Producer Price Index, divided by wholesale fluid milk price index,

RCS = retail cheese supply (bil. lbs. of milkfat equivalent), RCS=RCD*POP,

RCPWCP = consumer retail price index for cheese, divided by wholesale cheese price ($/lb.) from Dairy Situation and Outlook,

PFEWCP = producer price index for fuel and energy (1967 = 100), from Producer Price Index, divided by wholesale cheese price,

RBS = retail butter supply (bil. lbs. of milkfat equivalent), RBS=RBD*POP,

RBPWBP = consumer retail price index for butter, divided by wholesale butter price ($/lb.), from Dairy Situation and Outlook,

PFEWBP = producer price index for fuel and energy, divided by wholesale butter price,

RFZS = retail frozen dairy product supply (bil. lbs. of milkfat equivalent), RFZS=RFZD*POP,

Appendix Table 1. Variable definitions and sources--continued.

RFZPWFZP = consumer retail price index for frozen dairy products, divided by wholesale frozen dairy products price index (1982 = 100), from Producer Price Index,

WFS = wholesale fluid milk supply (bil. lbs. of milkfat equivalent), WFS = RFS = RFD*POP,

WFPP1 = wholesale fluid milk price index, divided by Class I price for raw milk ($/cwt.), from Federal Milk Order Market Statistics,

PFEP1 = producer price index for fuel and energy, divided by Class I price for raw milk,

WCS = wholesale cheese production (bil. lbs. of milkfat equivalent), from Dairy Products Annual Summary,

WCPP3 = wholesale cheese price, divided by Class III price for raw milk ($/cwt.) from Federal Milk Order Market Statistics,

MWAGEP3 = average hourly wage in manufacture sector ($/hr.) from Handbook of Basic Economic Statistics, divided by Class III price for raw milk,

MDP = intercept dummy variable for the Milk Diversion Program equal to 1 for 1984.1 through 1985.2; equal to 0 otherwise,

DTP = intercept dummy variable for the Dairy Termination Program equal to 1 for 1986.2 through 1987.3; equal to 0 otherwise,

WBS = wholesale butter production (bil. lbs. of milkfat equivalent), from Dairy Products Annual Summary,

WBPP3 = wholesale butter price, divided by Class III price for raw milk,

WFZS = wholesale frozen dairy product production (bil. lbs. of milkfat equivalent), from Dairy Products Annual Summary,

WFZPP3 = wholesale frozen dairy product price divided by Class III price for raw milk,

FMS = U.S. milk production (bil. lbs.), from Dairy Situation and Outlook,

AMPPFEED = U.S. average all milk price ($/cwt.), divided by the U.S. average dairy ration cost ($/cwt.), both from Dairy Situation and Outlook,
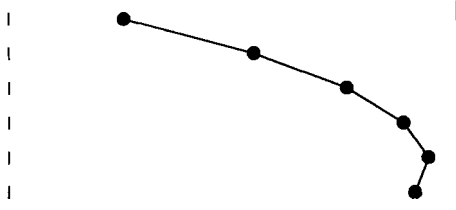
PCOWPFEED = U.S. average slaughter cow price ($/cwt.) from Dairy Situation and Outlook, divided by U.S. average dairy ration cost.
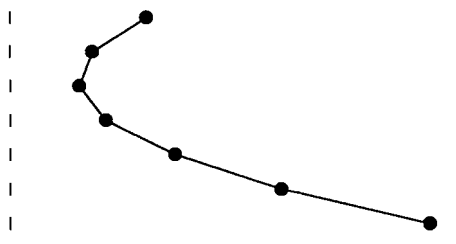
*An "L" in front of a variable means the variable has been transformed into natural logarithm.

LS // Dependent Variable is LRFD

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	-2.871807	0.239295	-12.00112	0.0000
LRFPBEV	-0.100921	0.053862	-1.873704	0.0653
LINCBEV	0.090514	0.054206	1.669808	0.0996
LT	-0.056140	0.016279	-3.448671	0.0010
DUMQ1	-0.011224	0.003562	-3.150695	0.0024
DUMQ2	-0.059950	0.004307	-13.91878	0.0000
DUMQ3	-0.052261	0.003392	-15.40538	0.0000
BST	-0.051310	0.007657	-6.701083	0.0000
PDL01	0.006872	0.002264	3.034738	0.0034
PDL02	0.001546	0.001227	1.260617	0.2118
PDL03	-0.000359	0.000730	-0.491949	0.6244
PDL04	0.001064	0.001764	0.602932	0.5486
PDL05	0.000517	0.000557	0.927862	0.3568
PDL06	0.000220	0.000363	0.607550	0.5455
MA(1)	0.371090	0.117050	3.170359	0.0023

R-squared	0.922333	Mean dependent var		-2.904816
Adjusted R-squared	0.906104	S.D. dependent var		0.040378
S.E. of regression	0.012373	Akaike info criterion		-8.620690
Sum squared resid	0.010257	Schwartz criterion		-8.180436
Log likelihood	252.0953	F-statistic		56.83272
Durbin-Watson stat	1.806135	Prob(F-statistic)		0.000000

Lag Distribution of LGFAD	i	Coefficient	Std. Error	T-Statistic
	0	0.00234	0.00367	0.63803
	1	0.00497	0.00189	2.62739
	2	0.00687	0.00226	3.03474
	3	0.00806	0.00227	3.54360
	4	0.00853	0.00188	4.54444
	5	0.00828	0.00357	2.31590
Sum of Lags		0.03905	0.00662	5.90012

Lag Distribution of LBFAD	i	Coefficient	Std. Error	T-Statistic
	0	0.00150	0.00291	0.51492
	1	0.00091	0.00165	0.55193
	2	0.00077	0.00160	0.47839
	3	0.00106	0.00176	0.60293
	4	0.00180	0.00162	1.10926
	5	0.00298	0.00161	1.85267
	6	0.00460	0.00275	1.67186
Sum of Lags		0.01361	0.00833	1.63469

LS // Dependent Variable is LRCD
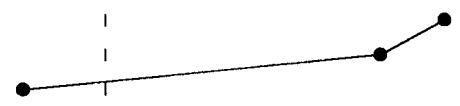
Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	-3.011266	0.261707	-11.50627	0.0000
LRCPMEA	-0.548984	0.131665	-4.169541	0.0001
LINCMEA	0.280907	0.091691	3.063612	0.0031
TSQ	6.62E-05	5.84E-06	11.34200	0.0000
DUMQ1	-0.096986	0.009122	-10.63258	0.0000
DUMQ2	-0.061768	0.008795	-7.023239	0.0000
DUMQ3	-0.055047	0.008500	-6.476376	0.0000
BST	-0.073228	0.018913	-3.871774	0.0002
PDL01	0.002518	0.004356	0.578042	0.5651
PDL02	0.005402	0.003484	1.550448	0.1256
PDL03	0.001400	0.005227	0.267818	0.7896
PDL04	0.016544	0.010902	1.517558	0.1337
PDL05	-0.012654	0.007714	-1.640437	0.1055
PDL06	-0.008794	0.013264	-0.663022	0.5095
AR(1)	0.304390	0.113387	2.684515	0.0091

R-squared	0.984422	Mean dependent var	-3.131654
Adjusted R-squared	0.981261	S.D. dependent var	0.194707
S.E. of regression	0.026654	Akaike info criterion	-7.089214
Sum squared resid	0.049019	Schwartz criterion	-6.655139
Log likelihood	193.5561	F-statistic	311.4421
Durbin-Watson stat	2.103089	Prob(F-statistic)	0.000000

Inverted AR Roots   .30

Lag Distribution of LGCAD	i	Coefficient	Std. Error	T-Statistic
	0	-0.00148	0.00445	-0.33332
	1	0.00252	0.00436	0.57804
	2	0.00932	0.00430	2.16605
Sum of Lags		0.01035	0.00667	1.55317

Lag Distribution of LBCAD	i	Coefficient	Std. Error	T-Statistic
	0	0.02040	0.01020	2.00022
	1	0.01654	0.01090	1.51756
	2	-0.00490	0.01091	-0.44959
Sum of Lags		0.03204	0.01780	1.80018

LS // Dependent Variable is LRBD

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	-2.739390	0.790682	-3.464591	0.0009
LRBPFAT	-0.256732	0.103254	-2.486411	0.0151
LINCFAT	0.378281	0.317435	1.191682	0.2371
T	-0.005243	0.002613	-2.006518	0.0484
DUMQ1	-0.182247	0.030470	-5.981206	0.0000
DUMQ2	-0.217205	0.036469	-5.955851	0.0000
DUMQ3	-0.138034	0.029897	-4.617040	0.0000
BST	0.184611	0.033782	5.464855	0.0000
AR(2)	-0.249045	0.113612	-2.192053	0.0315

R-squared	0.590719	Mean dependent var	-3.861517
Adjusted R-squared	0.547062	S.D. dependent var	0.132546
S.E. of regression	0.089204	Akaike info criterion	-4.732694
Sum squared resid	0.596806	Schwartz criterion	-4.472249
Log likelihood	88.58231	F-statistic	13.53100
Durbin-Watson stat	2.289630	Prob(F-statistic)	0.000000

LS // Dependent Variable is LRFZD

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	-2.785943	0.333995	-8.341274	0.0000
LRFZPFOO	-0.225646	0.304868	-0.740143	0.4615
LINCFOO	0.744128	0.144757	5.140544	0.0000
TSQ	-6.37E-05	1.04E-05	-6.106981	0.0000
DUMQ1	0.070795	0.014877	4.758519	0.0000
DUMQ2	0.319938	0.013234	24.17537	0.0000
DUMQ3	0.352085	0.014790	23.80630	0.0000
BST	0.106977	0.027361	3.909860	0.0002
AR(2)	0.103661	0.070693	1.466363	0.1467

R-squared	0.927950	Mean dependent var	-4.357732
Adjusted R-squared	0.920264	S.D. dependent var	0.164353
S.E. of regression	0.046409	Akaike info criterion	-6.039554
Sum squared resid	0.161537	Schwartz criterion	-5.779109
Log likelihood	143.4704	F-statistic	120.7421
Durbin-Watson stat	1.834851	Prob(F-statistic)	0.000000

Inverted AR Roots	.32	-.32

LS // Dependent Variable is LRFS

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.856108	0.213876	4.002824	0.0001
LRFPWFP	0.120637	0.086399	1.396270	0.1668
LPFEWFP	-0.042471	0.018295	-2.321459	0.0230
LRFS(-1)	0.655147	0.092352	7.094019	0.0000
LT	0.018650	0.005909	3.156064	0.0023
DUMQ1	-0.047818	0.005857	-8.164565	0.0000
DUMQ2	-0.085686	0.005095	-16.81703	0.0000
DUMQ3	-0.048021	0.003315	-14.48424	0.0000
AR(3)	0.185019	0.091938	2.012425	0.0478

R-squared	0.954135	Mean dependent var		2.582295
Adjusted R-squared	0.949243	S.D. dependent var		0.050497
S.E. of regression	0.011377	Akaike info criterion		-8.851435
Sum squared resid	0.009707	Schwartz criterion		-8.590990
Log likelihood	261.5694	F-statistic		195.0300
Durbin-Watson stat	2.326751	Prob(F-statistic)		0.000000

Inverted AR Roots	.57	-.28+.49i	-.28 -.49i

LS // Dependent Variable is LRCS

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.352083	0.236779	1.486973	0.1412
LRCPWCP	0.299389	0.066563	4.497841	0.0000
LPFEWCP	-0.229349	0.051099	-4.488346	0.0000
LRCS(-1)	0.471731	0.096253	4.900960	0.0000
LT	0.158882	0.035829	4.434504	0.0000
DUMQ1	-0.119556	0.011018	-10.85134	0.0000
DUMQ2	-0.034945	0.008518	-4.102575	0.0001
DUMQ3	-0.052006	0.009877	-5.265227	0.0000
AR(2)	0.250109	0.118742	2.106328	0.0385

R-squared	0.987707	Mean dependent var		2.353754
Adjusted R-squared	0.986396	S.D. dependent var		0.252262
S.E. of regression	0.029423	Akaike info criterion		-6.950986
Sum squared resid	0.064929	Schwartz criterion		-6.690541
Log likelihood	181.7506	F-statistic		753.2492
Durbin-Watson stat	2.001718	Prob(F-statistic)		0.000000

Inverted AR Roots	.50	-.50	

LS // Dependent Variable is LRBS

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	-0.242336	0.478173	-0.506796	0.6138
LRBPWBP	0.424569	0.145951	2.908988	0.0048
LPFEWBP	-0.016650	0.085206	-0.195414	0.8456
LRBS(-1)	0.165344	0.105965	1.560361	0.1228
DUMQ1	-0.217661	0.034230	-6.358798	0.0000
DUMQ2	-0.207004	0.031268	-6.620315	0.0000
DUMQ3	-0.119315	0.031857	-3.745389	0.0003
T	-0.001202	0.001213	-0.991395	0.3246

R-squared	0.588627	Mean dependent var		1.623890
Adjusted R-squared	0.550738	S.D. dependent var		0.149612
S.E. of regression	0.100281	Akaike info criterion		-4.509175
Sum squared resid	0.764270	Schwartz criterion		-4.277669
Log likelihood	78.19451	F-statistic		15.53533
Durbin-Watson stat	2.031450	Prob(F-statistic)		0.000000

LS // Dependent Variable is LRFZS

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.939284	0.013517	69.48692	0.0000
LRFZPWFZP	0.610937	0.251207	2.432005	0.0173
DUMQ1	0.075295	0.014658	5.136866	0.0000
DUMQ2	0.316144	0.016216	19.49635	0.0000
DUMQ3	0.349656	0.014506	24.10343	0.0000
AR(1)	0.356666	0.083258	4.283856	0.0001

R-squared	0.893628	Mean dependent var		1.127675
Adjusted R-squared	0.886810	S.D. dependent var		0.165395
S.E. of regression	0.055645	Akaike info criterion		-5.708770
Sum squared resid	0.241518	Schwartz criterion		-5.535140
Log likelihood	126.5775	F-statistic		131.0558
Durbin-Watson stat	1.978048	Prob(F-statistic)		0.000000

Inverted AR Roots	.36			

LS // Dependent Variable is LWFS

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.397234	0.162024	2.451699	0.0165
LWFPP1	0.078138	0.038901	2.008651	0.0481
LPFEP1	-0.010810	0.009051	-1.194272	0.2361
LWFS(-1)	0.811464	0.087540	9.269591	0.0000
DUMQ1	-0.053915	0.006116	-8.815102	0.0000
DUMQ2	-0.092514	0.004643	-19.92597	0.0000
DUMQ3	-0.046735	0.004292	-10.88825	0.0000
AR(1)	-0.255031	0.108297	-2.354917	0.0211

R-squared	0.952040	Mean dependent var		2.582295
Adjusted R-squared	0.947623	S.D. dependent var		0.050497
S.E. of regression	0.011557	Akaike info criterion		-8.830579
Sum squared resid	0.010150	Schwartz criterion		-8.599073
Log likelihood	259.6935	F-statistic		215.5228
Durbin-Watson stat	2.267153	Prob(F-statistic)		0.000000

Inverted AR Roots	-.26

LS // Dependent Variable is LWCS

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.438940	0.334426	1.312516	0.1935
LWCPP3	0.139874	0.154003	0.908251	0.3667
LMWAGEP3	-0.016235	0.054232	-0.299356	0.7655
LWCS(-1)	0.969505	0.088452	10.96083	0.0000
LWCS(-2)	-0.644245	0.121902	-5.284943	0.0000
LWCS(-3)	0.650398	0.087711	7.415204	0.0000
MDP	-0.025632	0.013702	-1.870708	0.0654
DTP	-0.018430	0.013524	-1.362683	0.1772
DUMQ1	-0.112967	0.020434	-5.528293	0.0000
DUMQ2	0.025675	0.015253	1.683351	0.0966
DUMQ3	-0.149027	0.019477	-7.651300	0.0000

R-squared	0.984345	Mean dependent var		2.361723
Adjusted R-squared	0.982201	S.D. dependent var		0.232983
S.E. of regression	0.031083	Akaike info criterion		-6.820633
Sum squared resid	0.070530	Schwartz criterion		-6.502312
Log likelihood	178.2758	F-statistic		459.0142
Durbin-Watson stat	2.088224	Prob(F-statistic)		0.000000

LS // Dependent Variable is LWBS

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.791748	0.152879	5.178909	0.0000
LWBPP3	0.067301	0.040344	1.668186	0.0994
T	0.001250	0.000507	2.465804	0.0160
DTP	-0.063689	0.026403	-2.412247	0.0183
MDP	-0.041172	0.024594	-1.674100	0.0983
DUMQ1	0.067066	0.022324	3.004158	0.0036
DUMQ2	-0.175464	0.033605	-5.221400	0.0000
DUMQ3	-0.394993	0.026935	-14.66479	0.0000
LWBS(-1)	0.700263	0.072775	9.622336	0.0000

R-squared	0.917693	Mean dependent var	1.861655
Adjusted R-squared	0.908914	S.D. dependent var	0.180119
S.E. of regression	0.054361	Akaike info criterion	-5.723266
Sum squared resid	0.221632	Schwartz criterion	-5.462822
Log likelihood	130.1864	F-statistic	104.5284
Durbin-Watson stat	1.798116	Prob(F-statistic)	0.000000

LS // Dependent Variable is LWFZS

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.481738	0.123171	3.911140	0.0002
LWFZPP3	0.211392	0.055841	3.785646	0.0003
DUMQ1	0.068186	0.014932	4.566388	0.0000
DUMQ2	0.309258	0.016207	19.08152	0.0000
DUMQ3	0.347969	0.014717	23.64377	0.0000
AR(1)	0.262896	0.092423	2.844498	0.0057

R-squared	0.899737	Mean dependent var		1.127675
Adjusted R-squared	0.893310	S.D. dependent var		0.165395
S.E. of regression	0.054024	Akaike info criterion		-5.767909
Sum squared resid	0.227649	Schwartz criterion		-5.594279
Log likelihood	129.0613	F-statistic		139.9904
Durbin-Watson stat	1.925830	Prob(F-statistic)		0.000000

Inverted AR Roots	.26			

LS // Dependent Variable is LFMS

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	1.175332	0.489707	2.400071	0.0190
LAMPPFEED	0.082271	0.043993	1.870079	0.0655
LPCOWPFEED	-0.040142	0.020865	-1.923870	0.0583
LFMS(-1)	0.792339	0.114138	6.941922	0.0000
LFMS(-2)	-0.576898	0.129669	-4.449015	0.0000
LFMS(-3)	0.453296	0.109471	4.140802	0.0001
DTP	-0.025471	0.009048	-2.815158	0.0063
MDP	-0.020561	0.008783	-2.341007	0.0220
DUMQ1	-0.001197	0.011920	-0.100447	0.9203
DUMQ2	0.044282	0.013163	3.364090	0.0012
DUMQ3	-0.027881	0.012619	-2.209504	0.0303
LT	0.042780	0.018562	2.304645	0.0241

R-squared	0.969249	Mean dependent var		3.550232
Adjusted R-squared	0.964551	S.D. dependent var		0.088284
S.E. of regression	0.016622	Akaike info criterion		-8.062498
Sum squared resid	0.019893	Schwartz criterion		-7.715239
Log likelihood	231.4341	F-statistic		206.3080
Durbin-Watson stat	1.994268	Prob(F-statistic)		0.000000

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