AN ECONOMIC ANALYSIS OF SELECTED U. S. DAIRY PROGRAM CHANGES

Glen D. Whipple, Charles Powe, and Morgan Gray

Abstract

An interregional reactive programming model of the United States dairy industry is used to test the welfare implications of several dairy program changes on milk producers, milk consumers, and taxpayers. The results showed that each of the tested alternatives (price support reduction, price support reduction with frozen minimum Class I price, assessments, and production quotas) could reduce price support expenditures substantially. However, assessments reduced expenditures most effectively in terms of cost to milk producers for the United States generally while price support reduction with frozen minimum Class I price was most efficacious in terms of cost to Southeast producers.

Key words: dairy policy, welfare analysis, reactive programming.

Generally, dairy market regulation has proven quite workable over the nearly 35 years it has existed in its present form. Under regulation, the industry has provided adequate quantities of milk at stable producer and consumer prices. Recently, the dairy industry has produced substantially more milk than has been consumed at legislatively supported market prices. This has resulted in large government outlays through the dairy price support program. Even though two of the goals of the dairy program are being satisfied, i.e., adequate supplies and stable prices, these large government outlays have brought calls for reform of dairy market regulation. Many factors have contributed to the recent milk over-supply, but one is particularly important.[1] That is, the price support program has maintained the milk price at parity related levels which have exceeded private sector market clearing prices.

Policy proposed to deal with the surplus milk problem has been aimed toward reducing production through price or other incentives. Congress eliminated the semiannual support price adjustment and has effectively frozen the support price at the October 1980 level or below. This action was not sufficient to keep production and price support purchases from increasing. A per hundredweight assessment on all milk marketed was legislated in 1982. The purpose of the assessment was to reduce production by lowering producer prices while providing revenue to offset price support costs. However, legal challenges and conditions in agriculture generally prevented the assessments from having much effect on production and price support purchases.

During the fall of 1983, a paid 15-month voluntary diversion program coupled with a reduction in the price support level and a per hundredweight assessment was legislated. Although production and price support outlays were down in 1984, both have been increasing since completion of the paid diversion. Several other policy proposals which were discussed before passage of the 1983 legislation are under discussion for the 1985 Farm Bill. Among these are simple support level reductions, reduced support level with fluid milk prices frozen at previous levels, and base licensing programs with restricted sales.

Glen D. Whipple is an Associate Professor, Division of Agricultural Economics, University of Wyoming (formerly an Assistant Professor with the University of Tennessee); Charles Powe is an Associate Professor, Department of Agricultural Economics, Mississippi State University; and Morgan Gray is a Computer Analyst, Department of Agricultural Economics, University of Tennessee.

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[1]Principle among these other factors were relatively low prices for feed and other agricultural commodities which when combined with price support policies have made dairy a relatively attractive enterprise as compared to alternatives.

The purpose of this paper is to detail and empirically estimate the welfare effects of possible federal dairy program changes on United States milk producers, consumers, and taxpayers. Four alternative policy changes are examined: per unit assessments, simple price support reductions, reduced support level with frozen fluid milk prices, and base licensing with restricted sales.

THE CONCEPTUAL MODEL

To accomplish the objective of this paper, a single period reactive programming model of the United States dairy industry was constructed (Seale and Trammel). The model includes classified pricing, price support program, and fluid/manufacturing milk quality conditions and is capable of defining market equilibrium under the assumptions of various dairy program changes. From the equilibrium solutions of the model, the welfare effects of the tested dairy program changes were calculated. Conceptually, the model builds on the earlier work of Ippolitto and Masson and Kessel and is similar to one developed by Whipple.

Functionally, the model is:

$$(1)\quad QA_i = A_o(PA_i)^{A_1}(PB_i)^{A_2},$$

$$(2)\quad QB_i = B_o(PB_i)^{B_1}(PA_i)^{B_2},$$

$$(3)\quad QI_i = F_o(PI_i)^{F_1},$$

$$(4)\quad QM_i = M_o(PM_i)^{M_1},$$

$$(5)\quad QII_i = QA_i + QAT_i - QI_i,$$

$$(6)\quad PI_i = PM_{MW} + CLI_i,$$

$$(7)\quad PII_i = PM_{MW},$$

$$(8)\quad PA_i = \frac{(QI_i)(PI_i) + (QII_i)(PII_i)}{QA_i + QAT_i},$$

$$(9)\quad PB_i = PM_i,$$

$$(10)\quad PM_i \geq SL,$$

$$(11)\quad QMT_i = QII_i + QB_i + QBT_i,$$

$$(12)\quad QMS_i = QMT_i - QM_i, \text{ and}$$

$$(13)\quad QI_i \leq QA_i + QAT_i,$$

where:

QA_i is quantity of Grade A milk produced in region i,

PA_i is blend price received by Grade A milk producers in region i,

PB_i is price received by Grade B milk producers in region i,

A_o, B_o, F_o, and M_o are constants,

A_1 is farm level elasticity of Grade A milk supply with respect to Grade A price,

A_2 is farm level elasticity of Grade A milk supply with respect to Grade B price,

QB_i is quantity of Grade B milk produced in region i,

B_1 is farm level elasticity of Grade B milk supply with respect to Grade B price,

B_2 is farm level elasticity of Grade B milk supply with respect to Grade A price,

QI_i is quantity of Grade A milk consumed in fluid products in region i,

PI_i is farm level fluid milk price in region i,

F_1 is the farm level elasticity of demand for fluid milk products with respect to the price of milk used in fluid products,

QM_i is quantity of milk used in manufactured products purchased by consumers in region i,

PM_i is farm level manufacturing milk price in region i,

M_1 is the farm level elasticity of demand for milk used in manufactured products with respect to the price of milk used in manufactured products,

QII_i is quantity of Grade A milk used in manufactured products in region i (Class II and Class III uses are combined for the purpose of this study),

QAT_i is the net quantity of Grade A milk traded in region i (positive for region i imports, negative for region i exports),

PM_{MW} is farm level Grade B milk price in Minnesota and Wisconsin,

PII_i is farm level price of Grade A milk used in manufactured products in region i,

CLI_i is the differential paid for Class I milk in region i,

SL is the USDA price support level for manufacturing milk,

QMT_i is quantity of milk used in manufactured products in region i,

QBT_i is net quantity of Grade B milk traded in region i (positive for region i imports, negative for region i exports), and

QMS_i is quantity of milk used in manufactured products in region i, purchased by the government sector.

Equations (1) and (2) are respective supply functions for Grade A and B milk. Equations (3) and (4) are demand functions for fluid and manufacturing milk. The remaining eight equations describe the allocation and pricing provisions of the market orders and price support restrictions. Equations (9) is a competitive pricing identity for manufacturing milk. Equations (6), (7), and (8) are pricing identities associated with classified pricing. Equation (13) restricts Class I (fluid) use milk to Grade A quality. Equation (5), the Class II allocation identity, shows the residual nature of manufacturing uses of Grade A milk. Class II and Class III market order uses are combined and denoted Class II (QII_i) for the purposes of this study. Equation (10) defines the price floor established by the price support program. Equation (11) is the manufacturing milk supply identity while equation (12) defines the quantity of price support purchases.

Market equilibrium in region i occurs when:

$$(14)\quad QA_i + QB_i + QAT_i + QBT_i = QI_i + QM_i + QMS_i$$

subject to the previously defined conditions (equations (1-13)).

Interregional equilibrium over N such markets (N>1) occurs when:

$$(15)\quad \sum_{i=1}^{N} (QA_i + QB_i) = \sum_{i=1}^{N} (QI_i + QM_i + QMS_i)$$

subject to the conditions that:

$$(16)\quad |PA_i - PA_j| \leq TF_{ij},$$

$$(17)\quad |PM_i - PM_j| \leq TM_{ij}, \text{ and}$$

$$(18)\quad |PI_i - PI_j| \leq TI_{ij},$$

where:

TF_{ij} is the transportation cost for bulk fluid milk between region i and region j,

TM_{ij} is the transportation cost for manufactured milk products between region i and region j, and

TI_{ij} is the transportation cost for packaged fluid milk products between region i and region j.

These equilibrium conditions (equations (14-18)) are met in the interregional model by the equilibrium seeking technique of the reactive programming algorithm. That is, supply must meet demand intraregionally (equation (14)) and for all regions (equation (15)), and interregional price differences cannot exceed transportation costs.

Empirical Model Specification

Computational difficulty required the summation of the Grade A and Grade B supply functions for an all milk supply schedule of the form:

$$(19)\quad QS_i = S_o(PS_i)^{S_1}$$

where:

QS_i is the quantity of milk supplied in region i,

PS_i is the average price paid milk producers in region i,

S_o is a constant, and

S_1 is the elasticity of milk supply with respect to price.

The use of an all milk supply schedule rather than Grade A and Grade B schedules requires the model assumption that the price paid for Grade B milk equals the price paid for Grade A milk used in manufactured products. Further, the estimated producer price is the average milk price rather than the Grade A blend price. The use of the all milk supply schedule does not seriously limit the usefulness of the empirical model if the results are properly interpreted for regions with Grade B milk production. Further, very little Grade B milk is produced outside the Upper Midwest; thus, this limitation does not affect most supply areas of the model.

The continental United States was divided into 21 regions, each with separate functions defining their fluid and manufacturing milk demands, as well as milk supply relationships. Demand and supply schedules were constructed for each region using 1981 State and Federal Market Order price and quantity data (USDA, 1981 a,b,c,d) and elasticity estimates.[2] The 1981 data were used because they were the most recent available when the research was conducted. Although these data are somewhat dated, their use should not seriously limit the usefulness of results since many of the economic and policy forces at work in the past several years were at work

[2]Supply schedules were based on marketings for each region and average milk prices in each region. Demand schedules were based on market order utilization and prices in each region. In areas not covered by a market order, demand schedules were based on per capital consumption in surrounding market orders. It was assumed that within each region, all milk not used in fluid products was used in manufactured products.

in 1981. Further, conditions in 1981 may better represent a status quo policy situation since producers were not adjusting to assessments and the diversion program. However, some type of congressional action in dealing with mounting government removals seemed imminent. Demand elasticity parameters were set based on estimates by Dahlgran. The elasticities of demand for fluid milk (F_1) and manufacturing milk (M_1) were set at -0.112 and -0.352, respectively, for all regions.

The supply elasticities were set by the authors based on a review of several elasticity estimates (Dahlgran; George and King; Brandow; Chen *et al.*). No particular study's estimates were used, rather the parameter values were selected from within the range of the available estimates so as to model the dairy industry's longterm and shortterm response to various program changes. In estimating longterm adjustments, a supply elasticity of .50 was used. In the authors' opinion, this parameter reflected the price/quantity responsiveness of milk supply over a 2- to 4-year adjustment period; a period thought to be the maximum time allowed a particular program to meet policy objectives before alternatives would be sought. An elasticity of 0.25 was used to reflect a shorter term response (1 to 2 years). Calculated demand and supply schedules were of the form shown in equations (3) and (4) and (19), respectively. Variation in elasticities among regions was not considered since Dahlgran showed such differences to be insignificant. Transfer costs between regions were estimated based on supply to demand point distances and transportation cost functions estimated by Lough and Hallberg *et al.* Transfer costs were adjusted to the 1981 price level by the consumer price index for transportation service.

To validate the model, the variable parameters were set to simulate observed 1981 market equilibrium. These estimates were compared with the actual price and quantity data. The base empirical model misestimated producer prices and quantities by 2.3 percent and 1.7 percent, respectively. Fluid milk prices and quantities were misestimated by 1.0 percent and 0.4 percent, respectively, while manufacturing milk prices and quantities were misestimated by 1.4 percent and 0.5 percent.[3] These results suggest the empirical model satisfactorily simulates market equilibrium. Even so, as with any simulation model, even perfect model validation using historical data does not ensure accurate model results for different environments.

Policy Alternatives

Four potential policy alternatives are examined in this paper: (1) a per hundredweight assessment on all milk produced; (2) a decrease in the price support level; (3) a decrease in the price support level while raising Class I differentials by the amount of the decrease to hold minimum Class I prices at current levels; and (4) a quota restricting each producer to a portion of his base production (usually the preceding year or an average of some years' production) while limiting entry of new producers to control the quantity of milk produced. Adjustments to the dairy industry model necessary to simulate equilibrium under alternative policies and definition of the welfare effects of alternative policies are detailed in the following discussion.

Assessment

With a per hundredweight assessment on all milk marketed, producers receive $PS_i - T$ for milk rather than PS_i where T is the amount of the assessment. The supply function for milk is then:

$$(20)\ QS_i = S_o(PS_i - T)^{S1}.$$

The post-assessment supply function is shifted along the price axis relative to the pre-assessment supply by the amount of the assessment. With the assessment, the average milk price would fall and production would decline. As long as production did not decline enough so as to avoid support activity and force prices to rise, the assessment would have no effect on consumer prices, and producer price would decline but by less than the assessment since the percentage of milk used in Class I would increase. Reduced prices and quantities indicate a loss of producers' surplus. Producers' surplus loss (PSL_i) is the area above the supply schedule, between the pre- and post-assessment equilibrium prices. Mathematically:

$$(21)\ PSL_i = \int_{PS_i\omega}^{PS_i\alpha} S_o(PS_i)^{S_1}\, d\, PS_i.$$

[3]The model was also validated using 1976, 1978, and 1980 data with similar result. Further, a sensitivity evaluation showed the model to be relatively insensitive to moderate (± 50 percent) change in the demand elasticity parameters.

The "α" indicates the pre-assessment value for the particular variable and "ω" indicates the post-assessment value for the particular variable. Total assessment revenue (TR) is:

$$(22)\ TR = (QS_i^{\omega})\ (T).$$

The assessment induced production decline results in a reduction in price support expenditures. Price support savings (PSS_i) are:

$$(23)\ PSS_i = (QMS_i^{\alpha} - QMS_i^{\omega})\ (PM_i^{\alpha} + PTSA),$$

where PTSA is the cost of processing, transportation, storage, and administration per hundredweight of milk purchased for price support.

Lowered price support

A reduction in the price support level reduces the floor under the manufacturing milk price. The demand for manufacturing milk (equation (4)) is then perfectly elastic at SL^{ω} rather than SL^{α} (equation (10)) where "α" indicates the initial support level and "ω" indicates the reduced support level. Assuming substantial price support activities in the market, a lower support level would lead to lower milk prices, with increased private sector consumption, decreased milk production, and decreased price support expenditures. As in the case of the assessment, lower prices and quantities would reduce producers' surplus. This loss of producers' surplus is defined by equation (21). Reduced fluid and manufacturing milk product prices would increase milk consumption and consumers' surplus. Fluid milk consumer surplus gain (FCSG) is defined by:

$$(24)\ FCSG_i = \int_{PI_i\omega}^{PI_i\alpha} F_o(PI_i)^{F_1}\ d\ PI_i$$

Similarly, manufacturing milk consumers' surplus gain (MCSG) is defined by:

$$(25)\ MCSG_i = \int_{PM_i\omega}^{PM_i\alpha} M_o(PM_i)^{M_1}\ d\ PM_i.$$

Lowered manufacturing milk prices with increased consumption and decreased production would reduce the expenditures required for price support. The saving in price support expenditure (PSS) is:

$$(26)\ PSS_i = [(PM_i^{\alpha} + PTSA)\ (QMS_i^{\alpha})] - [(PM_i^{\omega} + PTSA)\ (QMS_i^{\omega})].$$

Lowered support level with frozen minimum Class I prices

This policy calls for a reduction in the support level to SL^{ω} as in the previous case, while the Class I differential (CLI_i^{α}) is increased by the amount of the support level reduction to CLI_i^{ω}. The demand for manufacturing milk is perfectly elastic at SL^{ω} while the Class I price is:

$$(27)\ PI_i^{\omega} = PM_{MW}^{\omega} + CLI_i^{\alpha} + \Delta SL$$
$$= PM_{MW}^{\omega} + CLI_i^{\omega},$$

where ΔSL is the change in the price support level ($\Delta SL = SL^{\alpha} - SL^{\omega}$). As in the previous two cases, lowered prices and quantities would reduce producers' surplus as defined by equation (21). Lower manufacturing milk prices would increase consumption with a resulting rise in manufacturing milk consumers' surplus (defined by equation (25)). Finally, reduced manufacturing milk price, increased private sector consumption, and lower overall milk production reduces the expenditures required for price support (defined by equation (26)). Since fluid milk prices would be unaffected, fluid consumers' surplus would be unaffected by this program change.

Since Class I prices are frozen, this effect on milk producers in different markets would vary. If the percentage of Class I use in the market was near 100, the effect of the lowered support would be small. If the percentage used in Class I was low, most of the price effects of the lowered support level would be transmitted to the producer through a lower blend price. Producer prices for Grade B milk would decrease by the reduction in the support level.

Production quota

A production quota would limit each producer to a portion of the firm's previous annual production. The milk supply function would become:

$$(28)\ QS_i = S_o(PS_i)^{S_1} \text{ for } QS_i < QSQ_i,$$

otherwise:

$$QS_i = QSQ_i,$$

where QSQ_i is the total market production quota for region i.

The supply function is perfectly inelastic at the quota quantity. Assuming QS_i exceeds QSQ_i at the market price, the quota results in loss of producers' surplus, gain of quota rent, and lower price support expenditures. Producers' surplus loss is defined by equation (29) as:

$$(29)\ PSL_i = \int_{PSQ_i}^{PS_i\alpha} S_o(PS_i)^{S_1}\, d\, PS_i,$$

where:

$$(30)\ PSQ_i = (QSQ_i/S_o)^{s_1^{-1}}$$

PSQ_i is the supply price at the quota quantity (QSQ_i) and thus is the marginal cost of producing milk in region i under the quota. It should be noted that this is marginal cost for the industry within the region rather than marginal cost for an individual firm. If the price received by producers exceeds this marginal cost, the economic rent accrues to the owner of the quota. This rent is defined by:

$$(31)\ QR_i = QSQ_i(PS_i^{\omega} - PSQ_i),$$

where QR is the rent to the quota in region i.

Initially, the milk producer would be the quota owner, but if ownership were transferable or if quota could be leased, the economic rent might accrue to other than milk producers. These economic rent formulas are based on an assumption of a perfect market for quota. Quota reduced production would result in lowered price support expenditures as defined by equation (23).[4] Consumers' surplus would be unaffected by this program change as long as the quotas were not so limiting as to avoid price support activity forcing class prices to rise.

Specification of Policy Alternatives

The various model parameters were set to reflect alternative dairy market policy aimed toward reducing government expenditures on dairy price support. Specific policy alternatives modeled were: (1) per hundredweight assessment with T set at \$.50 and \$1.00, (2) price support level reductions with ΔSL set at \$1.00 and \$2.00, (3) price support level reductions with ΔSL set at \$1.00 and \$2.00 and minimum Class I prices frozen, and (4) production quotas with QSQ_i set at 95 percent and 90 percent of 1981 production. The effects of these potential policies on milk producers and consumers and government expenditures as previously defined were estimated for each of the model regions.

RESULTS

Estimates of the welfare implications of the aforementioned policies are listed in Table 1. A summary of price support purchase, government outlays, and welfare effects associated with each policy are listed in Table 2. Complete regional results are not shown in the interest of brevity, but regional implications of particular interest are discussed in the text. Other regional detail is available from the authors. Further, in the following discussion, only the long-term results are discussed except where contrast between the short- and long-term is particularly interesting.

Assessments

The simulation results indicate that a \$.50 per hundredweight assessment would have reduced price support acquisitions by 18 percent (10,511 million pounds down from 1981 purchases of 12,861 million pounds). Reduced purchases along with assessment revenue would have reduced price support cost by \$1,032.5 million, a 48 percent reduction from 1981 expenditures of \$2,134.0 million, Table 2.[5] Producers' surplus would have fallen to \$643.3 million, 3 percent of producers' revenue, Table 1. The unweighted sum of welfare effects which would have resulted from a \$.50 assessment totals \$389.2

[4]The longer run implications of quota transfer are not considered in this analysis. For example, sale or lease of a large portion of a region's quota to lower cost producers outside the region could lead to higher consumer prices due to increased transportation costs. It could also lead to lower consumer prices if over-order premiums were present.

[5]The cost of price support includes purchase, storage, transport, and processing costs. Revenue from the sale of stocks is not included. The resource misallocation and reallocation which results from dairy market intervention, both price support and market order, are not addressed in this paper. For such analyses, see Dahlgran and Buxton and Hammond. The cost of price support under alternative policies was estimated by multiplying the number of pounds purchased times the actual cost of the price support per pound purchased in 1981 plus or minus the per pound effect of the various policy options on the support level (i.e., \$2,134.0 million/12,861 million pounds ± support level adjustment factor). For example, a support level reduction of \$1.00 from the 1981 level would reduce price support outlays by \$0.01 per pound purchased.

TABLE 1. TOTAL EFFECTS OF THE SELECTED PROGRAM CHANGES ON PRODUCERS' AND CONSUMERS' SURPLUS IN THE U. S. DAIRY SECTOR, 1981

Policy option	Long-term effects (S_1 = 0.50) FCSG[a]	MCSG[a]	PSL[a]	QR[b]	Short-term run (S_1 = 0.25) FCSG[a]	MCSG[a]	PSL[a]
	---millions of dollars---						
No action	—	—	—	—	—	—	—
$.50 assessment[d]	—	—	643.3 [3.0%]	—	—	—	614.3 [3.4%]
$1.00 assessment[d]	—	—	1,284 .2 [7.1%]	—	—	—	1,219.9 [6.7%]
Lower support level $1.00	535.1 [6.7%]	607.8 [7.1%]	1,225.5 [6.7%]	—	535.5 [6.7%]	638.9 [7.5%]	1,283.4 [7.1%]
Lower support level $2.00	940.3 [11.8%]	1,095.8 [12.8%]	2,094.1 [11.5%]	—	1,085.6 [13.6%]	1,299.8 [15.2%]	2,453.1 [13.5%]
Lower support level $1.00, freeze Class I price	—	748.4 [7.3%]	722.4 [3.9%]	—	—	645.5 [7.6%]	737.4 [4.1%]
Lower support level $2.00, freeze Class I price	—	1,493.3 [14.7%]	1,475.5 [8.1%]	—	—	1,319.7 [15.5%]	1,481.1 [8.1%]
95 percent production[c] quota[d]	—	—	1,623.6 [8.9%]	1,657.9 [9.1%]	—	—	—
90 percent production[c] quota[d]	—	—	3,160.4 [17.4%]	3,066.7 [16.8%]	—	—	—

[a]FCSG=fluid milk consumers' surplus gain; MCSG=manufactured product consumers' surplus gain; PSL=producers' surplus loss. The numbers in brackets represent the gain (loss) in consumers' (producers') surplus as a percent of consumer (producer) expenditure (revenue).

[b]QR-quota rent. The numbers in brackets represent the quota rent as a percent of producers' revenue.

[c]Since production is at the limit of the quota, the producer operates on the perfectly inelastice portion of his supply schedule. Thus, the elasticity on the more elastic portion does not affect equilibrium.

[d]Consumer prices were unaffected by these program changes; thus, FCSG and MCSG equal zero.

million. A $1.00 assessment would have reduced support acquisitions by 37 percent. Price support expenditures would have fallen to $72.2 million, a savings of $2,061.8 million, and producers' surplus would have fallen by 7.1 percent of producers' revenue. The sum of the welfare impacts is $777.6 million. As expected, surplus loss as a percentage of revenue varies little across regions since the tax is applied to each hundredweight of milk marketed.

Price Support Reduction

The simulation solutions indicate that a $1.00 reduction in the support level would have reduced price support purchases by 56 percent (5,707 million pounds down from 1981 purchases of 12,861 million pounds, Table 2). Similarly, price support expenditure would have totaled $889.8 million, a $1,244.2 million savings over 1981 expenditures of $2,134.0 million (USDA, 1982).

TABLE 2. EFFECTS OF SELECTED PROGRAM CHANGES ON PRICE SUPPORT ACQUISITIONS AND EXPENDITURES AND THE SUM OF WELFARE EFFECTS, U. S. DAIRY SECTOR, 1981

Policy option	Price support acquisitions Long term	Short term	Net price support expenditure savings[a] Long term	Short term	Assessment revenue Long term	Short term	Sum of measured societal effects[b] Long term	Short term
	---million pounds---		---millions of dollars---					
No action	12,861.0	12,861.0	0.0	0.0	—	—	0	0
$0.50 assessment	10,511.0	11,981.0	1,032.5	789.7	647.8	654.4	389.2	175.4
$1.00 assessment	8,061.0	10,560.0	2,061.8	1,709.7	1,270.1	1,295.1	777.6	489.8
Lower support level $1.00	5,707.0	8.049.0	1,244.2	879.0	—		1,161.6	770.0
Lower support level $2.00	0.0	2,904.0	2,134.0	1,710.2	—		2,076.0	1,642.5
Lower support level $1.00, freeze CLI price	7,200.0	9,124.0	1,011.4	711.4	—		1,037.4	621.5
Lower support level $2.00, freeze CLI price	2,361.0	5,639.0	1,789.5	1,311.2	—		1,807.3	1,149.8
95 percent production quota	6,608.0		1,032.9		—		1,067.2	
90 percent production quota	0.0		2,134.0		—		2,040.3	

[a]Expenditure savings is defined as the savings on the cost of purchasing, transport, storage, and processing plus assessment revenue, if any. Price support expenditures in 1981 totaled $2,134.0 million.

[b]Consumers' surplus gains plus quota rent, if any, minus producers' surplus losses and plus savings on price support expenditures.

Fluid and manufactured product consumers would have netted surplus gains of $535.1 million and $607.8 million, respectively, Table 1. The support level reduction would have lowered producers' surplus $1,225.5 million (6.7 percent of producers' surplus). The simple sum of gains and losses was $1,161.6 million. Since consumers' gains nearly offset producers' losses, the simple net effect of the policy was approximately equal to the savings in support outlays.

A $1.74 reduction in the support level would have eliminated the need for price support purchases in the long run, reducing support outlays to zero, Table 2. Such a reduction would have increased fluid and manufactured products consumers' surplus by amounts equal to about 12 percent of consumer expenditures. Producers would have suffered a surplus loss equaling 11.5 percent of producers' revenue. Again, the simple net effect of the policy was about equal to the savings in support outlays. In the intermediate run, a $2.00 reduction in the support level would have reduced support purchases to 2,904 million pounds rather than zero as in the longrun case, Table 2. This was expected since the supply response associated with the intermediate run simulation is more inelastic.

The simulation results indicate little difference in the impact of the price support reduction across regions. This follows from the assumption that Class I prices adjust with the Minnesota-Wisconsin (M-W) price and thus with the support level. This assumption ignores the effects of over-order premiums and the abilities of producers in some regions to command these premiums.[6] If over-order premiums reflect the added costs of producing milk in some regions as well as the cost of moving milk into those regions, if deficit, and added handler costs in some orders (Babb and Bessler), then a reduction in the support price may not reduce the Class I price but merely raise the over-order premium received by the producer. Over-order premiums were not considered in this study because adequate data on over-order Class I prices were not available. In regions with high Class II or III utilization, Class I prices would be expected to change consistent with the support level and estimates should accurately reflect the effect of a support level change. However, in regions with little Class II or III utilization, Class I prices may not adjust with support level changes since an added premium may be necessary to meet Class I demand in the market. If this was the case (the Class I price does not follow the M-W price in each region), this model may overestimate FCSG and PSL.

Price Support Reduction With Frozen Class I Price

A $1.00 reduction in the support price coupled with frozen minimum Class I prices would have reduced annual price support acquisitions to 7,200 million pounds and expenditures to $1,222.6 million, respective reductions of 44 and 47 percent from 1981 levels, Table 2. Manufactured milk product consumers' surplus would have increased by $748.4 million which accounts for about 7 percent of consumer expenditures, Table 1. Milk producers' surplus would have been reduced $722.4 (about 4 percent of producer's revenue). The unweighted sum of the welfare effects totals $1,037.4 million, slightly less than the government price support expenditures. The producers' surplus loss varied widely by region. Losses in the Southeast totaled 1.7 percent of producer revenue while losses in the Lake States totaled 5.2 percent of producer revenue.

A $2.00 reduction in the support level with frozen Class I prices would have reduced price support acquisitions by 82 percent to 2,361 million pounds. The welfare implications for producers and consumers follow a pattern similar to that associated with a $1.00 support level reduction coupled frozen Class I prices, but the effects are larger in magnitude.

The welfare implications of this alternative vary widely across regions depending on each region's Class I utilization. Regions with high Class I use would be relatively unaffected while regions with low Class I use are most affected. For markets with high Class I utilization and/or over-order premiums, the model may underestimate the effect of this program change on PSL and FCSG since it is

[6]In many cases, the Class I price actually paid the producer is above the federal order Class I minimum price. The difference between the federal order minimum Class I price and the actual Class I price is defined as an over-order premium.

possible that over-order premiums in high Class I utilization markets would be reduced somewhat since lower blend prices in regions with low Class I use would make transporting milk to high Class I utilization markets more attractive.

Production Quotas

A 95 percent production quota (setting regional quotas at 95 percent of 1981 production) would have reduced price support acquisitions to 6,608 million pounds, a 49 percent reduction. Expenditures would have fallen by $1,032.9 million, Table 2. With a 90 percent production quota, there would have been no need for price support activity. Since the supply function is perfectly inelastic at the quota quantity, the intermediate-run and long-run equilibria do not differ. Thus, only the longrun implications are reported. Over all regions, a 95 percent quota would have reduced producers' surplus by $1,623.6 million (8.9 percent of revenue), while yielding rent or quota profit of $1,657.9 million (9.1 percent of revenue) for a net gain to producers of $34.4 million (assuming the milk producer captures the rent from the quota), Table 1. Quota rent may exceed producers' surplus loss without implying higher consumer prices since reduced production results in a higher portion of milk priced at the Class I price. The unweighted sum of welfare effects of a 95 percent quota is $1,067.2 million. With a 90 percent quota, producers would have lost $3,160.4 million producers' surplus, but rent to quota would have totaled $3,066.7 million. The unweighted sum of the welfare effects totaled $2,040.3 million.

Regionally, the rent attributed to quota was about the same as the loss of producers' surplus in each region. Thus, producer net gain or loss attributed to the quota would have been small both over all regions and within each region. This assumes the producer owns the quota and is able to capture the revenue generated by the quota as rent. Initially, the economic rent from the quota would probably accrue to the producer since quota would likely be assigned the producer based on some historical production pattern. For the quota system to work in the long term, it seems probable that some mechanism for transfer of the quota between producers would be necessary. If so, the quota would become a salable asset (its worth would be the value of the quota discounted for time and risk) and its rent would be lost to the purchasing producer.

CONCLUSIONS

Since the utility functions of milk producers and consumers and taxpayers are unknown, no "best" policy alternative can be selected. Even so, some interesting implications can be derived from these results. From the producers' perspective, the status quo is probably the most appealing alternative since all the other alternatives have producers' surplus losses. The 90 percent production quota may be either the most appealing or least appealing of the alternatives depending on the distribution of quota rents. It is improbable that quota rents would accrue to the milk producer in the long term, since the producer initially assigned the quota would likely capture the capitalized quota rents as revenue from sales of the quota. Thus, it would appear that quotas would be attractive to those initially receiving them but unattractive to those potential new producers who would have to buy them.

If the producer were to adopt the premise that price support outlays must be reduced in order to sustain the political acceptability of the regulatory system, then based on the ratio of producers' surplus to price support outlay savings, the assessments would be most appealing overall. A $.50 assessment costs producers $.53 of producers' surplus for each $1.00 of outlay savings compared to about $1.00 for price support reductions and $1.50 for quotas (assuming quota rent does not accrue to the producer). The reduced price support level with frozen minimum Class I price is the most attractive alternative in the Southeast ($.03 loss of Southeast producers' surplus to $1.00 reduction in price support outlays compared to $.06 for assessments) and the least attractive in the Lake States ($.28 loss of Lake States producers' surplus per $1.00 outlay reduction compared to $.18 loss for assessments). This result is due to differing Class I utilizations in the two regions.

If a policy of lower price support were adopted, it is probable that in regions with relatively high Class I utilizations and over-order premiums, the actual welfare implication would be near the result associated with lowered price support and a frozen minimum Class I price. As previously mentioned, this is due to the simulation model assumption in the case of a simple support level, which is probably inaccurate for some regions. Thus, some producers may support a simple price support level reduction because the welfare implication for their region is similar to that of a price support reduction with frozen Class I price.

Consumers would probably support a simple price support level reduction due to its yield of consumers' surplus. Although the consumers' surplus gain may be less than estimated in some regions (due to the model assumptions on Class I pricing), the gain associated with a lowered support level with a frozen minimum Class I price is a lower limit for the increase in consumers' surplus. Thus, a $2.00 support level reduction is probably the most appealing to consumers.

Taxpayers would best be served by a policy which eliminated price support outlays. Either a $2.00 price support decrease or a 90 percent quota would achieve this, and a $1.00 assessment would come close. If taxpayer and consumer interests were combined (a logical combination since most taxpayers are consumers and vice versa), the most attractive alternative would be a $2.00 support level reduction since it results in a large gain of consumers' surplus and elimination of support outlays. If taxpayer and producer interests were summed, the $1.00 assessment would be the alternative with the lowest cost (with exception of the 95 percent and 90 percent quotas when producer capture of the quota rent is assumed; however, quotas would likely lead to higher milk production costs and more difficult entry into dairying in the long term). This combination of producer and taxpayer interests may approximate the current political climate where large outlays have caught the taxpayer's eye and have brought demands for reductions and producers' interest groups are lobbying Congress for favorable treatment. The recently enacted assessment provisions are consistent with this explanation of the results.

REFERENCES

Babb, E. M. and D. A. Bessler. *Factors Affecting Over-Order Payments in Federal Milk Marketing Orders*, 1965-80. Agricultural Experiment Station, Purdue University, Research Bulletin 977; June, 1983.

Brandow, G. E. *Interrelations Among Demand for Farm Products and Implications for Control of Market Supply.* Pennsylvania Agricultural Experiment Station Bulletin 680, Pennsylvania State University, 1961.

Buxton, B. M. and J. W. Hammond. "Social Cost of Alternative Dairy Price Support Levels." *Amer. J. Agr. Econ.*, 56,2(1974): 286-91.

Chen, D., R. Courtney, and A. Schmitz. "A Polynomial Lag Formulation of Milk Production Response." *Amer. J. Agr. Econ.*, 54,1(1972): 77-83.

Dahlgran, R. A. "Welfare Costs and Interregional Income Transfers Due to Regulation of Dairy Markets." *Amer. J. Agr. Econ.*, 62,2(1980): 288-96.

George, P. S. and G. A. King. *Consumer Demand for Food Commodities in the United States with Projections for 1980.* Giannini Foundation, Monograph No. 26, California Agricultural Experiment Station; Berkeley, 1971.

Hallberg, M. C., D. E. Hahn, R. W. Stammer, G. J. Elterick, and C. E. Fife. *Impact of Alternative Federal Milk Order Pricing Policies on the U. S. Dairy Industry.* Pennsylvania State Agricultural Experiment Station Bulletin No. 818; May, 1978.

Ippolitto, R. A. and R. T. Masson. "The Social Cost of Government Regulation of Milk." *J. Law and Econ.*, 21(1978): 33-65.

Kessel, R. A. "Economic Effects of Federal Regulation of Milk Markets." *J. Law and Econ.*, 10(1967): 51-78.

Lough, H. W. *Truck Transportation Costs of Bulk Milk* . Washington, D. C.; U. S. Department of Agriculture, ESCS, Agr. Econ. Report 427, 1979.

Seale, A. D., Jr. and T. E. Trammel. "Reactive Programming Models." pp. 47-58, in R. A. King (ed.) *Interregional Competition Research Methods*, Agricultural Policy Institute Series 10, North Carolina State University, Raleigh, 1963.

U. S. Department of Agriculture. *Agricultural Prices, Annual Summary.* Crop Reporting Board, ESCS, U. S. Government Printing Office, Washington, D. C., 1981a.

———. *Agricultural Statistics.* U. S. Government Printing Office, Washington, D. C., 1981b.

———. *Dairy Outlook and Situation.* National Economics Division, ERS, U. S. Government Printing Office, Washington, D. C.; December, 1982.

———. *Milk: Production Disposition Income 1979-81.* Crop Rotating Board, ESS, U. S. Government Printing Office, Washington, D. C., 1981c.

———. *Federal Milk Order Market Statistics.* Agricultural Marketing Service, U. S. Government Printing Office, Washington, D. C., 1981d.

Whipple, Glen D. "An Analysis of Reconstituted Fluid Milk Pricing Policy." *Amer. J. Agr. Econ.,* 65,2(1983): 207-13.