REGIONAL GAINS AND LOSSES FOR CONSUMERS AND PRODUCERS FROM CHANGES IN FLUID MILK PRICES*

Leo V. Blakley and John B. Riley

Equilibrium in a free market can result in prices and quantities which maximize society welfare for a given resource distribution [17, p. 514]. Departures from equilibrium of the competitive model will involve changes in net social gains and losses not only for the national economy as an aggregate, but also for particular groups or regions. The trade-offs between groups or regions, in fact, may be much larger than the aggregate changes averaged over all groups.

Departures from equilibrium under restricted pricing conditions, such as exist with the federal order marketing system in the fluid milk industry, also will involve social gains and losses on national, regional, and local levels. Given the rapid decline in Grade B or manufacturing grade milk production, the concern about equity, and the evolution of new institutions in the milk market, conditions affecting equilibrium in the fluid milk industry also must change. The nature of these changes can have marked effects on the benefits received by the participants in the industry.

Consumer surplus and producer surplus are concepts frequently used to quantify gains and losses of groups. Tweeten and Tyner [18], Carmen and Youde [3], and King [8], among others, have used supply and demand schedules to illustrate and define areas of consumer surplus, producer surplus, trade-offs, and net social gains. Though it can be shown that the market demand schedule is not an accurate measure of consumer surplus [Knight 9 and Blakley 1], the error in such measurement may be small if the income effect of that price change is small.

THE FLUID MILK INDUSTRY SCHEDULES

Most illustrations of consumer and producer surpluses consider the market demand and supply schedules for a single product. The net social cost of maintaining a higher-than-equilibrium price (measured to the right of the point of intersection of the demand and supply schedules) or the net social gain from exporting a portion of production (measured upward from the point of intersection of the demand and supply schedules) involves only a single set of schedules. Moreover, the gains and losses in the aggregate are usually small relative to those for either consumers or producers considered separately.

More than one set of schedules must be considered for the fluid milk industry. Figure 1 shows a representative consumer-producer situation in a single market. D_r is the demand for fluid milk at the retail level, and S_f is the farm supply of Grade A milk eligible for the fluid market. The derived demand for Class I milk at the farm level is shown as D_I. D_I would have the same slope as D_r under the assumption of a constant per-unit marketing margin, but would have a smaller (absolute value) slope under the assumption of a constant percentage marketing margin. A comparable demand situation would exist for Class II or manufacturing grade milk

Given an increase in retail price from P_r to P_r' and the associated reduction in quantity consumed, the Class I price increases from P_I to P_I' in Figure 1. Consumer suplus decreases by the area $P_rP_r'AC$. This area could be approximated by considering only that portion of the area delineated as $P_rP_r'AB$ if the demand schedule were highly inelastic, since the triangular area ABC in that case would be small.

The decrease in consumer surplus cannot be estimated in Figure 1 by considering the area under the derived demand schedule. The area $P_IP_I'EG$ would be equal to the area $P_rP_r'AC$ only if per-unit

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Leo V. Blakley is professor of agricultural economics at Oklahoma State University, and John B. Riley is assistant professor of agricultural economics at Kansas State University.

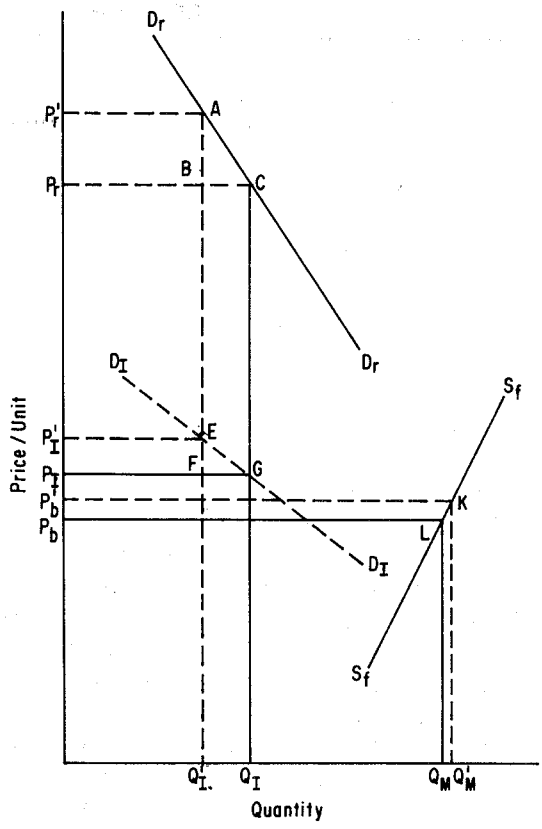

Figure 1. SUPPLY AND CLASS I DEMAND RELATIONSHIPS IN THE FLUID MILK INDUSTRY FOR ILLUSTRATING THE CHANGES IN PRODUCER AND CONSUMER SURPLUS GIVEN INCREASED PRICES

marketing margins were constant. As long as some portion of the margin or price-spread is based on a percentage mark-up, changes in consumer surplus based on the derived demand schedule are not the same as under the retail demand schedule. Generally, the change measured from the derived demand schedule will understate the actual value.

A higher Class I price results in an increase in the blend prices from P_b to P_b' if the price of Class II milk remains unchanged with the larger quantity diverted to manufactured product use, or if the diversion is from an inelastic to a more price-elastic market. The increase in producer surplus with the higher price is P_bP_b' KL. As the price elasticity of the supply schedule approaches zero, the area of producer surplus would approach a rectangle defined as the increase in blend price times the quantity produced. Producer surplus would be equal to this rectangular area given a blend price change and a fixed supply in the short run. Assuming a constant and equal utility of money among producers and consumers, the estimated change in producer surplus can be compared with the estimated change in consumer surplus as a measure of relative gain and loss between the two groups.

The measurements of consumer and producer surplus outlined above ignore the effects of Class I-Class II product substitution with lower Class I consumption, a higher Class I price, and increased milk production. Of necessity, the quantities of manufactured products increase. The larger quantities of manufactured products at lower prices will affect the demand for Class I milk. For example, non-fat dry milk powder can be substituted for fluid milk in some uses and by some consumers. The higher price represented by P_r' leads to Q_I' consumed in the short run, but leads to a long-run decrease in the retail demand schedule for Class I milk, though at some extra cost to sonsumers to make the substitution. Therefore, the change in estimated consumer surplus, area $P_IP_r'AC$, may be an approximation of only the initial change in consumer surplus for fluid consumption.

To this point, consumer surplus associated only with Class I or fluid milk consumption has been considered. Changes in consumer surplus also would be expected to result from changes in consumption of Class II milk or manufactured milk products. Generally, an increase in consumption of Class I milk with relatively fixed supplies will result in a decrease in consumption of Class II milk.Therefore, an increase in consumer surplus for Class I milk will be associated with a decrease in consumer surplus for Class II milk, and the net effects on consumer surplus would be partially offsetting. For decreasing Class I consumption, the opposite conditions prevail.

Changes in milk pricing policies or the relative supply and demand quantities of milk could have a significantly different impact on the gain or loss of producers and consumers in a given market or region as compared with an aggregate measure of changes in producers' and consumers', surpluses. Individual deviations would reflect differences in levels and elasticities of supply and demand as well as the differences in interdependence among areas. To determine the variability of gain and loss between producers and consumers within the fluid milk industry, the effects of industry pricing policy modifications for a given period are analyzed in the context of consumer surplus, producer receipts, and consumer expenditures for Class I products. Ratios of change in producer receipts to changes in consumer surplus and expenditures are also considered.

THE BASE FEDERAL ORDER PRICING MODEL

The model developed by Riley [15] using the Tramel and Seale [16] reactive programming routine as revised by Hurt [6] provided the basis for analysis. A spatial, least-cost equilibrium was estimated for the fluid milk industry based on: separate retail linear demand schedules for 31 market areas, price spreads for each area, processing costs related to market size and firm size, transportation costs related to distance, and quantities produced in each market which were fixed in 1973 but were based on response to prices in the two preceding years. Studies by Rauniker and Purcell [13], Rauniker, Purcell and Elrod [14], Bullion [2], Manchester [11 and 12], Kerchner [7], Christ [4], and Harrington [5] provided basic data and estimates of many of the coefficients included in the model.

The specific base model (Model A) was developed using the current federal order milk pricing structure; i.e. minimum federal order Class I price differentials imposed on a support price of $5.29 in 1973. A perfectly elastic demand for Class II milk at the support price was assumed for generating equilibrium conditions, but a demand schedule for Class II milk with a price elasticity of -0.86 at retail was specified to estimate aggregate changes in consumer surplus. Changes in consumer surplus associated with Class II products were then allocated to markets in proportion to the market share of total consumption of Class I milk.

Equilibrium quantities, utilization, and values of milk supplied and equilibrium retail demand values of the milk used for Class I and Class II purposes for Model A are presented in Table 1 for each of six

Table 1. EQUILIBRIUM FARM AND RETAIL VALUES, UTILIZATION, AND QUANTITIES SUPPLIED, BASIC FEDERAL ORDER PRICING SYSTEM OF MODEL A, 1973

Region and Market Number	Supply			Demand		
	Quantity (mil cwt)	Used As Class I (Pct)	Farm Value (mil dol)	Fluid Retail Value (mil dol)	Class II Retail Value (mil dol)	Total Retail Value (mil dol)
(1) Upper Midwest	141.5	40.8	870.9	824.0	773.5	1,597.5
24	90.4	39.3	573.1	547.3	506.7	1,054.0
25	30.8	42.9	177.9	158.0	162.5	320.5
26	12.1	57.9	73.9	89.1	47.0	136.1
27	8.3	25.0	46.5	29.5	57.3	86.8
(2) Central Midwest	213.8	66.2	1,407.8	1,907.2	668.0	2,575.2
15	18.0	71.5	122.3	180.0	47.2	227.2
16	28.8	65.1	188.9	256.5	92.8	349.3
17	32.2	71.8	213.8	306.6	83.9	390.5
18	20.0	68.0	132.8	179.0	59.2	238.2
19	32.9	65.2	219.5	302.1	105.7	407.8
23	41.6	62.2	267.6	328.8	145.1	473.9
28	14.1	51.2	86.5	93.9	63.4	157.3
29	14.4	62.2	92.2	131.9	50.1	182.0
31	11.8	81.3	84.2	128.3	20.4	148.7
(3) Northeast	192.0	59.2	1,338.3	1,700.5	724.2	2,424.7
20	44.6	68.4	323.7	474.8	130.1	604.9
21	99.0	52.3	662.9	759.1	436.3	1,195.4
22	48.4	64.7	351.6	466.5	157.9	624.4
(4) Southeast	54.3	78.1	422.3	729.2	109.9	839.1
9	6.8	63.3	49.0	96.2	22.9	119.1
10	8.3	74.3	59.9	96.2	19.8	116.0
11	6.4	63.3	45.6	57.5	21.8	79.3
12	12.3	81.3	107.2	174.6	21.2	195.8
13	6.4	81.3	52.0	88.3	11.0	99.3
14	14.1	81.3	108.6	216.4	24.4	240.8
(5) Southwest	48.9	73.7	349.1	522.5	118.9	641.4
5	9.3	77.8	66.8	107.5	19.0	126.5
6	13.0	72.7	91.4	138.6	32.7	171.3
7	18.6	73.3	136.9	196.7	45.9	242.6
8	8.0	71.4	54.2	79.6	21.2	100.8
(6) West	51.3	57.9	336.1	411.7	199.8	611.5
1	15.4	40.7	93.8	89.2	84.7	173.9
2	15.0	57.6	96.7	118.9	58.6	177.5
3	6.4	58.4	41.4	50.1	24.7	74.8
4	6.9	74.1	49.8	65.3	16.5	81.8
30	7.9	77.3	56.5	88.3	16.6	104.9
Total	701.8	60.0	4,724.6	6,095.0	2,594.3	8,689.3

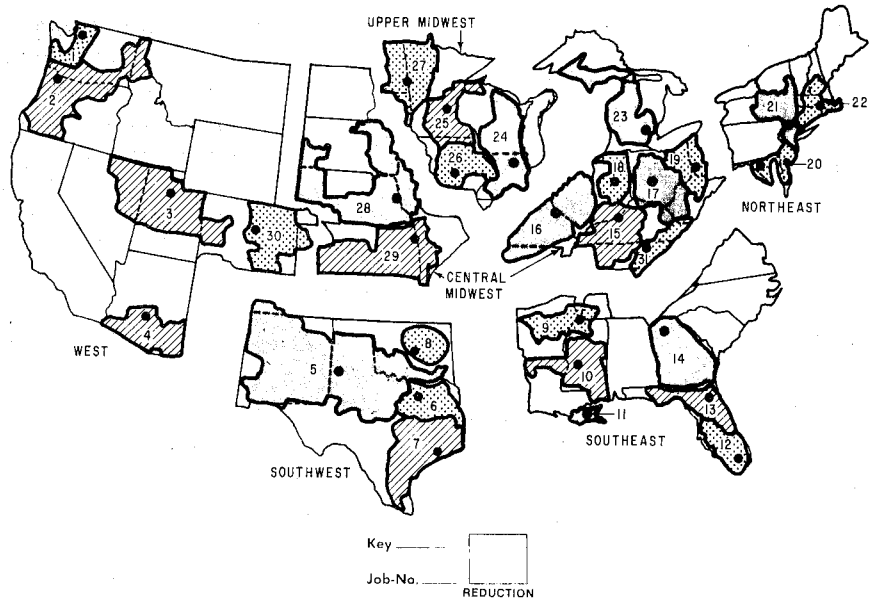

Figure 2. Market Areas of the United States Defined for the Study

regions and for the individual market areas within each region. The market areas are shown in Figure 2. Regional totals may differ from the sum of the market values because of rounding involved in the latter values. The Central Midwest region included the largest number of markets, the largest total production, and the highest farm and retail values. The Northeast region was second largest in production, consumption, and farm and retail values. The West had the smallest regional farm and retail demand values while the Southwest had the smallest regional supply quantity. The quantity of fluid milk consumed as a percentage of the quantity supplied was greatest in the Southeast where a 23 percent minimum reserve requirement of the model was effective in some markets.

IMPACTS OF PRICE CHANGES

A Uniform Minimum Class I Price Near the Projected 1973 Level

Establishing a uniform minimum Class I price in each market of $7.36 per cwt. resulted in a decline in the aggregate retail value of Class I milk. Estimated consumer surplus associated with Class I milk increased $29.5 million, less than one-half of 1 percent of the current value based on the 1973 federal order Class I price differentials.

The larger consumer surplus and lower retail value reflected the use of a larger quantity of milk as Class I in a price-inelastic, retail demand setting. The increased use as Class I required a decreased use as Class II, since the 1973 quantity was assumed fixed. The decrease in Class II use, in turn, resulted in a decrease in consumer surplus of $7.9 million. The net increase in consumer surplus, therefore, was $21.6 million (Table 2).

The producer or farm value of milk decreased by $18.6 million under the uniform pricing system. Under the assumptions of fixed supplies, producer surplus was lower by this amount. Therefore, consumer surplus increased more than producer surplus decreased. Stated another way, producer surplus (receipts) decreased by $0.86 for each $1 increase in consumer surplus, measured in all uses (Class I and Class II). The absolute value of this ratio is about the same as the ratio of decrease in producer receipts to decrease in retail value of Class I milk, 0.79. The signs are different because retail value and consumer surplus changes have opposite signs.

The Northeast region had the largest increase in consumer surplus under the uniform minimum Class I price of $7.36 per cwt. The total of $59.3 million for the fluid sector was only partially offset by the decrease of $2.1 million in the Class II sector. The net was larger than the decrease in producer surplus of $35.7 million with a $0.62 loss in producer receipts for each $1 increase in consumer surplus.

Two regions indicated large decreases in consumer surplus under the uniform minimum Class I price system. These were the Central Midwest at $31.3 million and the Upper Midwest at $22.8 million. Increases in producer surplus per $1 decrease in consumer surplus averaged $0.50 to $0.58 for the two regions. Though producer surplus increased in most of these markets, a few had lower producer surplus and higher consumer surplus values. For

Table 2. **PRODUCER RECEIPT AND CONSUMER SURPLUS CHANGES AND RATIOS RESULTING FROM ESTABLISHMENT OF UNIFORM MINIMUM CLASS I PRICE STRUCTURE OF $7.36 PER CWT., MODEL B**

		Change in Producer Receipts (mil dol)	Change in Consumer Surplus (mil dol)	Ratio of Change in Producer Receipts to Changes in Consumer Surplus (retail) (dol)	Ratio of Change in Producer Receipts to Changes in Retail Values[a] (dol)
(1)	Upper Midwest	13.0	-22.3	-0.58	0.85
	24	-5.6	6.4	-0.88	1.08
	25	12.8	-18.6	-0.69	0.91
	26	4.3	-7.0	-0.61	0.93
	27	1.6	-2.5	-0.64	0.84
(2)	Central Midwest	15.1	-30.3	-0.50	0.78
	15	-1.0	1.3	-0.77	1.25
	16	2.3	-4.6	-0.50	0.79
	17	3.2	-7.2	-0.44	0.74
	18	1.7	-3.3	-0.52	0.89
	19	-1.0	1.1	-0.91	1.00
	23	5.6	-9.3	-0.60	0.82
	28	2.8	-4.4	-0.64	0.97
	29	2.1	-4.0	-0.53	0.81
	31	-0.7	0.6	-1.17	2.33
(3)	Northeast	-35.7	57.2	-0.62	0.75
	20	-8.1	15.1	-0.54	0.65
	21	-16.8	25.1	-0.67	0.80
	22	-10.7	17.0	-0.63	0.76
(4)	Southeast	-5.1	10.5	-0.49	1.06
	9	≈ 0	-1.2	≈ 0	∞
	10	-1.9	3.6	-0.53	1.36
	11	-1.0	4.4	-0.23	0.43
	12	-1.6	2.3	-0.70	1.78
	13	-0.3	0.3	-1.00	1.50
	14	-0.7	1.1	-0.64	1.40
(5)	Southwest	-3.8	6.2	-0.61	1.12
	5	-1.0	1.9	-0.53	1.11
	6	-1.3	2.2	-0.59	1.08
	7	-1.5	2.3	-0.65	1.15
	8	0.1	-0.2	-0.50	1.00
(6)	West	-2.1	2.4	-0.88	0.84
	1	0.1	-1.5	-0.07	0.09
	2	≈ 0	-0.8	≈ 0	∞
	3	≈ 0	-0.5	≈ 0	∞
	4	-1.7	2.4	-0.71	0.81
	30	-2.0	2.9	-0.69	0.83
	U.S.	-18.6	21.6	-0.86	0.79

[a]Class I Milk only.

example, Minnesota producers (region 25) gained $0.69 for each $1 decrease in consumer surplus. In contrast, Chicago producers (region 24), a potentially strong export market, would sustain a loss of $0.88 for each $1 increase in consumer surplus in the market.

Changes in consumer surplus as a result of a uniform Class I price system were relatively small in the other regions. The ratios of change in producer receipts to the change in consumer surplus in the Southwest and Southeast averaged 0.49 to 0.61, about the same as for the regions previously discussed. The regional ratio was largest at 0.88 for the West, but this ratio was not typical for any market included in the region. Three of the markets in the West experienced little change in producer receipts because blend prices were essentially unaffected by the establishment of a uniform minimum price of $7.36 per cwt.

A Uniform Minimum Class I Price Near the Projected Support Price for Class II Milk

Elimination of all Class I price differentials among markets with retention of a general support price for manufacturing grade milk would permit an entirely different geographical structure of Class I prices than prevails under the federal order system now in effect. Markets which are self-sufficient in production could experience rather large changes in consumer and producer prices. Moreover, the general level of Class I prices could decline. Equilibrium under such a price situation was estimated in Model C. The only restrictions were that (1) the Class II prices in each market must equal or exceed the support price, and (2) the Class I price must be equal to or greater than the support price plus a handling charge of 20 cents per cwt. The latter is equivalent to a nominal Class I price differential, but it is the same for all markets.

Retail values of Class I milk in Model C declined $242.1 million from the aggregate value in Model A. Producer receipts declined $157.7 million, indicating a loss of $0.65 to producers for each $1 lower cost to consumers through lower retail prices (Table 3). The increase in consumer surplus was about the same as the decline in retail value of Class I milk. The increased consumption of Class I milk at lower prices resulted in an increase in consumer surplus for Class I milk. It also resulted in a decrease in consumption and in consumer surplus for Class II milk at the higher price. The net change was an increase in consumer surplus of $239.6 million. Producers lost less than consumers gained with a ratio of a $0.61 loss in producer surplus per $1 increase in consumer surplus. In every region except the Northeast there was at least one market with a ratio of producer loss to consumer gain which was above 1.00.

The largest dollar increase in consumer surplus occurred in the Northeast, with the major share in market 20 centered in Baltimore. The Northeast also had one of the lower ratios of decrease in producer receipts per $1 increase in consumer surplus. The second largest increase in consumer surplus occurred in the Central Midwest. Some of the ratios for individual markets were high (absolute values) because of the small changes in consumer surplus.

The Upper Midwest region had the lowest ratio of producer to consumer gain, -0.41. The average, however, concealed individual market differences. One market had both a consumer and a producer gain while another had a consumer loss and a producer gain. The major effect, however, was in market 24 (Chicago) with a producer loss-consumer gain ratio of 0.48.

The Southeast had high ratios of changes in producer receipts to changes in retail values of Class I milk, -1.50. However, the trade-off between producers and consumers within the region was only somewhat above average with a ratio of -0.87.

Producers in the Southwest lost more than consumers gained. The ratio of change in producer receipts to change in consumer surplus was unity or larger in three of the four markets as well as the region.

The ratio of change in producer receipts to change in consumer surplus averaged -0.66 for the West. The range was from -0.10 in market 1 (Washington) to -1.08 in market 4 (Southern Arizona).

CONCLUSIONS

Gains and losses to producers and consumers would result from changes in the methods of pricing Class I milk. The trade-offs of gains and losses between producers and consumers from these changes are not uniform and vary with both the pricing policy and the geographical region of the United States.

Establishment of a uniform minimum Class I price of $7.36 per cwt. in all markets for 1973 conditions resulted in only a slight change in net social gain. Consumers paid slightly less for fluid milk consumed as compared with expenditures under the minimum federal order Class I price differentials. Consumer surplus therefore increased for fluid milk, but was partially offset by a small loss in consumer surplus for Class II milk. Producers lost almost as much as consumers gained, a loss of $.86 for each $1 net gain to consumers. The ratios ranged from 0.50 to 0.88 for regional aggregates and $\approx$ 0 to 1.50 for individual market areas.

Table 3. **PRODUCER RECEIPT AND CONSUMER SURPLUS CHANGES AND RATIOS RESULTING FROM ESTABLISHMENT OF A UNIFORM MINIMUM CLASS I PRICE STRUCTURE OF $5.49 PER CWT., MODEL C**

		Change in Producer Receipts (mil dol)	Change in Consumer Surplus (mil dol)	Ratio of Change in Producer Receipts to Changes in: Consumer Surplus (retail) (dol)	Retail Values[a] (dol)
(1)	Upper Midwest	-13.8	33.3	-0.41	0.39
	24	-15.7	32.5	-0.48	0.51
	25	2.3	-1.5	-1.53	-1.77
	26	-1.1	1.7	-0.65	0.46
	27	0.7	0.5	1.40	-0.88
(2)	Central Midwest	-40.5	53.8	-0.75	0.70
	15	-4.1	6.1	-0.67	0.85
	16	-5.1	6.2	-0.82	0.71
	17	-4.1	3.3	-1.24	0.71
	18	-3.9	4.9	-0.80	0.76
	19	-4.0	5.5	-0.73	0.58
	23	-2.0	1.9	-1.05	0.31
	28	-6.9	10.9	-0.63	0.77
	29	-7.2	12.7	-0.57	0.67
	31	-3.1	2.5	-1.24	1.63
(3)	Northeast	-60.6	101.2	-0.60	0.58
	20	-46.2	75.7	-0.61	0.68
	21	-7.2	15.2	-0.47	0.33
	22	-7.1	9.9	-0.72	0.51
(4)	Southeast	-19.2	22.1	-0.87	1.50
	9	-3.0	3.4	-0.88	1.58
	10	-1.8	2.1	-0.86	1.29
	11	-2.2	1.6	-1.38	1.83
	12	-5.8	6.8	-0.85	1.61
	13	-3.0	3.6	-0.83	1.50
	14	-3.4	4.2	-0.81	1.26
(5)	Southwest	-12.0	11.7	-1.03	1.05
	5	-2.1	2.2	-0.95	1.05
	6	-3.1	2.8	-1.11	1.19
	7	-4.4	4.1	-1.07	1.16
	8	-2.4	2.7	-0.89	0.83
(6)	West	-11.6	17.5	-0.66	0.58
	1	-0.2	2.1	-0.10	0.07
	2	-1.6	2.8	-0.57	0.41
	3	-0.8	1.3	-0.62	0.44
	4	-1.3	1.2	-1.08	0.62
	30	-7.7	9.9	-0.78	0.82
	U.S.	-157.7	239.6	-0.66	0.65

[a]Class I Milk only.

An essentially free market equilibrium with only a support price floor would result in lower producer values for milk. A policy change toward lower producer prices established without the traditional Class I price differentials would reduce producer receipts in all areas, but the greatest burden would fall on producers in the Northeast and Southeast with declines in excess of 30 percent. The indicated decline in producer receipts was only 10 percent for the Upper Midwest. Lower retail values of milk would accompany the lower producer values, and a substantial net social gain would result. Producers in the aggregate would lose $.66 per $1 consumer gain, but the regional effects were not uniform. Moreover, ratios were both above and below -1.00 for individual markets in most regions.

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