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A Market Analysis of Dairy Compacts Using
A Model of Discriminatory Pricing

by

Kenneth W. Bailey

The 1996 Federal Agriculture Improvement and Reform Act contained a provision to create a new price support program for a select group of dairy farmers. Section 147 of the Act established the Northeast Interstate Dairy Compact (Northeast Compact) consisting of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont. The legislation was specified in section 1(b), Senate Joint Resolution 28 of the 104th Congress, and was subject to a number of conditions.

There is growing interest in expanding the Northeast Compact to include states like New York and Pennsylvania, and creating multi-region dairy compacts from Ohio to Florida and all the way west to Texas and Oklahoma. Many states are losing dairy farms and rural economic activity. State and federal legislators in these states are looking to dairy compacts as a regulatory measure to provide additional support to their local dairy industry.

The objective of this paper is to evaluate the market impacts of forming regional dairy compacts. A national study will be conducted to evaluate the economic tradeoffs between dairy farmers, fluid milk consumers, processors, and retailers both in and outside of dairy compact regions.

Model

A discriminatory pricing model will be used to evaluate the market impacts of regional dairy compacts under federal milk marketing orders. Kessel developed an earlier model of discriminatory pricing under classified pricing for an individual federal order. Ippolito and Masson developed a market model for milk under classified pricing. That model assumed regulators set classified prices not solely to maximize farm rents, but also to develop an adequate milk supply to meet the needs of consumers. The limitation of the Ippolito and Masson model, however, is that it assumed the price of milk for manufacturing purposes was set by federal regulators. Thus a revised model of discriminatory pricing will be developed to solve simultaneously for the price of manufactured milk (see Bailey and Gamboa for more detail).

An intermediate-run regional economic simulation model of the U.S. dairy industry was developed in this paper (see Table 1). This model (Dairy Compact Model) reflects the economics of federal and state orders, and includes a set of elasticities derived from the literature. The model will be "calibrated" to a baseline reflecting regional supply, demand and prices. A number of dairy compacts (i.e. Northern, Mid-Atlantic, and Southeast) will be imposed on the model. The model will then be simultaneously resolved. The difference between the baseline and the model simulations would represent the economic impact of dairy compacts.

A baseline will be constructed to reflect Secretary Glickman's proposed federal order reform structure. Secretary Glickman proposed a number of options for redefining Class 1 differentials. The least controversial was Option 1A. This option is most similar to current Class 1 differentials and will be used in this analysis. In addition, Secretary Glickman's proposal contained new definitions of class prices

The Dairy Compact model will be similar in structure to policy models developed by Gardner. Supply and demand equations will be specified using a constant elasticity functional form. The model is a static equilibrium model that reflects intermediate-run adjustments in the milk supply. It is multi-regional; thus it reflects supply, demand and prices for milk and dairy products in each federal milk marketing order.

Assumptions Used in the Study

The results in this study are conditioned on the following critical assumptions:

1. A fixed $2 per cwt compact premium used in all of the compact scenarios,
2. Market over-order premiums remain unchanged in the compact scenarios,
3. A fixed dollar mark up will be used in the farm-to-retail margin for fluid milk prices. That dollar margin will remain unchanged under model scenarios.
4. Number of states defined in the Combined Dairy Compact scenario.

Instead of defining a compact price for each compact region, a fixed $2 per cwt compact premium (price wedge) was assigned. This premium is similar to the average effective compact premium realized by the Northeast Compact during July-October,1997, a period that can be described as normal marketing conditions (U.S. market prices escalated sharply thereafter). It was also assumed that existing market over-order premiums in 1997, which were used in the 1999 baseline, would be maintained under the Combined Dairy Compact scenario. Also, the compact results are dependent on the definition of the farm-to-retail margin. In this study, a fixed dollar (rather than a fixed percentage) farm to retail markup was used.

Three regional compacts will be simulated: Northern, Mid-Atlantic, and Southeast. Together they will form a combined dairy compact scenario. This scenario will then be compared to the baseline. The boundaries for these compacts are in Table 2.

Model Results

The model results in this study are similar to that of the Office of Management and Budget study on dairy compacts(see Tables 3 and 4). They show that within a dairy compact region, dairy producers receive a higher effective farm price ($0.54-$1.13 per cwt.) due to the compact premium. Farmers expand milk production and hence milk marketings 1.4 - 2.6 percent. Consumers pay more for fluid milk since the compact premium raises the cost of milk to processors ($0.15 per gallon). Hence fluid milk consumption and Class 1 use declines 1.6 - 1.8 percent. Overall spending by consumers on fluid milk in the compact region increases 3.4 - 4.0 percent. Greater milk marketings and less fluid milk consumption in the compact region results in more milk being used for Class 3 and 4 purposes. That results in increased production of butter, nonfat dry milk and cheese in compact regions. Those products are then sold on the national market which results in lower national wholesale prices for butter, nonfat dry milk and cheese.

The increase in dairy product production in the compact region has an impact on dairy producers and consumers outside the compact region. Lower wholesale prices for butter, nonfat dry milk and cheese result in lower class prices in all federal milk marketing orders. The new formulas for class prices under order reform are directly linked to dairy commodity prices. Lower dairy commodity prices result in a lower Class 1 price mover, and lower prices for Class 2, 3, and 4 milk. Thus farmers in non-compact regions and states receive a lower price for their milk ($0.16-$0.21 per cwt.). They then respond by producing less milk. Consumers in non-compact regions and states, on the other hand, face a slightly lower price for fluid milk and marginally increase their fluid milk consumption. Thus farm milk sales decline and fluid milk consumption increase marginally in non-compact regions and states.

Butter and nonfat dry milk production in the U.S. increased 0.4 percent and cheese production increased 0.6 percent due to increased milk production and reduced Class 1 use. Declines in cheese, butter and nonfat dry milk prices due to increased production resulted in lower component prices. That resulted in lower skim milk and butterfat prices for all class prices under federal orders and the California order.

The gains in milk marketings in the Northeast, Appalachian, Florida and Southeast orders were not entirely offset by declining marketings elsewhere. This increase in U.S. milk marketings was due to a $0.076 per cwt increase in the weighted effective U.S. average farm price. Total U.S. Class 1 milk sales declined 343 million pounds. All of the declining Class 1 sales were in the compact orders and were due to the $2 compact premium.

Economic Tradeoffs

The economic tradeoffs between dairy farmers, processors/retailers, and consumers by region are presented in Table 4 below. The results suggest that within a compact region, earnings for dairy farmers increase at the expense of processors/retailers and consumers. Processors/retailers face lower earnings due to reduced fluid milk consumption. Consumers must pay more for fluid milk.

Outside the compact regions, dairy farmers face lower farm prices and earnings. That's due to lower class prices due to reduced prices for butter, nonfat dry milk, and cheese. Consumers in these regions, on the other hand, pay less for milk and dairy products since lower class prices result in slightly lower retail prices.

Conclusions

This analysis indicates that dairy compacts represent a new form of discriminatory pricing that will result in economic tradeoffs between dairy producers, consumers, processors and retailers. The results of this study depend on: (1) the degree of price enhancement resulting from the compact, (2) the number of states involved in compacts, (3) how prices are marked up from farm to retail, and (4) whether or not existing market over-order premiums change.

It was assumed that only 27 percent of the nations milk supply was involved in one or more dairy compacts. Given a $2 compact premium, farmers in compact regions realized a net increase in farm-gate milk prices of $0.54-$1.13 per cwt. However, consumers in the compact paid more for fluid milk, at least $0.15 per gallon. Also, dairy farmers outside the compact region realized lower farm-gate milk prices of $0.16 to $0.21 per cwt. Thus clear economic tradeoffs are evident.

Congress has the authority to allow the Northeast Interstate Dairy Compact to be maintained and/or expanded, and to create new regional dairy compacts. Clearly this will be a divisive issue since some farmers will gain an economic advantage over other farmers, and processors and retailers in compact regions will sell less fluid milk. Thus Congress should consider the economic tradeoffs presented in this study before deciding on the future of dairy compacts.

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Table 1. Dairy Compact Simulation Model

Marketings and Milk Use

1. $S^i = A^i (P_b^i)^\alpha$

2. $C1U^i = TFC^i$

3. $C2U^i = C^i (C2P^i)^\theta$

4. $CGE = P_c * 9.87 + P_w * 5.6 + (P_{bt} - 0.10) * 0.238$

5. $BPGE = P_{bt} * 4.27 + P_n * 8.07 + P_{bm} * 0.42$

6. $C3U^i = \xi^i * (S^i - C1U^i - C2U^i)$

7. $\xi^i = D^i * CGE^\delta * BPGE^{-\delta}$

8. $C4U^i = S^i - C1U^i - C2U^i - C3U^i$

Price Identities

9. $C1P^i = C1DIF^i + C1MOVER$

10. $P_b^i = (C1P^i * C1U^i + C2P * C2U^i + C3P * C3U^i + C4P * C4U^i) / S^i + PR^i * C1U^i$

Retail Fluid Milk Consumption

11. $PCF^i = B^i (RPF^i)^\beta$

12. $RPF^i = C1PG^i + \$MU^i$

13. $C1PG^i = (C1P^i + PR^i + CP^i) * 8.62 / 100$

14. $TFC^i = PCF^i * POP^i$

15. $RFME^i = (TFC^i / 8.62) * RPF^i$

Production Identities

16. $PRD_c = \sum_i C3U^i * MEC_c$

17. $PRD_{bt} = \sum_i (C3U^i + C4U^i * \lambda) * MEC_{bt}$

18. $PRD_n = \sum_i C4U^i * MEC_n$

Dairy Commodity Demand

19. $DU_c = E(P_c)^{\eta_c}$

20. $DU_{bt} = F(P_{bt})^{\eta_{bt}}$

21. $DU_n = G(P_n)^{\eta_n}$

Endogenous Variables

$BPGE$:	butter/nonfat dry milk gross earnings, \$/cwt. milk
$C1DIF^i$:	class 1 differential, \$/cwt., federal order i
$C1MOVER$:	class 1 mover, \$/cwt.
$C1P^i$:	class 1 price, \$/cwt., federal order i
$C1PG^i$:	class 1 cost of fluid milk to processors, \$/gal., federal order i

$C1U^i$: class 1 use, mil. lbs., federal order i
$C2P$: class 2 price, \$/cwt.
$C2U^i$: class 2 use, mil. lbs., federal order i
$C3P$: class 3 price, \$/cwt.
$C3U^i$: class 3 use, mil. lbs., federal order i
$C4P$: class 4 price, \$/cwt.
$C4U^i$: class 4 use, mil. lbs., federal order i
CGE: cheese gross earnings, \$/cwt milk
DU_j: domestic use, mil. lbs., dairy commodity j
P_{bt}: price of grade AA butter, Chicago, \$/lb.
P_c: price of 40-lb. block cheese, Chicago, \$/lb.
P_b^i: farm blend price, \$/cwt., federal order i
P_n: price of nonfat dry milk, Central States, \$/lb.
PCF^i: per capita fluid milk consumption, lbs., federal order i
PRD_j: production, mil. lbs., dairy commodity j
$RFME^i$: retail fluid milk expenditures, mil. dollars, federal order i
RPF^i: retail fluid milk price, \$/gal., federal order i
S^i: milk marketings, mil. lbs., federal order i
TFC^i: total fluid milk consumption, mil. lbs., federal order i

Exogenous Variables

α: milk supply elasticity
β: retail fluid demand elasticity
θ: class 2 elasticity
ξ^i: the proportion of residual milk used for class 3 use, percent, federal order i
δ: class 3 elasticity
λ: proportion of class 3 milk used to make butter from whey cream
η_j: demand elasticity, dairy commodity j
$\$MU^i$: farm to retail markup, \$/gal., federal order i
CP^i: compact premium, \$/cwt., federal order i
MEC_j: milk equivalent conversion factor, dairy commodity j
P_{bm}: price of dry buttermilk, Central States, \$/lb.
P_w: price of dry whey, Central States, \$/lb.
POP^i: civilian residential population, mil., federal order i
PR^i: class 1 market over-order premium, \$/cwt., federal order i
j: dairy commodity (c=cheese, bt=butter, n=nonfat dry milk)
$A-G$: model constants

Table 2. Regional Boundaries for Dairy Compacts Used in the Model Simulation

Dairy Compacts	**Proposed Federal Orders included in the Compacts**	**Unregulated Areas included in the Compacts**
Northern Dairy Compact	Northeast	Maine
Mid-Atlantic Dairy Compact	Appalachian	Virginia
Southeast Dairy Compact	Southeast, Florida, and the northern portion of Missouri that will be in the proposed Central order.	

Table 3. Economic Impact of the Combined Dairy Compact Scenarios

	Marketings		Class 1 Use		Class 3 Use		Class 4 Use		Class 1 Cost	Farm Price
	Change	*% Chng*	*Change*	*% Chng*	*Change*	*% Chng*	*Change*	*% Chng*	*Change*	*Change*
	mil. lbs.	percent	mil. lbs.	percent	mil. lbs.	Percent	mil. lbs.	Percent	$/cwt	$/cwt
Compact Orders:										
Northeast	342.32	1.4%	-187.41	-1.8%	378.77	5.1%	141.2	5.7%	$1.77	$0.54
Appalachian	128.85	2.6%	-74.03	-1.8%	201.41	62.6%	NA	NA	$1.77	$1.13
Florida	63.86	2.2%	-39.46	-1.6%	102.72	49.3%	NA	NA	$1.77	$1.11
Southeast	168.20	2.2%	-84.30	-1.6%	250.66	17.8%	NA	NA	$1.77	$0.97
Non-Compact Orders:										
Mideast	-63.03	-0.5%	15.99	0.2%	-78.04	-2.4%	-6.8	-1.4%	-$0.23	-$0.19
Upper Midwest	-128.53	-0.6%	10.39	0.2%	-163.74	-1.0%	21.7	13.8%	-$0.23	-$0.21
Central	-42.99	-0.4%	5.18	0.1%	-51.82	-1.3%	1.2	0.3%	-$0.11	-$0.17
Southwest	-41.28	-0.5%	8.91	0.2%	-46.06	-1.8%	-7.0	-1.1%	-$0.23	-$0.19
Western	-29.77	-0.6%	2.64	0.2%	-33.16	-1.0%	NA	NA	-$0.23	-$0.21
Arizona-Las Vegas	-17.20	-0.6%	2.38	0.2%	-20.01	-1.2%	NA	NA	-$0.23	-$0.21
Pacific Northwest	-29.57	-0.5%	5.00	0.2%	-11.11	-1.1%	-24.8	-0.9%	-$0.23	-$0.16
Other Unregulated	-41.62	-0.2%	-20.87	-0.3%	-25.74	-0.2%	NA	NA	$0.34	-$0.07
California	-157.38	-0.5%	12.22	0.2%	NA	NA	NA	NA	-$0.21	-$0.17

Table 4. Select Economic Tradeoffs for Farmers, Processor/Retailers, and Consumers due to a Combined Dairy Compact

	Baseline	Combined Dairy Compact Scenario Change	% Change
NORTHEAST			
Farm milk sales (mil $)	3,373.4	182.7	5.4%
Fluid processor/retail margin (mil $)	1,628.6	-28.7	-1.8%
Retail fluid milk expenditures (mil $)	3,302.0	127.1	3.9%
APPALACHIA			
Farm milk sales (mil $)	746.2	77.0	10.3%
Fluid processor/retail margin (mil $)	570.1	-10.5	-1.8%
Retail fluid milk expenditures (mil $)	1,199.1	48.2	4.0%
SOUTHEAST			
Farm milk sales (mil $)	1,126.8	99.9	8.9%
Fluid processor/retail margin (mil $)	998.1	-15.8	-1.6%
Retail fluid milk expenditures (mil $)	1,858.3	63.9	3.4%
FLORIDA			
Farm milk sales (mil $)	526.8	45.1	8.6%
Fluid processor/retail margin (mil $)	399.6	-6.3	-1.6%
Retail fluid milk expenditures (mil $)	869.9	29.9	3.4%
MIDEAST			
Farm milk sales (mil $)	1,777.1	-32.8	-1.8%
Fluid processor/retail margin (mil $)	1,083.2	2.5	0.2%
Retail fluid milk expenditures (mil $)	2,109.3	-10.5	-0.5%
UPPER MIDWEST			
Farm milk sales (mil $)	2,768.9	-62.3	-2.3%
Fluid processor/retail margin (mil $)	681.9	1.6	0.2%
Retail fluid milk expenditures (mil $)	1,371.0	-6.8	-0.5%
CENTRAL			
Farm milk sales (mil $)	1,307.0	-22.1	-1.7%
Fluid processor/retail margin (mil $)	705.6	0.8	0.1%
Retail fluid milk expenditures (mil $)	1,380.1	-3.4	-0.2%
SOUTHWEST			
Farm milk sales (mil $)	1,134.4	-21.3	-1.9%
Fluid processor/retail margin (mil $)	694.9	1.5	0.2%
Retail fluid milk expenditures (mil $)	1,301.7	-6.1	-0.5%
WESTERN			
Farm milk sales (mil $)	603.4	-14.1	-2.3%
Fluid processor/retail margin (mil $)	197.0	0.5	0.2%
Retail fluid milk expenditures (mil $)	352.8	-1.7	-0.5%
ARIZONA-LOS VEGAS			
Farm milk sales (mil $)	376.4	-8.4	-2.2%
Fluid processor/retail margin (mil $)	180.2	0.4	0.2%
Retail fluid milk expenditures (mil $)	328.0	-1.6	-0.5%
PACIFIC NORTHWEST			

Farm milk sales (mil $)	820.1	-14.2	-1.7%
Fluid processor/retail margin (mil $)	377.3	0.9	0.2%
Retail fluid milk expenditures (mil $)	684.5	-3.3	-0.5%
OTHER UNREGULATED REGIONS			
Farm milk sales (mil $)	2,818.5	-20.6	-0.7%
Fluid processor/retail margin (mil $)	1,101.6	-3.6	-0.3%
Retail fluid milk expenditures (mil $)	2,055.7	14.5	0.7%
CALIFORNIA			
Farm milk sales (mil $)	3,297.6	-66.9	-2.0%
Fluid processor/retail margin (mil $)	1,489.9	2.8	0.2%
Retail fluid milk expenditures (mil $)	2,294.3	-9.2	-0.4%
TOTAL U.S.			
Farm milk sales (mil $)	20,676.6	141.8	0.7%
Fluid processor/retail margin (mil $)	10,108.0	-53.8	-0.5%
Retail fluid milk expenditures (mil $)	19,106.9	240.8	1.3%